

# **1 Background to the Study**

This thesis investigates performance related musculoskeletal disorders (PRMDs) experienced by bassoon players. PRMDs include any pain, weakness, numbness, tingling, or other symptom that interferes with the ability to play an instrument at the level to which the musician is accustomed. Diagnosed injuries, such as carpal tunnel or tendinitis, are included with PRMDs for the majority of this thesis. When differentiation between the two conditions is required, a clear delineation will be made; otherwise the terms injury and PRMD are interchangeable throughout this thesis.

Musicians have long recognized that playing an instrument involves physical risks. The medical field began acknowledging these physical risks in the 1980s and the field of performing arts medicine began to grow dramatically (Sataloff et al. 1998; Brandfonbrener and Lederman 2002; Chesky et al. 2002b; Horvath 2002; Gilbert 2003). Numerous studies have taken place proving that all types of musicians incur diverse types of injuries (Hochberg et al. 1983; Fry 1984; Lederman 1986; Lederman 1987; Dawson 1988b; Fishbein et al. 1988; Lederman 1988; Lockwood 1989; Brandfonbrener 1991; Lederman 2003; Crnivec 2004). In recent years many books have been published teaching musicians how to avoid injuries (Norris 1993; Sazer and Katz 1995; Bruser 1997; Paull and Harrison 1997; Conable and Conable 2000; Horvath 2002; Workman 2006; Dawson 2007a; Rosset i Llobet and Odam 2007). The growth of the body of literature offering musicians suggestions has yet to curb the epidemic of PRMDs. Musicians continue to report injuries, seek treatment options, and search for more information on injury prevention. The field of performing arts medicine continues to

grow.

No book on injury prevention has been written solely for the bassoon. Very few studies have been conducted into the rate at which bassoon players' incur PRMDs. Very little information is known about the types of PRMDs bassoon players' experience or which locations are most susceptible. This lack of information could stem from the scarcity of bassoon players (Creagh 2004). Compounded with the bassoon's rarity, the bassoon has many characteristics that make it very high-risk for the instrumentalist to develop PRMDs.

### **1.1 The Bassoon – Introduction to a Menace**

The origin of the bassoon and its development are still debated by scholars (for a brief history of the bassoon, citing developmental shortcomings that may exacerbate PRMDs, see Appendix A). What is agreed upon is that the vast majority of improvements to the bassoon occurred around 150 years ago (Camden 1962; Jansen 1978). It is important to note that these improvements, "lagged behind the flute and clarinet in technological development as well as in teaching and performance" (Sadie and Levy 2001). The standard German bassoon is primarily used today and basically patterns Almenraeder's 1840 model.

The bassoon is a heavy instrument that is held diagonally and/or obliquely across the right side of the body (Figure 1). A modern bassoon weighs between 3 and 4 kilograms depending on the type of wood used and the key work requested by the player. This instrument position puts the vast majority of the weight of the instrument on the neck and upper body of the performer, or seat strap, while the left arm of the performer supports

the remaining weight. Depending on how close the performer's elbow is to the side of his/her body a sharp right wrist angle can occur.



**Figure 1: Angle of bassoon while playing**

The wrist angle and arm height of the player can be significantly different depending on a physical profile of the player and type of bocal the player uses. The bocal is a metal tube that connects the main wooden body of the instrument to the reed. There are two styles of bocals, “German” and “English.” The two styles have the same length of tubing (when comparing similar models) but the amount of bend is different between the styles. The “German” style has a much deeper bend, meaning the instrument will be closer to the body because there is the same amount of tube covering a shorter distance. The

“English” style has a more gradual bend (shown in Figure 1), which means the instrument is further from the body. Each player can select his or her own bocal style preferences. It is unusual for a player to play with both styles of bocals.

Regardless of which style of bocal is used, the bassoon is heavy and is held at an angle. The modern performer is required to play in two positions, sitting and standing. When a violin or flute player performs in a sitting or standing position, the breathing and lower body may change depending on position, however the upper body, arm, and hand positions basically remain the same. This is not the case on the bassoon. When playing the bassoon sitting, the performer is usually using some type of seat strap or floor peg to support the weight of the instrument. This means the load on the left arm is eased. However, when a bassoonist plays standing, he or she must use some type of neck strap. Playing standing puts the entire load of the bassoon on the body. Some of this load is held by the neck strap, however a greater proportion of the weight is placed on the left arm. Playing standing also results in a change to the angle of the instrument, which changes the performer’s hand position.

There is no standardized support system used by bassoon players. When playing sitting a performer can use a floor peg, a leg rest, a neck strap or most commonly a seat strap. There are multiple kinds of seat straps such as a hook, a cup, or a ring. Some bassoon players use a strap that connects to the back of the chair to help take the weight off the left arm (Danziger 2006). Every one of these sitting support variations will alter the instrument’s center of gravity, by changing the angle of the instrument. This results in

numerous variations on where the performer supports the weight of the instrument and how much the hand has to correct the angle.

Similarly when standing a bassoonist may use a neck strap that goes only around the neck, one that goes over the right shoulder and under the left arm, one that goes over left shoulder and under the right arm, or a harness around both shoulders for which there are “male” and “female” versions. When playing standing, some bassoonists use a balance hanger. A balance hanger changes the center of gravity of the instrument and takes weight off the left hand. Not all bassoonists choose to use a balance hanger because it may cause the instrument to be closer to the player’s body, which may be uncomfortable.

There is no standard way to sit or stand when playing the bassoon. This lack of standardization makes it extremely hard to gain definitive information on how bassoon players function on a musculoskeletal level, because each different support method puts different stresses on different parts of the body. It is not difficult to infer that with the problems associated with the design of the instrument and the multitude of support systems in practice there are numerous PRMDs in this population.

Bearing in mind each of the aforementioned support methods change the center of gravity of the instrument; each variation will also change the wrist angle, the weight on the hands, and the stress on the fingers. These changes are intensified by the complexity of the bassoon keywork. A modern bassoon has between 23 and 33 keys (Fox 2008; Heckel 2008; Püchner 2008; Wolf 2008). The right thumb has a minimum of four keys to navigate and manipulate. The left thumb has a minimum of eight, usually nine, keys

to navigate. The range of movement required to traverse that number of keys is much greater than on any other keyboard instrument. The bassoon is the only orchestral instrument where all ten fingers are used to depress keys.

The fingering combinations on the bassoon are endless. When playing bassoon, all musical passages have multiple fingering options making the bassoon a technically challenging instrument. The bassoon is often recognized as having more complicated fingering combinations than any other instrument (Weisberg 1998; Purdue 2008; Smith 2008). This difficulty level exacerbates muscle strain and increases the likelihood of PRMDs. When all of these factors are combined in performance, the potential for PRMDs is high.

## **1.2 Research Questions**

Considering all of these issues, this thesis proposes the following research questions:

- How frequently do bassoon players experience PRMDs?
- What types of PRMDs do bassoon players experience?
- Where in the body do bassoon players experience PRMDs?
- Does gender influence the development of PRMDs?
- Does age influence the development of PRMDs?
- What treatments are bassoon players using in the management PRMDs?
- What do bassoon players believe contribute to the development of PRMDs?
- How does the bassoon community perceive PRMDs?

As no bassoon specific study has been located, this study commences by establishing a base line of information on PRMDs among bassoonists. For this reason, the research questions that have been posed are generic and in their simplest form.

### **1.3 Abbreviations**

**ANCOVA:** Analysis of covariance; a statistical general linear model with one continuous outcome variable and one other variable

**ANOVA:** Analysis of variance; a statistical model with observed variance is partitioned into groups due to other variables

**EMG:** Electromyography; a technique for evaluating and recording the activation signals of muscles

**HREC:** Human Research Ethics Committee; governing ethics body at the University of Sydney

**IBQ:** *International Bassoonists Questionnaire*; the survey on which this thesis is based

**ICSOM:** International Conference of Symphony and Opera Musicians

**IDRS:** International Double Reed Society

**IP:** Internet protocol; individual address for a computer

**MPPA:** *Medical Problems of Performing Artists*; journal

**SPSS:** Statistical package for the social sciences; computer program used for statistical analysis

**TMJ:** Temporomandibular joint; also known as temporomandibular joint disorder, pain or dysfunction of the jaw

**UNT:** The University of North Texas

**USYD:** The University of Sydney

## 1.4 Definitions

**Alexander Technique:** a method of study to change movement habits in our everyday activities, created by Frederick Matthias Alexander (1869-1955)

**Carpal tunnel syndrome:** a condition in which the median nerve, which runs from the forearm into the hand, becomes pressed or squeezed at the wrist

**Dystonia:** a neurological condition affecting muscles in a part of the body causing an undesirable muscular contraction

**Feldenkrais technique:** a method of study on the principal of body awareness through movement, created by Moshe Feldenkrais (1904-1984)

**Injury:** damage or harm to the structure or function of the body, caused by an outside force

**Massage therapy:** treatment and practice of manipulation of the soft body tissues

**Mean:** sum of a set of numbers divided by the total numbers in the set, also called the average

**Overuse syndrome:** any activity that produces a musculoskeletal symptom, like pain, that negatively affects the function of an area

**Performance Related Musculoskeletal Disorders (PRMDs):** any pain, weakness, numbness, tingling, loss of dexterity, loss of flexibility, or diagnosed injury that interferes with the ability to play an instrument at the level to which the musician is accustomed

**Repetitive strain injury:** condition resulting from overuse of any activity that requires repeated movements

**Symptom:** an indication of some disorder, such as pain or tingling

**Tendinitis:** inflammatory condition of the tendon

**Thoracic outlet syndrome:** a group of distinct disorders that affect the nerves that pass into the arms from the neck or between the base of the neck and armpit

**Ulnar nerve entrapment:** occurs when the ulnar nerve (which runs through the elbow) in the arm becomes compressed

**Upper extremity:** region of the body that includes the upper chest, upper back, arms, forearms, and hands

**Upper extremity disorder:** any injury or condition located in the upper body - most usually the arms, hands, and wrists

## **1.5 Structure of the Thesis**

This chapter has set out the topic of this thesis, introduced the research questions, and provided background about the bassoon that explains possible causes of PRMDs in bassoon players. The following chapter presents a review of literature on PRMDs and identifies the lack of information available on the rate at which bassoon players experience PRMDs. The third chapter explains the methodology used in this thesis. The fourth chapter reports the results of the research, identifying the frequency and severity of symptoms as well as the locations where bassoon players experience PRMDs. The fifth chapter continues explaining the results of the survey, focusing on the treatments, contributing factors, and perceptions of the bassoon community in regards to PRMDs. Finally, the sixth chapter summarizes the thesis, interprets the findings, and makes suggestions for future research.

ANOVA was one of the main statistical techniques initially used. However, as analysis was run, a problem was encountered. The sample showed a strong correlation between gender and age. The statistical techniques used in analysis had to be adapted from ANOVA to ANCOVA in order to account for this strong correlation between variables. ANCOVA allowed one of the correlating variables to be held as a co-variant and limited the effects of this strong relationship between variables on the reported results.

### **3.9 Conclusion**

This chapter set out the complete method of the study. This chapter explained the choice of methodology, means of Internet distribution, obtaining Ethics approval, creation of the website, creation of the survey, recruitment of participants, handling of the data, and analysis of the data. The following chapter presents demographic information about the sample. Chapter 4 explores the injury data gained from the *IBQ* starting with an overview of injury sustained by the bassoon population, specifying PRMD types, and concluding with injury location. Gender differences and age affecting injury will also be explored.

## **2 Literature Review**

This chapter presents the literature related to the topic of PRMDs in bassoon players. There are numerous ways this literature could be organized but the method chosen for this thesis was to concentrate on the history of performing arts medicine as it adapted to the focus on orchestral instrumentalists. This chapter is organized in the following way: the growth of the performing arts medicine field, types of injuries and PRMDs that musicians experience, subsequent studies that identified orchestral musicians' symptoms, limitations with bassoon research to date, and studies that included the bassoon player. While this produces general information about the range of injuries across all instruments it must be noted that there is limited literature available on the bassoon. The bassoon player has been part of a few overall orchestral studies but few studies have been conducted solely on this small population. This way of approaching the literature has been adopted because it was the most logical way to investigate the issues raised in the research questions.

A problem with the literature on PRMDs is that musicians often present the medical community with non-structural problems and give them the task to diagnose a pain that the performer attributes to poor technique, poor posture, etc. The terms "overuse" and "repetitive strain" are perfect examples of the medical community having difficulty with diagnosis as both of these terms are used as the basis for treatment of musician PRMDs, but are by definition vague and unspecific. To further complicate the literature, musicians report multiple locations of pain and/or multiple PRMD symptoms. As could be expected, many of the writings discussed below appear in more than one section of

this literature review. According to Dawson's 10 year review of performing arts medicine literature, performing arts medicine journals account for more than 40% of the overall literature, with *Medical Problems of Performing Artists (MPPA)* having the most number of articles (Dawson 2007b). Dawson does stipulate that although specific performing arts journals have emerged:

The most valid research results are likely to be found in scientific periodicals, not artistic ones (Dawson 2003c, p.31).

## **2.1 Historical Development of Performing Arts Medicine**

Musicians have been around since the beginning of history. The artwork from Ancient Egypt records the use of string, percussion, and wind instruments (including double and single reed instruments) (Egypt 2008). But in the artwork that depicts musicians there is no record of musicians sustaining injuries. The first written record of musicians' incurring injuries was in the 1713 treaty about the *Diseases of Workers* by Ramazzini (Ramazzini 1964). Very little literature was published on musician injuries for the next 100 years, until the late 19<sup>th</sup> century when injuries sustained by piano players were discussed in the *British Medical Journal* (Haward 1887; Poore 1887). Between 1830 and 1911 overuse syndrome in musicians was documented in 21 books and 54 journal articles (Fry 1986a). Singer's book in 1932 was the next large publication detailing musicians' injuries (Singer 1932). Again there was a period of sporadic literature until the 1980s when two prominent pianists openly discussed their hand injuries.

Leon Fleisher (b. 1928) was a classical pianist who lost the ability to use his right hand in the late 1960's due to repetitive strain, later diagnosed as focal dystonia (Brandfonbrener and Lederman 2002). In the 1980s Fleisher began performing and

recording literature for the left hand alone which brought attention to his physical limitations (Fleisher 2008). In 1995 Fleisher, after many years of rehabilitation, including the use of botox injections and massage, regained the ability to perform with both hands. In 2004 Fleisher released his first CD in over 40 years with both hands, aptly entitled “Two Hands” (Fleisher et al. 2004). Although Fleisher lost the ability to use his right hand in the late 1960’s, it was not openly discussed until the early 1980s when a fellow pianist and close friend spoke to a reporter from *The New York Times* about his own experience with focal dystonia (Dunning 1981). Gary Graffman (b. 1928) was a prominent piano soloist who had been having difficulty with his right hand since 1967. Graffman recognized that he needed to see a doctor in 1979, after suffering in silence for over 11 years. He consulted a number of doctors and after a year of successful treatments with a team of doctors from Massachusetts General Hospital in Boston, Graffman told the public of his ordeal (Dunning 1981). With these two pianists willing to speak openly about their musical injuries, a number of other musicians came forward. Graffman said in a later interview (1986) that after *The New York Times* article he was inundated with fellow musicians calling him wanting to speak about their difficulties (Parry 2004). Musicians were finally starting to talk about the physical demands of playing, this discussion encouraged the medical community to expand its treatment options to provide better care for the musician. The field of performing arts medicine began to grow.

In 1986 the first volume of *Medical Problems of Performing Artists (MPPA)* gave musicians and physicians a journal dedicated to performing arts injuries. A body of literature began to develop for this specialized area with more doctors becoming aware

of PRMDs and specialty clinics proliferating around the world. Graffman again assisted the communication of musicians by writing an article for the first *MPPA* entitled, “Doctor, can you lend an ear?” (Graffman 1986). Also in the first edition of *MPPA* was an article about double reed players incurring injuries due to the repetitive strain of making reeds (Dawson 1986) showing the diverse difficulties that musicians face. Most importantly, attention was finally being paid to the field of musician care. As Fry wrote in the first *MPPA*:

The appearance of this journal is a sign that performing arts medicine has come of age. With maturity come certain responsibilities, including proper communication. Cross-disciplinary communication between physicians and musicians has been, in the past, less than satisfactory (Fry 1986d).

With the establishment of a journal specifically for performing artist medicine, musicians started to gain much needed information on appropriate terminology to use when speaking with physicians, but also the knowledge that they need not suffer in silence. Physicians gained perspective on the enormity of the epidemic. In a five year review of performing arts literature Dawson noted that:

A most promising finding from this study is that more medical texts, especially those relating to the hand and upper extremity, contain chapters dealing with musicians’ problems (Dawson 2003c, p.30).

In 1989 the Performing Arts Medicine Association was established to further improve health care for musicians (PAMA 2008). Now that musicians were talking, incidences in

earlier history regarding injuries became known. In an ABC radio interview Graffman recounted pianists from the 1800s that had documented injuries to the right hand for a period of time (Graffman 2006). Graffman cited examples of piano literature available for the left hand alone as indications of time periods in influential composers' and performers' lives when the right hand was over worked, including the renowned pianist Clara Schumann (1819-1896). These periods of rest, due to overuse, from the 1800s were not generally recognized without extensive knowledge of the single hand piano repertoire.

Graffman became a proponent for the performing arts medicine field. He wrote the forward to the first ever *Textbook of Performing Arts Medicine* (Sataloff et al. 1991). In the seven years between the first edition and second edition of the textbook, the field of performance arts medicine had expanded greatly. The 15 chapters in the first edition were expanded to 21 chapters in the second edition, now including: “respiratory problems in singers and wind instrumentalists,” “applied ergonomics: adaptive equipment and instrument modification for musicians,” “therapeutic management of the instrumental musician,” and “pain and injury in performing musicians: a psychodynamic approach” (Sataloff et al. 1998). The field of performing arts medicine and what it incorporated was growing to suit the needs of performers.

## **2.2 Types of Injuries Sustained by Musicians**

When Ramazzini first documented musician injury in 1713 he concentrated primarily on incidents of bleeding lungs, specifically in singers but also in flutists and those “who play pipes” (Ramazzini 1964). He also commented on hernia in trumpet players, which are still prevalent (Brandfonbrener 1998), but did not comment on musculoskeletal

disorders or upper extremity problems. Although Ramazzini's pages on musician health did not specify overuse injuries as classified today, overuse injury was foreshadowed in his book with the first sentence of the chapter on musicians, which read:

No sort of exercise is so healthful or harmless that it does not cause serious disorders, that is, when over-done (Ramazzini 1964, p.329).

Since Ramazzini's reported musician injuries, numerous other types of injuries have been attributed to musicians. Ramazzini alluded to the most common affliction, overuse, in the quote above. Overuse was the most common condition afflicting all types of instrumental musicians (Fry 1986b; Fry 1986c; Mandel et al. 1986; Newmark and Lederman 1987; Fry et al. 1988; Goodman and Staz 1989; Lockwood 1989; Dawson 2001b). Overuse was often categorized as musculoskeletal pain and overuse syndromes (Brandfonbrener 2000, p.172). Overuse goes by many names in the literature, such as repetitive strain injury, tendinitis, and repetitive motion disorder. Overuse is often confused with misuse. Misuse differs from overuse because misuse is caused by an incorrect activity or improper technique while overuse is caused by excessive physical use of an area. Parry wrote about the confusion between overuse and misuse in *Musical Excellence* stating that 52% of musicians presented with vague or general symptoms which they attributed to "doing it wrong" (Parry 2004). The symptoms for overuse and misuse are the same; the difference is the cause. The distinction between overuse and misuse is very murky in both the musicians' mind and in the literature.

Many other diagnosed conditions were found in the literature of performing artists. The most common were: dystonia (Lockwood 1989; Lederman 2001; Yeo et al. 2002;

Dawson 2003b; Lederman 2003; Schuele and Lederman 2004), thoracic outlet syndrome (Lockwood 1989; Lederman 2003; Schuele and Lederman 2004), nerve problems (Lockwood 1989; Amadio 1993; Lederman 1993; Lederman 2003; Schuele and Lederman 2004), and carpal tunnel (Amadio 1993; Maclean 1993; Lederman 2003; Burkholder and Brandfonbrener 2004; Schuele and Lederman 2004). Despite the plethora of diagnosed conditions afflicting musicians, the biggest challenge in the performing arts medicine field was that only about half of musicians actually exhibit “clear-cut pathology” for a specific diagnosis (Parry 2004, p.42). This may be why the term overuse was used to cover so many symptoms and injury presentations.

The improper use of the term overuse, in relation to tendinitis, has caused another obstacle in performing arts medicine; many confuse tendinitis with overuse and use the terms interchangeably. In Dawson’s recent book, *Fit as a Fiddle*, he expressed the confusion of musicians, as well as medical professionals, by their interchangeable use of the terms. Dawson then explained that tendinitis was related to inflammation unlike overuse which was not inflammation dependant (Dawson 2007a, p.49). Regardless of the terminology confusion, tendinitis was often reported as commonly afflicting musicians (Caldron et al. 1986; Burkholder and Brandfonbrener 2004; Dawson 2007a). Parry disputes the commonality of tendinitis, reporting it was relatively rare (12%) and that the label was “too liberally used to describe any ache or pain in a specific area” (Parry 2004, p.43). Lederman’s research concurs with Parry finding that tendinitis was much less common than other diagnoses like musculoskeletal disorders, nerve problems, and focal dystonia (Lederman 2003). But many still believed that tendinitis was common and that they correctly understood what it was. In Zaza’s study (1992) students

were asked to define tendinitis; 69% believed they knew the meaning, but only 29% had the correct definition (Zaza 1992). Despite attempts by members of the medical community (Fry 1986d; Dawson et al. 1998) to differentiate the term tendinitis from overuse, the confusion and inaccurate use of the term still remains.

Terminology has been hotly disputed in the performing arts since the inception of the literature. In the first edition of *MPPA* Fry tried to define terminology that would assist in the diagnosis of performing arts problems (Fry 1986d). Although Fry specifically defined tendinitis as an inflammatory condition, as Parry preferred (Parry 2004), the term was not limited to his definition, and therefore currently is accepted as a diagnosis for pain that may not be related to inflammation. As the field of performance arts medicine has grown, the definitions have become clouded and new terms have been coined to try to more accurately describe symptoms. In 1994, the Performing Arts Medical Association assembled a committee to investigate the accurate use of terms in arts medicine and an article was released in 1998 with the findings (Dawson et al. 1998). The term overuse was split into two categories in the article, overuse practice and overuse syndrome, differentiating between the cause (overuse practice) and the effect (overuse syndrome). Since then, the term overuse syndrome (the effect) has been limited and is gradually being replaced by the term “regional pain syndrome” (Brandfonbrener and Lederman 2002, p.1015). The inconsistent terminology presents continual challenges in the field of performing arts medicine.

Despite the difficulty with terminology, the field of performing arts medicine agreed on three things. First, no instrumentalist was immune to the possibility of performance

related injuries. Literature documented PRMDs for pianists (Hochberg et al. 1983; Collett 2005; Bragge et al. 2006; Sakai 2007; Bragge et al. 2008), singers (Bailey and Bailey 1988; Sataloff 1992; Rubin et al. 2007), strings players (Mandel et al. 1986; Hiner et al. 1987; Birkedahl 1989; Wilkinson and Grimmer 2001), guitar players (Wee and Brandfonbrener 2005; Fjellman-Wiklund and Chesky 2006), brass players (Lederman 2001; Quarrier 2001; Chesky et al. 2002a; Cheshire 2006), percussionists (Judkins 1991; Judkins 1992; Lederman 2004), composers (Abréu-Ramos and Micheo 2007), woodwind players (Wilson 1989; Spence 2001; Thrasher and Chesky 2001; Cheshire 2006; Nemoto and Arino 2007) and even bagpipe players (Barr et al. 2005). The vast majority of studies have been conducted on classical musicians; more research needs to be conducted on the rate of musculoskeletal problems in rock, jazz, and other genres of musicians (Brandfonbrener 2000).

The second point the literature agreed on was that musicians suffer from PRMDs in the upper extremity areas most frequently (Fry 1988; Zetterberg et al. 1998; Thrasher and Chesky 2001; Warrington et al. 2002; Lederman 2003; Burkholder and Brandfonbrener 2004; Toledo et al. 2004; Nemoto and Arino 2007). The upper extremity region, covers everything from the chest up, includes: the scapula (shoulders), pectoral muscles (chest), arms, forearms, hands, and wrists. It was not surprising that this broad area was most affected by PRMDs in musicians. All instruments require repetitive movements of the fingers and arms. It was believed that string players and keyboard players were most susceptible to injuries caused by this repetitive movement (Caldron et al. 1986; Fishbein et al. 1988; Larsson et al. 1993; Zaza and Farewell 1997; Cayea and Manchester 1998;

Davies and Mangion 2002). Keyboard and string players currently have the most PRMD literature available.

The third point agreed upon in the literature was that musicians were incurring injuries. The rate of injury seemed to increase with each article published; in 1986 Caldon et al. reported that 57% of participating musicians reported an injury (Caldron et al. 1986), in 1987 Newark and Lederman reported that 72% of their sample had an injury (Newmark and Lederman 1987), and in 1988 Fishbein et al. found that 76% of musicians disclosed a medical problem severe enough to negatively affect their playing (Fishbein et al. 1988). Newark and Lederman hypothesized the large variation in response rates may be because a significant number of musicians would not self-disclose in surveys for fear of not being hired due to perceived unreliability (Newmark and Lederman 1987). Brandfonbrener presented another option for the fluctuation in numbers of musicians reporting PRMDs, hypothesizing that many musicians blamed themselves for their injury. The musician was unwilling to come forward in surveys because participation admitted that they had a problem directly related to their own inadequacies (Brandfonbrener 1991). Musicians felt that if they were a better player and had better technique, they would not be injured. Regardless of the reason, the rate of PRMDs in instrumental musicians fluctuates from 37% to 87% in the literature (Zaza 1998).

### **2.3 Influential Factors to PRMD Development**

Females presented with PRMDs more frequently than males (Fry et al. 1988; Lockwood 1988; Middlestadt and Fishbein 1989; Zaza and Farewell 1997; Cayea and Manchester 1998; Dawson 2001b; Abréu-Ramos and Micheo 2007). Justification for the significant gender difference was attributed to hand size (Dawson 2007a, p.36) and muscle strength

(Burkholder and Brandfonbrener 2004). An increased predisposition to joint laxity in females was cited as a possible cause for the greater prevalence of PRMDs in females (Burkholder and Brandfonbrener 2004). In 1998, Zetterberg et al. reported that although males practiced more than females, females still reported more areas of pain in the body. Zetterberg et al. hypothesized that this might be linked to females indicating a higher level of stress than males (Zetterberg et al. 1998). Stress was considered a major contributory risk factor to PRMD development (Brandfonbrener and Lederman 2002, p.1013).

Davies and Mangion's research partially contradicts the majority of other researchers. In their 2002 study of Sydney musicians, they found that female string players still reported higher PRMD rates than male string players, but males were more inclined to have injuries on all other instrument types (Davies and Mangion 2002). Burkholder and Brandfonbrener did not differentiate between instruments, but differentiated between symptoms. They found that males were more frequently diagnosed with carpal tunnel syndrome and tendinitis than females, but overall females were diagnosed with more PRMDs (Burkholder and Brandfonbrener 2004). Burkholder and Brandfonbrener also disputed Zetterberg et al.'s finding that males practiced more, instead saying that females, in the age bracket they researched, tended to practice more than males and that may be a reason more females presented at the specialty clinic with music related injuries. Fry et al. concurred with Burkholder and Brandfonbrener that females on average practiced more than males and practice time could be an influential factor in PRMD development (Fry et al. 1988).

Age was believed to be a factor in PRMD development. Many studies showed that younger demographics were more likely to develop PRMDs (Fishbein et al. 1988; Dawson 2001b; Warrington et al. 2002; Abréu-Ramos and Micheo 2007). Therefore, many researchers focused their research on the younger demographic by researching PRMD occurrence in high school and Conservatory students (Lockwood 1988; Manchester 1988; Burkholder and Brandfonbrener 2004; Britsch 2005).

Warrington et al. studied age in relation to three categories: trauma, degenerative, and non-specific pain (Warrington et al. 2002). First, concluding that all musicians were susceptible to trauma. Dawson concurs that all are susceptible to trauma, but also found that amateur musicians (30.4%) were more likely to have traumatic conditions than professional or collegiate musicians (27.5%) (Dawson 1988a). Next, Warrington et al. reported that older musicians were more susceptible to degenerative conditions (Warrington et al. 2002). With the increase in arthritis in the aging population, an increase in pain from degenerative conditions was not surprising (Hoppmann and Ekman 1999). The third category Warrington et al. reported on was non-specific pain, which could be generalized as overuse. Warrington et al. found that non-specific pain was “overwhelmingly present” in the younger demographics with 49% of participants under the age of 25 suffering from non-specific pain, versus 2% of participants over the age of 40 years (Warrington et al. 2002). Fry’s study of 658 musicians concurred that the younger demographics experienced non-specific pain more frequently (Fry 1988). For every instrument that had a large enough sample size to identify an age pattern, the “peak prevalence” of pain manifested in musicians below 35 years of age for every instrument. Fry reported in his study investigating pain in symphony musicians that there was little

change in the incidence or severity of pain above the age of 30 (Fry 1986c). Fishbein et al. found in their national study of symphony orchestras that medical problems peaked between ages 35-45 (Fishbein et al. 1988).

Smith investigated age in relation to PRMDs as well. Instead of concentrating on the symptom, he concentrated on the aging musician population. He reported that many music students had difficulty with pain and therefore “some students probably drop out of professional music” while in school because of “recurrent or chronic medical problems” (Smith 1992). This indicated that those with difficulties might leave the field of music all together. Conversely, his study of retired musicians reported that those who retired from symphony playing felt it had to do with advancing age and not with an injury or specific disability (Smith 1989). But, perhaps the players that made it to retirement age did not have PRMDs earlier in life (like school age players who left the profession if PRMDs presented) so they continued to play without having PRMD concerns influence their decision to retire.

The size of the instrument was indicated as a factor in PRMD development. Research showed that the bigger the instrument, the more injuries (Fry et al. 1988; Lockwood 1988; Middlestadt and Fishbein 1989).

As the size of the string instrument increases from violin to viola to cello, so does the vulnerability of women with respect to severe musculoskeletal problems at the hand and wrist (Middlestadt and Fishbein 1989, p.46).

## **2.4 Orchestral Musician Studies**

Studies have taken place to assess the prevalence of PRMDs in orchestral musicians. Fry conducted the first international study in 1986, investigating the severity of pain from overuse experienced by symphony orchestra musicians (Fry 1986c). This first overuse study interviewed and physically examined eight orchestras in Australia, America, and England. A scale of 1-5 was established for the grading of pain severity. Sixty-four percent of musicians surveyed reported pain from overuse. Forty-two percent of symphony orchestra musicians reported pain at 2 or above. The majority of pain experienced by musicians was a grade 1 or 2. Pain was experienced most frequently in the hand and wrist (41%), neck (38%) and shoulder (35%). Females playing woodwinds, viola and cello reported higher pain severities than their male counterparts. Male violin players seemed “slightly more affected” than female violin players. The younger demographics, specifically between 25 and 35 years of age had the most incidence of pain. Most musicians reported that the pain they experienced was normal. All woodwind players were grouped together in the results and were “frequently affected with overuse because of static loading as well as repetitious keywork.” Bassoon players were included in the study and it was concluded that playing with a floor spike supporting the weight of the instrument while seated was the safest way to play the bassoon.

The second international study was conducted in 1997 by the Fédération Internationale des Musiciens (Parry 2004, p.42). Stress and psychological factors were the major focus of this study, 57 orchestras participated. Medical problems were a section on the questionnaire. Forty-eight percent of players reported muscle pain and 46% reported

backache. Fifty-seven percent of respondents said that severe stress with medical problems negatively affected their playing. General pain was experienced by 58% of performers, 22% reported that pain had stopped them from playing at times in their career (James 2000).

The most cited study on musicians' health was the 1987 International Conference of Symphony and Opera Musicians (ICSOM) study (Fishbein et al. 1988). The ICSOM study issued a self-completion questionnaire to 48 orchestras in America. Fifty-five percent of all ICSOM musicians participated in the study. This landmark study found that 82% of ICSOM musicians reported medical problems and 76% felt that the problem was severe enough to negatively affect performance. Other important results include: females were more likely to report at least one medical problem; musicians between the ages of 35 and 45 were most likely to report a medical problem; musicians under 35 were more likely to report a severe problem (77%) than musicians over the age of 45 (71%); and that string players were more susceptible (84%).

Bassoon players were included in the ICSOM study. Fifty-one percent of bassoon players in the ICSOM orchestras participated ( $n = 79$ ). Female bassoon players were more willing to participate in the study (64%) while male bassoon players were not as willing to complete the questionnaire (48%). Specific types of problems afflicting bassoon players or the rate of PRMDs experienced by bassoon players were not printed in journal articles.

The University of North Texas (UNT) conducted the most recent large-scale study into musician health problems. Chesky et al. adapted the design of the ICSOM study to make it applicable to all types of musicians, not just classical, and changed the format to distribute via the Internet. This web-based musician survey was the first of its kind and was able to obtain a much larger heterogeneous sample of musicians than previous studies. The UNT study gathered data on specific instruments in order to “identify possible relationships to biomechanical risks associated with certain instruments” (Chesky et al. 2002b, p.1026). The data from this study was also disseminated differently than previous studies. The results were published in a series of articles that focused on specific instrument groups: keyboard (Pak and Chesky 2001), flute (Spence 2001), clarinet (Thrasher and Chesky 1998), double reeds (Thrasher and Chesky 2001), and brass instruments (Chesky et al. 2002a). The UNT study also allowed for comparisons between classical musicians and non-classical musicians (Chesky and Henoeh 2000).

## **2.5 Bassoon Specific Literature**

According to Creagh (2004), the bassoon can be considered an endangered species (Creagh 2004). Despite its current popularity in movie and commercial soundtracks, young children are not taking up the instrument and the population of bassoon players is dwindling. Bassoon is not popular and research has not been found specifically investigating PRMDs in the bassoon player. The bassoon player was part of some studies but the number of bassoonists participating has been small and the information gained limited. Burkholder and Brandfonbrener commented on this distribution of instrumentalist participation:

The distribution of instruments corresponds roughly to that in the general classically trained population of musicians, so the fact that there were few of any particular instrument (i.e., bassoon) is not indicative of protection from injury, but rather of the relative rarity of the instrument (Burkholder and Brandfonbrener 2004, p.119).

In 1987 Newmark and Lederman's investigated overuse in amateur musicians. Out of 79 participants, three were bassoon players. The study investigated how a sudden increase in playing time contributed to the onset of PRMDs by observing musicians as they increased their playing hours during a conference. The result was that 72% of the sample developed some PRMDs at the Conference due to the sudden increase in playing time (Newmark and Lederman 1987). The study identified a pattern for overall musicians and we can infer that it probably pertained to bassoon players, but with such a small sample of bassoon players participating ( $n = 3$ ), no patterns regarding sudden increase in playing time contributing to bassoon players' PRMDs can be verified.

Due to the small bassoon population many studies that included the bassoon grouped it with other instruments when reporting the results. Information found on the bassoon from these studies was clouded because other instruments with different characteristics and problems were reported simultaneously. For example, Shoup's study on young musicians grouped the bassoon with the oboe when reporting results (Shoup 1995). In the study the bassoon and oboe category had four participants. Due to the grouping, we do not know if there was one bassoon player or three bassoon players. Fifty-two percent

of students in the study had a current musculoskeletal problem. Due to the method of reporting it was unclear whether the bassoon player(s) reported any PRMDs.

Researchers poorly report results by creating random instrument groupings. Burkholder and Brandfonbrener reported the results from their study of student musicians by reporting the bassoon information along with the saxophone (Burkholder and Brandfonbrener 2004). The study was reported with five “other woodwinds (bassoon/saxophone).” Somehow the bassoon was not important enough to warrant its own category, even though other instruments with relatively small numbers were kept separate such as three harp players and four guitar players. The study further muddied the results by reporting lateralization symptoms in large instrument groups: piano, strings, woodwind, brass, percussion, and harp. Woodwind players reported slightly more problems on the right side than the left, but bilateralization of PRMDs was most frequent (Burkholder and Brandfonbrener 2004, p.118). However, the woodwind family has a very diverse range of arm and hand positions for each instrument. The clarinet (Thrasher and Chesky 1998) and the oboe (Thrasher and Chesky 2001) use the right hand to support the weight of the instrument while playing, where as the bassoon has more weight on the left arm than the right while playing. Reporting that woodwind players had slightly more problems on the right side seems indicative of the larger samples sizes from the more popular clarinet and oboe, rather than any lateralization information about the bassoon. Reporting lateralization by grouping all the woodwinds together did not facilitate accurate information. Researchers must be more specific when reporting results if the studies they produce are to be beneficial to the musician.

One of the ways that the bassoon has been properly handled in the literature was through case studies. A case study was a beneficial way to report on bassoon problems because it could be about one participant and the limited numbers in the bassoon population were not a factor. An example of a case study was when Quarrier reported on a bassoonist recovering from muscle strain in the thoracic region of the back (Quarrier 1993). Recovery was expected after a treatment of moving the music stand to the left, twisting to the left whenever possible in rehearsals, and having the bassoonist do strengthening exercises. Though the study was only about one person, and did not give any large overviews into the plight of the bassoonist, this specific information may give bassoonists an idea on how to aid their own recovery. This was more beneficial than knowing that woodwind players have slightly more problems with the right side than the left, but bilateralization of PRMDs was most frequent (Burkholder and Brandfonbrener 2004, p.118).

Fry clearly reported results from his study of 658 musicians (Fry 1988). When reporting results each instrument was kept separate regardless of the number of participants. There were 17 bassoon players with overuse in his sample. Due to the limited size of the sample he did not make any large statements about gender differences for the bassoon, as he was able to do with the large sample of violin players ( $n = 153$ ). But by reporting the bassoon separate, his study identified that the highest occurrence of pain symptoms associated with overuse in bassoon players lasted two to five years, but could last 40. Bassoon players reported pain most frequently in the hand and wrist. Additionally, the severity of pain experienced by bassoonists was “mostly in the Grades 2 and 3” (Fry

1988, p.14). Fry's method of reporting gave the bassoon community valuable insight into the PRMDs.

Cayea and Manchester mimicked Fry's method of keeping instruments separate when reporting results. In their study on "upper-extremity injuries in music students" they reported that the injury rate among bassoon players was 5.1% (Cayea and Manchester 1998). The overall rate of injury for the study was 8.3% so the bassoon player reported low injury rates compared to other instrumentalists. With a bassoon sample size of 236, they were able to conclude that females reported injury more frequently (9.3%) than males (1.3%). Based on their system of low, medium, and high ratings, the male bassoon player had a low rate of injury while the female bassoon player reported a medium rate. The overall rate of injury for female musicians in the study was 8.9%. The female bassoon player was more likely to have an injury than the general musician. Though this was not discussed as a possibility in the article disseminating the results of the study, this difference in female bassoonists' rate of injury, compared to that of other instrumental female musicians, could be related to the size of the instrument. As reported by Middlestadt and Brandfonbrener, female string players were more susceptible to PRMDs as the size of the instrument increased (Middlestadt and Fishbein 1989). Perhaps this same relationship exists in the woodwind family. The bassoon is the largest woodwind instrument and female bassoon players reported a higher rate of injury than the overall sample.

The most comprehensive study to date on bassoon player PRMDs was the University of North Texas Musician Health Survey (UNT) (Thrasher and Chesky 2001). Conducted

via the Internet, the results were disseminated in papers separating each instrument. Even though the paper for bassoon was on double reed performers, the two instruments (oboe and bassoon) were not combined when reporting the results. The UNT study informed that 80% of bassoonists ( $n = 75$ ) reported one or more musculoskeletal problems, higher than previous data on the rate of injury to bassoon players. Bassoon players reported a higher rate of musculoskeletal problems than oboists (72%). Bassoon players reported that locations on the left side of the body were most prevalent, with the left wrist being the worst afflicted area (48%). Female bassoon players reported higher frequency of injury for 11 of the 18 body areas. Bassoon players also had a higher severity of PRMDs than oboe players for 15 of the 20 locations. Perhaps this was an indication that the prevalence of PRMDs does increase with the size of the instrument in woodwinds as well as strings.

In addition to the large size of the instrument, another factor that may influence bassoon PRMDs was the complex keywork required to play the instrument. Quarrier reported that the more fingers required to play an instrument, the higher the risk of injury (Quarrier 1993). If this was true, bassoon players should have the highest injury rates of any instrumentalists because bassoon is the only orchestral instrument where all ten fingers are used to facilitate keywork. Every other instrument has a finger supporting the weight of the instrument that is not used to depress keys; while some of the weight of the bassoon is supported by the left hand, yet all the fingers are required to depress keys.

Bassoon players use their hands not only to play the instrument, but also to make their own reeds. Making bassoon reeds requires repetitive motion of the hands and wrists. A

strong grip is needed to hold the knife (usually in the dominant hand) and other tools (file, sandpaper) while the other hand holds the reed that is being worked on absolutely still. It must be noted that this could have a negative impact on the player. Dawson wrote of injury sustained while reed making in the first volume of *Medical Problems of Performing Artists* (Dawson 1986). No research has been conducted on this topic since Dawson, despite the probability of injury in reed making bassoon players.

Although the bassoon is a large, heavy instrument that requires the use of all ten fingers to play and requires the player to use their hands to make reeds, very little has been written about prevention of PRMDs specifically for the bassoon player. Other instrumentalists have books specifically targeted for the demands of the instrument. For example, even though percussionists were the least injured musicians (Fishbein et al. 1988), a book was dedicated solely to their injury treatment and prevention (Workman 2006). Many books are available about generalized musicians' health and could be applied to any instrument (Norris 1993; Horvath 2002; Rosset i Llobet and Odam 2007). Books that are available on bassoon technique do not include sections on injury prevention (Camden 1962; Spencer 1969; Jooste 1984). The best source of information on bassoon injury is the "Ask the Doctor" section of the International Double Reed Society's journal, *The Double Reed*. Dr William Dawson, a hand surgeon and bassoonist, has written this column for many years (Dawson 1988b; Dawson 2003a; Dawson 2004; Dawson 2006a). In 2007, Dawson published a book on "playing healthy" that was a revised, expanded version of "Ask the Doctor" (Dawson 2007a). Even though Dawson is a bassoon player himself, he did not investigate at length bassoon specific problems in his book; instead it is an overview for all instrumentalists.

## 2.6 Conclusion

The field of performing arts medicine is a new specialty that is growing quickly due to increasing demand. Musicians are incurring PRMDs from playing at an alarming rate. The rate of PRMDs in instrumental musicians fluctuated from 37% to 87% in the literature (Zaza 1998). Overuse was the most common condition afflicting all types of instrumental musicians (Fry 1986c; Mandel et al. 1986; Newmark and Lederman 1987; Fry et al. 1988; Goodman and Staz 1989; Lockwood 1989; Dawson 2001b). Overuse was often categorized as musculoskeletal pain and overuse syndromes (Brandfonbrener 2000, p.172). Musicians experienced PRMDs most frequently in the upper-extremities (Fry 1988; Zetterberg et al. 1998; Thrasher and Chesky 2001; Warrington et al. 2002; Lederman 2003; Burkholder and Brandfonbrener 2004; Toledo et al. 2004; Nemoto and Arino 2007). Females were more likely to suffer from PRMDs than males (Fry et al. 1988; Lockwood 1988; Middlestadt and Fishbein 1989; Zaza and Farewell 1997; Cayea and Manchester 1998; Dawson 2001b; Abréu-Ramos and Micheo 2007). The younger demographics were more susceptible to PRMDs (Fishbein et al. 1988; Dawson 2001b; Warrington et al. 2002; Abréu-Ramos and Micheo 2007). The larger the instrument was, the more likely the player would incur an injury (Fry et al. 1988; Lockwood 1988; Middlestadt and Fishbein 1989).

Many studies grouped the bassoon with dissimilar instruments when publishing results thus tainting specific findings. Bassoon was often poorly represented in sample sizes because of the rarity of the instrument (Burkholder and Brandfonbrener 2004). Bassoonists were incurring injuries from playing, between 5% (Cayea and Manchester 1998) to 80% (Thrasher and Chesky 2001). Bassoonists reported injuries most

frequently in the left wrist (Thrasher and Chesky 2001). Currently, no large studies have been undertaken solely on the bassoon players' health. No bassoon specific PRMD prevention guide exists.

### **3 Methodology**

This chapter lays out the process that was used to conduct the research for this study and thesis. This chapter sets out the steps of the research process in the following order: an introduction to the research method, the Internet method of distribution, ethics requirements, creating a website, creating the *International Bassoonist Questionnaire (IBQ)*, recruiting participants, collecting the data, handling the data, and analyzing the data.

The research method was a survey, which included both qualitative and quantitative information. The survey addressed the lack of hard statistical evidence on PRMDs in bassoon players. Along with collecting quantitative data, qualitative questions in the form of open-ended questions were included to garner the experiences and beliefs of bassoonists. This provided a mixed method approach to the research questions (Cohen et al. 2000). According to the literature, using both closed response and open answer questions broadens the scope of a questionnaire (Cohen et al. 2000; Kumar 2005; Welman et al. 2005; Pepper 2007).

#### **3.1 Using the Internet to Distribute a Survey**

The vehicle for collecting data was a survey administered on the World Wide Web. The Internet was a successful tool used by researchers conducting surveys starting in the mid 1990s (Bell and Kahn 1996; Houston and Fiore 1998). The World Wide Web was already being used as a tool by the music community (Harman 2001b; Harman 2001a). The University of North Texas (UNT) conducted the first survey, via Internet distribution, for musicians. The University of North Texas Musician Health Survey was

developed as an online survey “to generate a nonrandomized, recruited sample of musicians” (Chesky et al. 2002b). The results of the UNT study were compared to data from the 1999 National Flute Association conference to establish the validity of a web-based survey. “Results indicated no significant differences” between the two samples (Chesky et al. 2002b) validating the use of Internet distribution for future studies.

To date no comprehensive study had been conducted to specifically address PRMDs for bassoon players. Bassoonists have been part of numerous studies that were conducted across the instrumentalist population (Fishbein et al. 1988; Cayea and Manchester 1998; Thrasher and Chesky 2001). One reason for the lack of research on bassoon PRMDs is the limited number of bassoon players in any one location. A professional orchestra will hire between two to four full-time bassoonists, whereas 30 violinists may be under contract. This population distribution has resulted in more research being conducted on instrumentalists who are readily available. Due to the fewer number of bassoon players in any location, it was decided that an international cross section of the population would provide the largest sample size, with hopes of obtaining the most accurate and detailed information. In order to reach an international audience, conducting the survey via the Internet was the most productive and cost effective avenue.

The Internet allowed the study to reach bassoonists throughout the English-speaking world. Polling the international bassoon playing community also gave a comprehensive view of the different schools of bassoon playing. Studying bassoon in Germany, France, England, and the USA results in four different styles and techniques of playing the instrument. These differences include: reeds design, bocal curve, fingerings,

articulations, phrasing, and desired sound quality. If only one region was studied the results could be due to the style of playing, not the instrument, so it was important to have participants from all schools of playing with the instrument the common denominator. As this was the first exclusive study on bassoon PRMD rates it was important that the school/style of playing was less consequential than the instrument. With the success of the UNT study, an Internet survey was chosen as the method to provide the largest possible sample of participants.

### **3.2 Ethics**

Conducting any form of survey involves ethical consideration. In this case, protecting the medical information of the participants was foremost. Musicians feared being “blacklisted” from future performance opportunities if they were known to have injuries (Newmark and Lederman 1987). Subsequently, participant anonymity was guaranteed. Institutionally, the Human Research Committee (HREC) of the University of Sydney was required to approve all processes for this study. Approval was granted on 23 June 2006, reference number: 06-2006/2/8885 (Appendix B).

### **3.3 Establishing the Web Site**

The first step in the research process was to establish a website ([www.paulabrusky.com](http://www.paulabrusky.com)). The purpose of the website was to attract bassoon players to a valid website about bassoon playing and create a vehicle for questionnaire distribution. This website had to entice participants to visit it and participate in the study, so it was extremely important for the site to have a respectable image. In this case, the credibility created by the website was crucial to make participants comfortable about disclosing their medical

history. If the website did not look professional and credible, bassoon players may not choose to participate in the study.

One way the website fostered bassoonists' comfort was by establishing a dialog with the student researcher, a bassoonist. The website had a section where bassoonists were able to contact the researcher with questions as well as read about her experiences and credentials as a bassoon player. A link to the Sydney Conservatorium of Music, University of Sydney was furnished to provide validity to the study.

After discussions with bassoon community members, it was decided that if the website provided more to bassoonists than just the link to take the survey, it would increase likelihood of participation. The website was designed to have a "resources" section with additional information that might be useful to bassoonists, such as: a step by step demonstration on "How to Make Reeds;" a list of bassoon solo repertoire; and a table of the Vivaldi Concerti with all their different numbering codes (courtesy of Dr Jeffrey Lyman). The hope was that a "resources" section would be useful to the bassoon community and therefore bassoonists would be more willing to contribute to the study.

The homepage of the website provided an area that could be updated as the study progressed, allowing participants to go back to the website at any future date to see what information had been learned through the survey data and to stay abreast of subsequent studies. This provided an interaction between researcher and participants, and created an avenue to continue following the latest bassoon research. Being privy to information

about the study and its findings was believed to give participants an incentive to participate.

The website, [www.paulabrusky.com](http://www.paulabrusky.com), was created in conjunction with Globetrotter Design. The initial html coding was done by their technician with artistic and design elements approved by the student researcher. Tutorial sessions were held by the Globetrotter technician to teach the student researcher how to maintain and update the site using *Dreamweaver 8*. The decision to use the student researcher's name, Paula Brusky, as the domain name was necessary for the site to be maintained after the initial study was completed and created a place for bassoonists to get further information. On 15 August 2006 [www.paulabrusky.com](http://www.paulabrusky.com) was launched. (Appendix C contains a printout of the main pages from the website).

The website, [www.paulabrusky.com](http://www.paulabrusky.com), has four main sections. From the homepage a visitor can access:

- A link to a “research” section providing information about the PRMD study. The link to the *IBQ* was on both the homepage and on the “research” page. On this page participant information, as required by HREC, was available. This page was updated as the study progressed. Additional updates, with results and discussion, will be available to the bassoon community after the marking of this thesis.
- A link to a “resources” section providing information relevant to the bassoon community. On this page, multiple links to pages containing information on

books to read, repertoire choices, and step-by-step information on how to make reeds are available.

- A link to an “about” section providing information about the student researcher who is a bassoonist and owner of the website. Additionally, the student researcher’s biography, resume, videos of recent performances, and photos showing a diverse range of activities that are not music related are included.
- A link to a “contact” page providing contact information for the student researcher. Giving bassoon players visiting the website information on how to contact the student researcher and owner of the website.

From the homepage, all areas of the website can be accessed. The right hand side of the homepage has an area that can be updated as the survey and study progresses, so the most current information is at the front of the web page.

### **3.4 Creating the *International Bassoonist Questionnaire***

Many studies have investigated musician health through questionnaires (Lockwood 1988; Lehrer et al. 1990; Spence 2001; Davies and Mangion 2002; Spahn et al. 2002; Kaneko et al. 2005). No exclusive bassoon study into PRMDs was found, so the first step was establishing the main avenue of survey questions by reviewing the literature. An initial comprehensive question list was generated from the literature and incorporated the student researcher’s personal experiences in teaching and playing the bassoon. One example from the literature that was used as a basis for musician questionnaires was a flute study conducted at the University of Sydney. In this study the survey was the first part of a larger study with an electromyography (EMG) component looking at muscle tension in flute players in relation to PRMDs experienced (Fortune 2007). This flute

study was based on a previous violin study (Ackermann 2003). Although the bassoon study would not take the same EMG focus as the flute study, some of its PRMD questions were relevant and the methodology was proven to be successful.

The questions that appeared in the final bassoon survey were modifications of the student researcher's original comprehensive question list and were based on current literature incorporating proven methodologies from other instrumentalist studies.

The *International Bassoonist Questionnaire* covered:

1. Types of injuries and PRMDs experienced by bassoon players
2. Injury and PRMD frequency among bassoon players
3. Severity of PRMDs
4. Location of PRMDs
5. Duration of PRMDs
6. Treatments used
7. Contributing factors to the development of PRMDs
8. Perceptions of the bassoon community regarding PRMDs
9. Exercise regiment of bassoon players
10. Demographic information

In order to obtain Ethics approval, a paper copy was created and submitted (Appendix D). The paper copy was only a list of the probable questions that would be included in the final survey. Little time was spent on beautifying the paper copy because the web-based version would have different constraints on layout and a different appearance.

Creating the online survey began by choosing a web-survey housing company. Numerous companies offer online survey capabilities; many trial software programs were downloaded and tested including Formsite, Zapsurvey, Checkbox, and Surveybuilder. The company that was easiest to use, most versatile, inexpensive, and provided the most comprehensive features matching the needs of the bassoonist survey was *SurveyMonkey.com*.

*SurveyMonkey.com* was completely interfaced on the World Wide Web. This meant that there was no software to download. A user visited their website and everything was provided to create a survey. Since everything was on the *SurveyMonkey.com* website there were no compatibility issues between PC and Mac users, both when creating the survey and when participants completed it.

*SurveyMonkey.com* also provided many features that allowed a survey to be personalized. By purchasing a “professional subscription” many additional options became available, such as:

- There were 20 types of questions that could be inserted into a survey including
  - Multiple choice, single answer
  - Multiple choice, multiple answer
  - Drop down answer
  - Essay/open answer
  - Matrix with single answer
  - Matrix with multiple answer
- There was no advertising on the *SurveyMonkey.com* survey that was created.

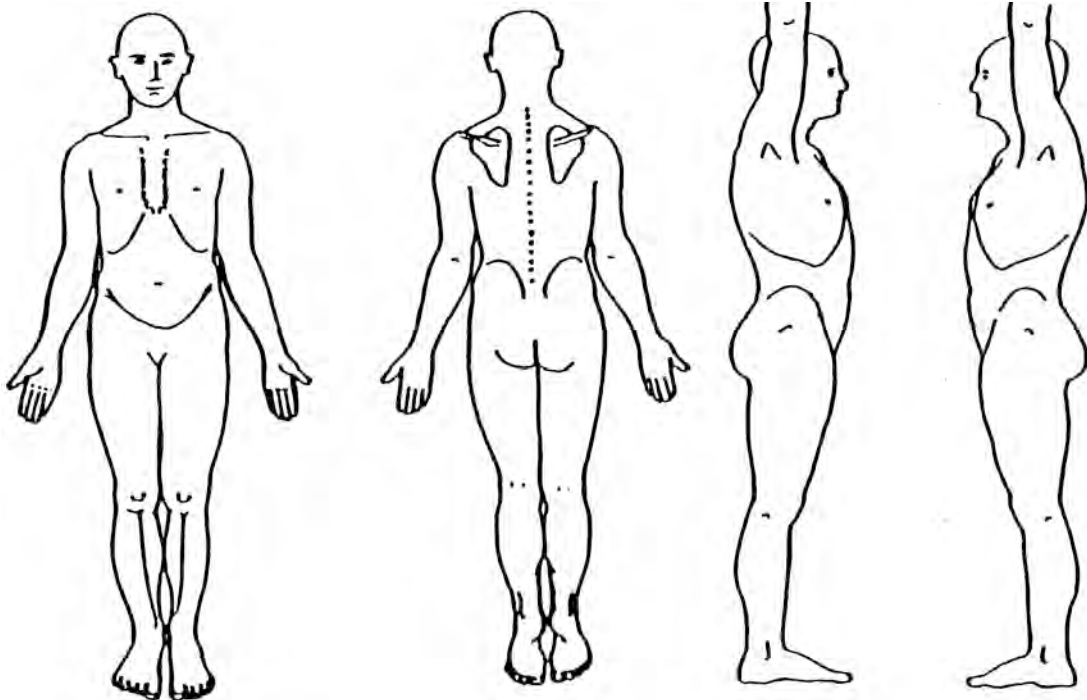
- An unlimited number of responses was possible.
- Your own logo could be added to your survey, branding the survey created. A University of Sydney logo was on each page establishing credibility with participants. This also complied with the HREC requirements.
- When respondents filled out the survey, their Internet Protocol (IP) address was recorded so they could return to complete the survey at a later time without creating a personal account.
- There were no time constrictions or obligations with the purchased membership. Membership could be cancelled at anytime and the researcher was only charged for the months used.
- No limit was enforced regarding the length of a survey (the number of questions).

The privacy of respondents was paramount. When asking questions about their medical history, it was important the respondents remain anonymous. Many of the online survey companies required that survey respondents create an account, which would require identification of the user, in order to submit a survey. *SurveyMonkey.com* did not require that respondents create an account. Instead, *SurveyMonkey.com* tracked the respondent's IP address so that if the respondent wished to return and complete the survey at a later time they could, and their anonymity was protected. Since the *IBQ* was long, it was important that it could be completed in more than one sitting; but participants had to know that their anonymity was always protected. *SurveyMonkey.com* provided both of these aspects: anonymity and return visits. In addition, by keeping track of IP addresses no one could fill out the survey more than once from the same computer, increasing the validity of the results.

*SurveyMonkey.com* provided basic compilation of the data. The data was collected and tabulated by the company; then it was made available in both EXCEL and Statistical Package for the Social Sciences (SPSS) compatible formats. The data was available in three-output style: a full answer version, a numeric version, and statistical version. The numeric version saved numerous hours of simplistic data entry.

Having decided on a company to house the *IBQ*, the creation of the online version began on 8 June 2006. Numerous emails to the *SurveyMonkey.com* help staff were used to generate the final questionnaire. The most difficult problem to overcome was the “body part” diagram questions, where specific body locations experiencing PRMDs and injuries were identified. In the flute player EMG survey, participants indicated on a picture of the body where they experienced symptoms by hand drawing the locations of PRMDs using colored markers (Fortune 2007). Figure 2 is an example of this type of methodology.

*Please indicate on the body chart below where you have experienced pain or injuries related to playing the flute, and indicate next to the shaded area how long the pain has been present for (or was present for).*



**Color Legend:** *Red for current pain, less than 1 month duration*

*Green for pain lasting from 1-3 months*

*Blue for pain lasting over 3 months*

*Black for previous significant pain episodes (not including transient aches and pains)*

**Figure 2: Excerpt from flute EMG survey identifying PRMD body locations**

**(Used with permission from (Fortune 2007))**

The *IBQ* was a computer-based survey. When completing a survey online colored markers and paper pictures could not be used; a new approach was needed. The body was split into five regions: head/neck, back/chest/shoulders, legs/hips/feet, arms/wrists, and hands. Then each body region had color-coded shapes (rectangles, circles, etc.) inserted where PRMDs might occur creating specific body locations. Figures 3 and 4 show the resulting images, used to identify PRMD locations in the *IBQ*.

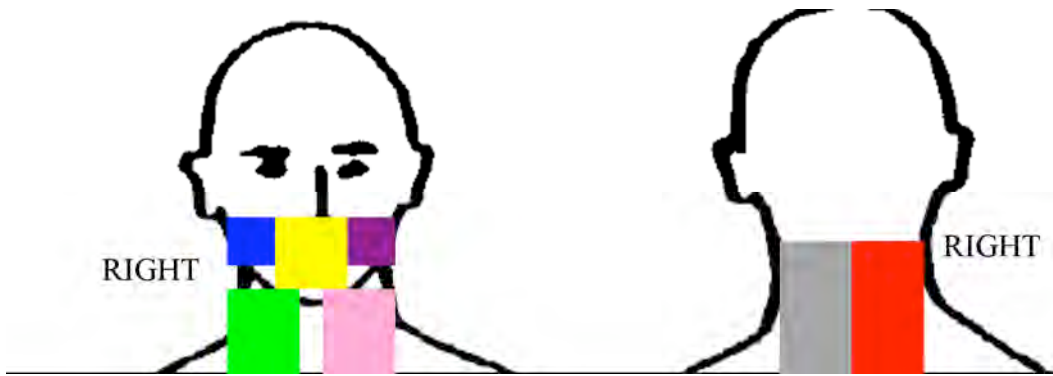


Figure 3: Head and neck region in *IBQ*

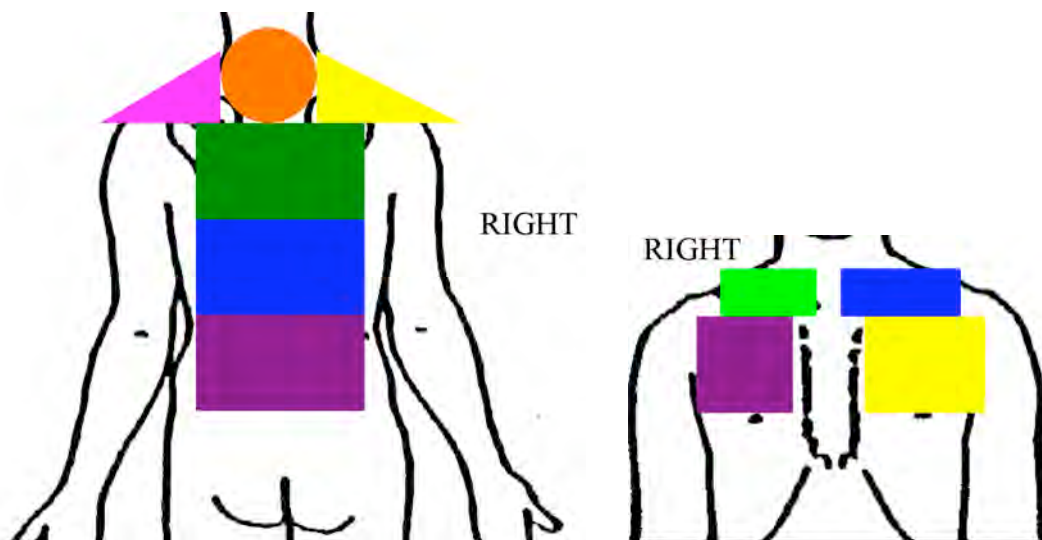


Figure 4: Back, chest, and shoulders region in *IBQ*

These figures were saved as a PDF and uploaded to back pages on [www.paulabrusky.com](http://www.paulabrusky.com) for the *SurveyMonkey.com* site to reference for inclusion in the survey. A matrix style question was then created for each of the five body regions asking about the duration of PRMDs with the figures used to identify body locations of PRMDs.

### **3.4.1 Piloting the Questionnaire**

Before opening the online questionnaire to the international bassoon population the survey was piloted twice to determine how participants would interpret it, reveal any confusion over the questions, ascertain how the software would work, and specify how results would be submitted. Musicians at the Sydney Conservatorium of Music, University of Sydney, who were not bassoonists, volunteered to participate in both pilot tests. All test participants were asked to insert the instrument they played whenever there were references to the bassoon.

The first pilot test was comprised of ten Conservatorium students who volunteered to take the survey and provide feedback. The first test subjects reported that having figures for the arms/wrists and hands questions regarding PRMD location and duration were confusing. They felt that left verses right was very difficult to distinguish when viewing the figures. The figures of the arms/wrists and hands were removed from subsequent versions of the survey. The arms/wrists and hands questions were adjusted to continue using the matrix questions, but with the terms “right side” and “left side” instead of figures.

The pilot test version submitted to test group one had different questions for students than for teachers. The idea was to get a difference in perspective between those learning and those teaching. However, this turned out to be very difficult as many students also teach and all teachers were students at one time. The feedback was that this distinction was often confusing and made the survey unnecessarily long. In the revised version, all questions were made universal with no distinction between student and teacher, and

worded to not be confusing. For example, “I teach my students injury prevention” and “my teacher has taught me injury prevention” were changed. The question directed at the teacher, “I teach my students injury prevention,” was removed. The student question, “my teacher has taught me injury prevention,” was adapted to a final version, that included both teacher and student, and read, “I was taught injury prevention in my bassoon lessons.” By combining the most important questions from the student and teacher versions, the final survey was deemed to be less confusing and shorter in length.

After fixing the problems reported in the first pilot test, a second test was run. The second pilot test had different participants. Ten students from the Conservatorium who were not bassoon players volunteered to participate. The feedback was overwhelmingly positive. A few wording changes were made for clarity. The most notable of these was the PRMD definition, which was modified to include reoccurring pain areas. All ten subjects on the second pilot test felt that the survey was very clear and ready to be released to the target audience.

The *International Bassoonists Questionnaire* was opened for responses on 16 September 2006. The survey was 17 pages long with 43 questions, which generated a possible 343 variables (Appendix E). A link could be activated on [www.paulabrusky.com](http://www.paulabrusky.com) homepage or “resources” page, bringing participants directly to the *SurveyMonkey.com* questionnaire. When participants submitted a completed questionnaire, they were directed back to a thank you page on [www.paulabrusky.com](http://www.paulabrusky.com).

### 3.5 Recruiting Participants

The only requirements for participation in this study were experience playing the bassoon and the ability to use the Internet. There were no restrictions on how long the participant had played or whether the player was a student, amateur, or professional.

Once the survey was open to collect responses, recruiting participants to fill in the survey became the focus. The goal was to make sure that members of the bassoon community were aware of the survey and knew how to access it to participate.

Participants were chronologically recruited in five ways:

1. A flyer was displayed around the Sydney Conservatorium of Music at the University of Sydney, encouraging bassoonists to go online and complete the survey (Appendix F). The same flyer was also printed in a miniature size and placed in an envelope in the woodwind department so bassoon students could take a flyer for reference.
2. An article was submitted to the International Double Reed Society Journal, *The Double Reed* (Kenny and Brusky 2006). The article introduced the study and encouraged bassoon-playing members of the IDRS to participate (Appendix G).
3. Personal contacts of the student researcher were used to contact other bassoon players. Each person contacted was asked to forward the email containing information about the study, with the link to the survey, to any bassoon player of his or her acquaintance (Appendix H).
4. The on-line forum for the International Double Reed Society (IDRS) allowed the student researcher to post information about the survey. The posting contained a

link to the survey. It also opened an avenue of communication between the student researcher and the online bassoon community where questions about the study could be asked/answered.

5. As a member of the IDRS, the student researcher had access to the username of all IDRS forum members. Each username was attached to an email address. Personal emails were sent to registered online member of the IDRS (Appendix H).
  - a. The IDRS online database was not separated by instrument (the IDRS also includes oboe players and other musicians interested in the double reeds) nor did it give the members' name. The emails could not be downloaded. Emails could only be sent through the IDRS server. This meant that for each of the approximately 1200 members of IDRS online, the individual link on the site had to be accessed and an email personally sent, one at a time.
  - b. IDRS members were screened by username or familiarity to the student researcher. Any IDRS online member whose username indicated their instrument was not the bassoon, such as "oboegirl" or "eh forever," were not sent emails. Emails were not sent if the student researcher could identify the member by their email address and had contacted them previously. In total, approximately half of the emails sent would have gone to bassoonists; the rest would have gone to other instrumentalists registered on IDRS online. Anyone receiving the email, whether a bassoonist or not, was asked to forward the email to any bassoonists in their acquaintance.

- c. An EXCEL spreadsheet was created to show the usernames of all IDRS members that were emailed and if there was a response. This spreadsheet also included previously emailed personal contacts of the student researcher. This master list showed how many emails were sent during the entire recruitment process. Over 841 emails were sent to recruit participants.
- d. Twenty-eight bassoonists contacted the researcher after the initial email asking questions and sharing personal stories of pain and suffering.

Demographic information about the sample will be discussed in chapter 4, section 4.1.

### **3.6 Collecting the Data**

After the bassoon community was notified of the survey, all that was left to do was to wait and see how many responses ensued. During the planning process it was decided that the survey would remain online for bassoonists to fill out for six months. However, responses continued to trickle in, so the survey was left open for over eight months. The *International Bassoonist Questionnaire* was closed, and taken off line, on 25 May 2007. At closing, there were 212 responses to the *International Bassoonist Questionnaire*, far exceeding the number of participants in most earlier studies that included the bassoonist (Fishbein et al. 1988; Burkholder and Brandfonbrener 2004).

### **3.7 Handling the Data**

An electronic data analysis program was chosen to assist in analysis. The main program that would be used was SPSS with EXCEL supplementing where necessary. SPSS was chosen for the versatility it presented with statistical analysis. SPSS was a proven

analysis program with numerous researchers using it successfully in studies about musicians (Thrasher and Chesky 1998; Ackermann and Adams 2003; Spahn et al. 2004). *SurveyMonkey.com* was selected as the company to house the *IBQ* partly because of how the company provided access to the results. The raw data was available in both SPSS and EXCEL formats; there was a statistical version, full answers version, and a numeric version available. All possible versions were downloaded and saved for the future. The raw data needed to be cleaned before it could be analyzed in SPSS. The version of raw data from *SurveyMonkey.com* that was used as the source for all future analysis was the EXCEL numeric version. The EXCEL numeric version data was cleaned in EXCEL before being exported into SPSS for analysis.

A major concern when using an online survey was that it was universally open for responses. Even people who did not fit the criteria (non-bassoonists) may have taken the survey. For example, some people surfing the Internet may have stumble across the survey and had nothing better to do than take it, even though they never played the bassoon. Because of this concern, after downloading the data into EXCEL from *SurveyMonkey.com* many hours were spent reviewing answers and removing all participants that seemed unauthentic. First of all, surveys that were not completed were removed. Next, anyone who did not fill out the 15<sup>th</sup> and 16<sup>th</sup> pages (questions about level of agreement with statements and basic information about the amount they exercise) was removed. Third, anomalies in the “completed” answers were reviewed to find unauthentic responses. For example, if someone said he or she played the bassoon for 67 years then said they were only 23 years old, they were removed from the data set. Lastly, the short answer questions helped find the non-bassoon players with answers like

“I don’t play the bassoon.” All of the participants that were deemed non-bassoon players were removed from the main data list and put into a separate EXCEL file. There were 166 responses that were complete and believed to be from bassoon players.

Once the data set was established, great effort was taken to clean it up. There were numerous mistakes from respondents on pages 6-10 (Appendix E contains the *IBQ*). Each of these pages started with the overall question “have you experienced any PRMD or injury [in each body region]?” Then following were figures for the body region, color-coded, with a matrix question detailing the duration component. The duration component identified the number of months the worst experience lasted and if the location had both a previous and current episode. Some bassoonists must not have thought of a PRMD/injury until they saw the figures because they initially indicated in the overall question that they did not experience any problems in that body region, but then after seeing the figures and thinking about the duration component, would select a location and duration. When cleaning the data in each of these situations, the overall question regarding PRMDs in the body region was changed from a “no” to a “yes” to concur with the answer of a specific location and duration. It was decided that if someone took the time to fill out a specific location and duration they most likely had experienced a problem in that area.

When the data was downloaded from *SurveyMonkey.com*, each possible answer had a column. For example, the question asking the gender of participants had two possible answers, “male” and “female,” and therefore had two separate columns. In order to run analysis on the data, each of the single-answer questions had to have only one column.

In the case of gender, this meant adding a third column where the sum of the two gender columns was calculated, resulting in one column for all of the participants' genders. Equations were used to shrink multiple columns into a single column for each of the single-response questions.

In order to input the EXCEL file into SPSS, each of the column headings had to have a variable name that did not use spaces or punctuation. Each question was given a shortened name for the column heading and a codebook was created to assist in understanding the shortened name (Appendix I). The codebook was a word document with three columns. The first column contained each of the actual questions of the survey. The second column in the codebook listed the SPSS variable name and shorthand that would be used for each of the questions. The third column listed all of the possible answers in numeric form for each question and the equivalent, for example "1 = no" and "2 = yes." The codebook assisted in the deciphering of the data.

After the data was cleaned and compacted in EXCEL it was exported to SPSS 13.0 for Mac OS X. All of the codebook information was then typed into SPSS. The data was ready for analysis.

### **3.8 Analyzing the Data**

The new University of Sydney PhD in performance degree had different requirements from a traditional PhD, with 2/3 of the degree time focused on instrumental performance and 1/3 of the degree time focused on research and thesis. The survey generated more information than was needed to satisfy the 1/3 research degree requirement. The research questions were revised and the data was evaluated to satisfy this constraint.

Due to the large amount of information acquired on the duration of PRMDs, it was decided that this information would be saved for analysis after the completion of this thesis. All of the essay style questions were saved for future analysis. Information on exercise habits was also saved for future analysis. The main analysis for this thesis would be: types of injuries and PRMDs experienced, locations and frequency of PRMDs, treatments being used, factors believed to contribute to PRMD development, and the perceptions of the bassoon community on PRMDs. These areas provided the direct information needed to satisfy the research questions.

Within the scope of data that would be analyzed, descriptive statistics were run to explore it, looking for patterns and interests. Descriptive, explore, and frequency analysis techniques were conducted. In the initial analysis, frequency provided the most useful information.

By using frequency analysis, areas of interest, such as gender differences, were highlighted. Groupings within the data became clear, such as a bi-modal distribution of age. When frequency and descriptive were used to explore the data, it was evident that more variables within the data needed to be created to aid in analysis. For example, the data showed an obvious bi-modal distribution of age where no participant was aged 41 or 42, but there were a similar number of participants under the age of 41 as above the age of 42 so a new grouping variable was created. A “young” group was created for those under the age of 41 and an “old” group was created for those over the age of 42. This new variable allowed for different types of analysis (Chi-Square and T-Tests) than was possible with only a continuous variable.

ANOVA was one of the main statistical techniques initially used. However, as analysis was run, a problem was encountered. The sample showed a strong correlation between gender and age. The statistical techniques used in analysis had to be adapted from ANOVA to ANCOVA in order to account for this strong correlation between variables. ANCOVA allowed one of the correlating variables to be held as a co-variant and limited the effects of this strong relationship between variables on the reported results.

### **3.9 Conclusion**

This chapter set out the complete method of the study. This chapter explained the choice of methodology, means of Internet distribution, obtaining Ethics approval, creation of the website, creation of the survey, recruitment of participants, handling of the data, and analysis of the data. The following chapter presents demographic information about the sample. Chapter 4 explores the injury data gained from the *IBQ* starting with an overview of injury sustained by the bassoon population, specifying PRMD types, and concluding with injury location. Gender differences and age affecting injury will also be explored.

## **4 Results – PRMD Frequency, Severity, Location**

The results of the *International Bassoonist Questionnaire (IBQ)* are reported in the following two chapters. Chapter 4 begins with the demographic information about the participants, then explores the injury data gained from the study. First an overview of injuries sustained by the bassoon population is investigated, next specifying PRMD types, and concluding with the locations where bassoon players incur PRMDs. Gender differences and age affecting PRMDs will be explored where pertinent. The majority of the information was quantitative in nature, but some of the qualitative questions will be used when discussing injury diagnosis and PRMD location. The second results chapter, Chapter 5, examines the treatments being used as well as perceptions investigated in the study, including what bassoonists believe contributed to the development of PRMDs. Both chapters of results have some discussion of the analysis alongside the statistics. As there are numerous research questions, each with its own set of sub-questions, and a large amount of information covered, beginning to discuss the results at the time of reporting makes the information comprehensible.

### **4.1 Demographics of Sample**

The total sample size was 211, but only 166 had fully completed the questionnaire and were deemed credible bassoonists. All of the statistics reported are run with a 166-sample size ( $n = 166$ ).

### 4.1.1 Gender

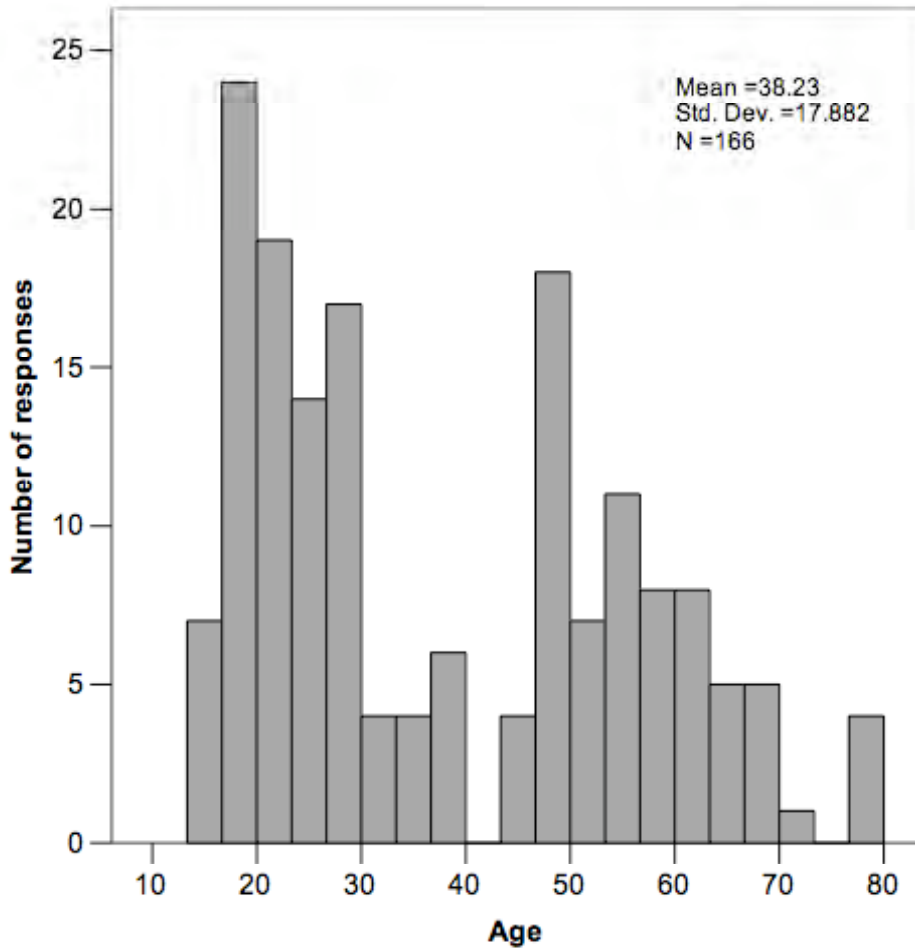
More males than females participated in the *IBQ*. The gender split was 58% male and 42% female. Traditionally, more males than females play bassoon (Zervoudakes 1994; Green 1997) so this was not unexpected.

### 4.1.2 Age

The average age of respondents to the *IBQ* was 38 (min = 14, max = 78, range = 64). The ages that appeared most frequently were 19 and 21, both having eight responses. Eighteen and 50 were the second most frequent ages with seven respondents for each. Many of the respondents were likely to be university students, as indicated by 18, 19, and 21 being three of the most frequent ages. Previous PRMD studies have used university student musicians and have reported a high level of injury in this population (Manchester and Lustik 1989; Zaza 1992; Eijsdenbesseling et al. 1993; Zetterberg et al. 1998; Burkholder and Brandfonbrener 2004). Researching university musicians has the added benefit that they are in one location and are easily accessible to researchers. When proximity to the researcher was no longer necessary, as for the online *IBQ*, this age group was still the most prevalent in responding to research requests. A contributing factor could be the web form of the survey, as university students are often comfortable with the online medium.

Figure 5 shows a clear bi-modal distribution of age, meaning that there were two separate groups naturally occurring within the entire age range. A grouping variable was created from the continuous variable, taking into account this natural division, to aid in the statistical analysis. The first age group included participants through the age of 41 (*n*

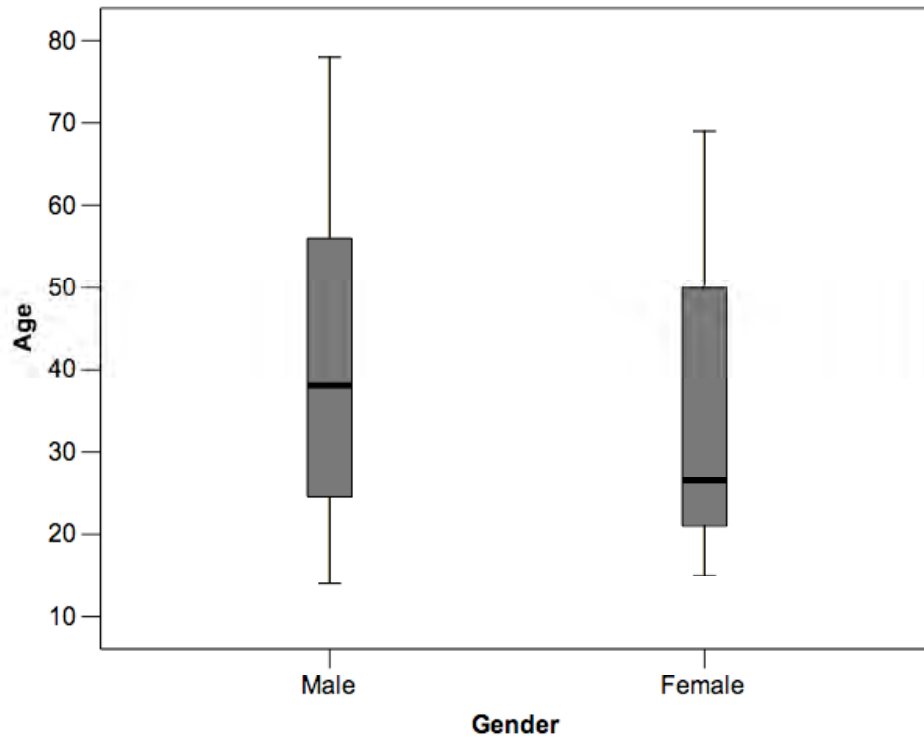
= 95, 57%). The second age group included participants from the age of 42 and up ( $n = 71, 43\%$ ).



**Figure 5: Age distribution of sample in years**

There was a relationship between gender and age in study participants, shown in figure 6. An independent-samples t-test was used to compare the age between males and females. Males ( $M = 41, SD = 18.4$ ) were on average 6 years older than females ( $M = 35, SD = 16.7$ ). There was a significant effect for age on gender [ $t(156) = 2.8, p < 0.033$ ]. The significant relationship between gender and age altered future statistical techniques used. ANCOVA became the primary analysis on gender and age questions

because a covariant could limit the effects of this pre-tested significance, while a t-test or ANOVA did not take into account this significant relationship between the variables.



**Figure 6: Mean age and range differences between genders**

The grey box represents 50% of responses for each gender, the black line in the box represents the median value, and the whiskers protruding from the boxes extend to the smallest and largest value for each gender<sup>1</sup>

### 4.1.3 Playing Experience

On average, participants had played the bassoon for 21 years (min = 1, max = 64). Males on average played 6 years longer than females [ $t(163) = 2.8, p < 0.006$ ]. There was a significant difference in length of time males played ( $M = 24, SD = 16.8$ ) versus

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<sup>1</sup> Interpretation of boxplot from (Pallant 2005)

how long females ( $M = 18$ ,  $SD = 12.4$ ) had played. Males on average had played 6 years longer than females, but males were also on average 6 years older. An ANCOVA was run on the length of time playing in relation to gender while holding the age as covariant. This analysis resulted in no significance between genders in relation to years playing the bassoon. No statistically significant difference in playing time between males and females solidified the importance of the gender and age relationship in the sample.

The average starting age of *IBQ* participants to learn the bassoon was 17 (min = 7, max = 51). Fishbein et al. reported that the average starting age for all musicians in a professional orchestra was ten year olds (Fishbein et al. 1988). The Suzuki™ Method for string instruments encourages students to start at the age of three or four (ISA 2005). With an average start age of 17, the bassoon was started much later than other instruments. This is most likely because the bassoon is large and cumbersome. For a child, small in stature, reaching the keys on the bassoon would not be possible. In the last 50 years bassoon manufacturers have started to address this difficulty and are now making “small reach” bassoons (Fox 2008; Püchner 2008). However, parents are reluctant to purchase a small reach instrument because they are as expensive as a standard student bassoon and their child will outgrow it in a few years. A new development to make the bassoon accessible at an earlier age is the tenoroon. The tenoroon is a smaller sized bassoon, currently in three size versions. The tenoroon is gaining in popularity. However, many schools do not choose to purchase tenoroons because they are pitched a 4<sup>th</sup> or 5<sup>th</sup> above the bassoon, so students learning on the tenoroon are not able to play in groups without a great deal of musical arrangement to bring their pitch in line with the other instruments. Although developments have

occurred which encourage younger students to learn the bassoon, so far, the bassoon is started later than other instruments.

To gauge the playing level of respondents, question 5 on the *IBQ* (Appendix E) asked if participants earned money from playing the bassoon. Sixty-four percent of respondents reported some income from bassoon playing. Question 6 followed by asking what percentage of a respondent's income was from playing bassoon. Only 24% of the participants reported that over 50% of their income was from playing the bassoon. These individuals were labeled "professionals" for future analysis options. There was no significant difference between genders regarding income from bassoon playing. Additionally, there was no significant difference in age between those that were "professional" and those that were not. It was expected that older participants would be "professionals" and younger participants would be "students," but no difference in age was noted between "professionals" and "non-professionals." This shows that younger players were gaining income from the instrument. It could also indicate that: the older professionals did not take the time to fill out an online survey; the older respondents were not the bassoonists playing in orchestras around the world, but instead were the amateur musicians playing for fun during retirement; the older players who used to be professionals were no longer playing bassoon due to reoccurring injury or a career change.

Over half of the respondents (52%) teach the bassoon. There were no significant gender or age differences regarding teaching according to Chi-Square analysis. There was no

statistically significance difference in age between those that teach and those that do not, but the average age of those that teach was slightly older.

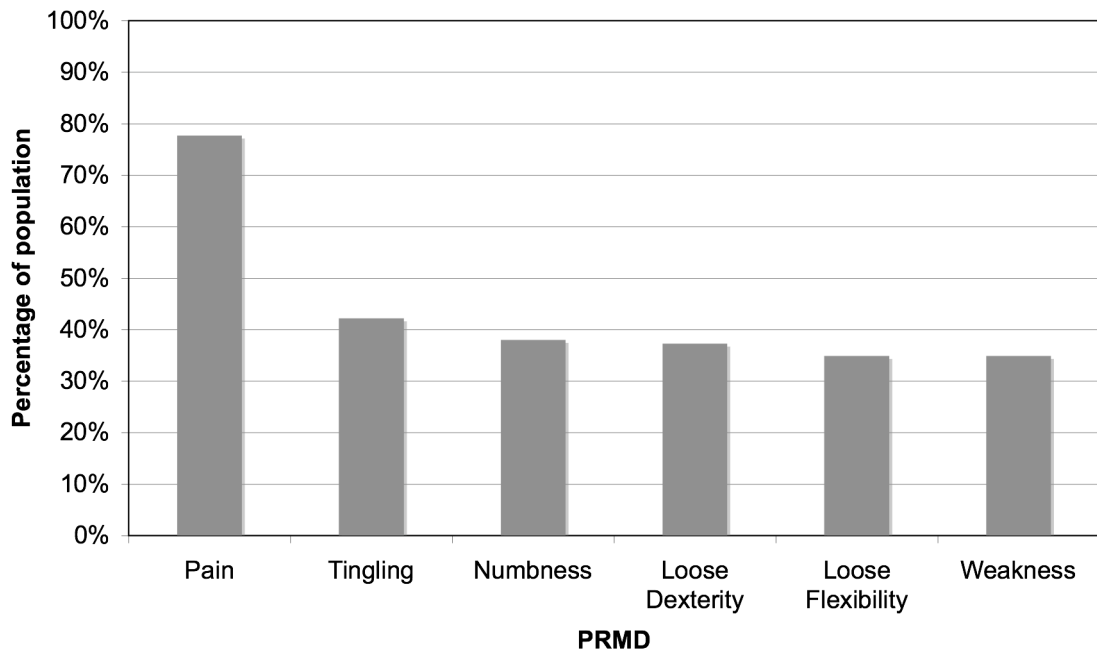
## **4.2 Injury and PRMD Information**

Injury and PRMDs were common in bassoon players; 86% of bassoonists indicated experiencing some type of injury or PRMDs. Only 14% of the respondents indicated they had never experienced any physical problems while playing the bassoon. It was possible that because the survey was web-based, those who had experienced PRMDs took the time to fill out the survey and those who had no episodes of PRMDs were not inclined to participate. This rate of PRMDs was higher than those found in previous studies encompassing many instruments (Fry 1986c; Fishbein et al. 1988; Lockwood 1989; Larsson et al. 1993). The range of PRMDs reported across all musicians was between 37% and 87% (Zaza 1998). Bassoon players reported at the high end of this range. With the significant PRMD rates found in similar research, either the majority of researchers found that those with symptoms were more disposed to participate in discussions about PRMDs than those who had not experienced PRMDs, or musicians overwhelmingly experienced PRMDs.

Females reported more PRMDs than males; 96% of females reported a diagnosed injury or PRMD symptom compared to 78% of males. Available research showed females reported more injuries while playing other instruments (Lockwood 1989; Larsson et al. 1993; Zetterberg et al. 1998; Davies and Mangion 2002). Female bassoonists reported much higher PRMD rates than male bassoonists. Only three females that participated in the *IBQ* did not report a diagnosed injury or PRMD symptom.

Page 4, question 9 of the *IBQ* (Appendix E), differentiated between an injury and PRMD symptom, asking specifically if players had been diagnosed with an injury from bassoon playing. Thirty-one percent of respondents reported a diagnosed injury. Seventy-five percent continued to play and perform while injured. Females were diagnosed with an injury more frequently than males; 44% of female bassoon players had been diagnosed with an injury while only 22% of males had been. Tendinitis was the most commonly diagnosed injury (54%). Other reported diagnosed injuries were: non-occlusion of soft palate, carpal tunnel syndrome, pinched nerve in neck or back, abraded nerves, Bells Palsy, thoracic outlet syndrome, torn rotator cuff, temporomandibular joint disorder (TMJ), and muscle imbalance.

Another question that differentiated between injury and PRMDs was on page 5, question 13 of the *IBQ* (Appendix E). This section defined PRMDs and asked about six symptom types: pain, weakness, numbness, tingling, loss of dexterity, and loss of flexibility. Pain was the most commonly experienced PRMD symptom (78%). Tingling was the second most experienced PRMD, but with 42% of participants reporting it, tingling was experienced almost half as frequently as pain. Loss of flexibility (35%) and feeling weakness (35%) were the least reported PRMDs. Figure 7 shows that pain was much more prevalent than any of the other PRMDs specified. Figure 7 also shows that all of the other PRMD symptoms, other than pain, had a similar percentage of responses.



**Figure 7: Percentage of bassoonists that reported each PRMD symptom**

Many bassoon players reported experiencing multiple PRMD symptoms. The *IBQ* investigated six specific PRMD symptoms: pain, weakness, numbness, tingling, loss of dexterity and loss of flexibility. Sixty-five percent of bassoon players reported the occurrence of more than one PRMD symptom. Almost 11% of bassoon players reported experiencing all six PRMD symptoms. Table 1 shows the percentage of bassoon players that reported multiple PRMD symptoms.

**Table 1: Percentage of bassoonists that reported multiple PRMD symptoms**

<b>Number of PRMD Symptoms</b>	<b>Percentage</b>
No PRMD symptoms	17.5%
1 PRMD symptom	18.1%
2 PRMD symptoms	12.7%
3 PRMD symptoms	16.3%
4 PRMD symptoms	15.7%
5 PRMD symptoms	9%
All 6 PRMD symptoms	10.8%

#### **4.2.1 Severity of PRMDs**

The severity of each PRMD symptom was measured on a ten-point scale in the *IBQ*. Respondents were asked to rate the most recent occurrence of each PRMD symptom type. In retrospect, this was not the best way to ascertain information on PRMD symptom severity; a measure of the most severe episode in a player’s history would have been more beneficial. Data on the severity of PRMD symptoms must be treated with caution. The wording of the question may have resulted in different interpretations: some may have rated their last PRMD occurrence directly at symptom onset, before they were beginning to improve; others may have rated their last PRMD occurrence as the very last time they felt the PRMD symptom, which may have been during treatment.

Severity for the most recent occurrence of each PRMD symptom was measured on a ten-point scale, with “10 = the most severe imaginable.” Table 2 shows the mean severity for each PRMD symptom with the standard deviation (*SD*). Only three of the PRMD symptoms had individuals report severities over the entire ten-point range: numbness,

tingling, and loss of flexibility. Pain, weakness, and loss of dexterity did not have any respondent indicate a severity of “10 = the most severe imaginable.”

**Table 2: Mean severity for each PRMD symptom**  
**On a ten-point scale and including the standard deviation (SD)**

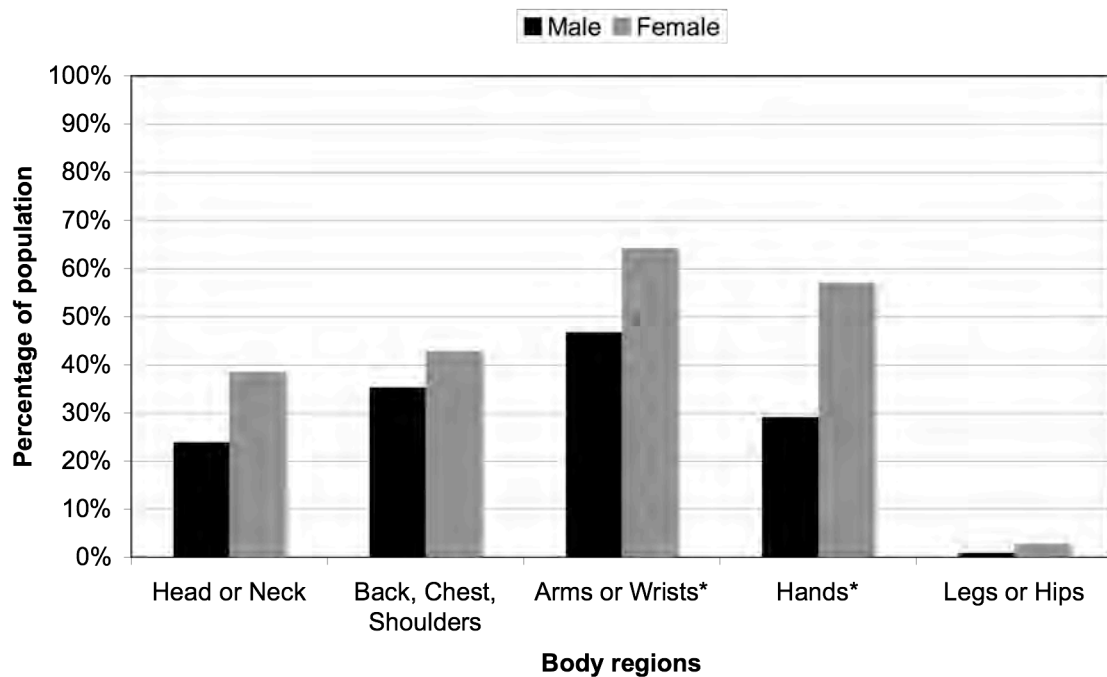
<b>PRMD</b>	<b>Mean</b>	<b>(SD)</b>
Pain	3.53	(1.82)
Numbness	3.49	(2.28)
Flexibility	3.36	(2.03)
Weakness	3.33	(1.75)
Tingling	3.15	(2.12)
Dexterity	3	(1.83)

Pain was not only the most frequent PRMD symptom experienced by bassoon players, it was also the most severe with an average on a ten-point scale of 3.53 ( $SD = 1.82$ ). Tingling, the second most experienced PRMD symptom, had the second lowest severity ( $M = 3.15$ ,  $SD = 2.12$ ). All of the mean severities were similar regardless of PRMD type, unlike the great difference in the frequency of PRMDs reported, with pain reported almost double the other PRMDs. No PRMD reported a mean severity of 4 or above, all of the mean severities occurred between 3 and 3.6.

#### **4.2.2 Frequency of PRMDs**

Gender influenced the frequency of PRMDs reported by bassoon players. Figure 8 illustrates that females reported more occurrences of PRMDs than males in all body regions. Only two of the body regions reported a statistical difference ( $p < 0.05$ ) between genders: the arms/wrists and the hands. The percentage of PRMDs reported in the arms/wrists differed by gender, with continuity correction [ $\chi^2(1, N = 166) = 4.27, p =$

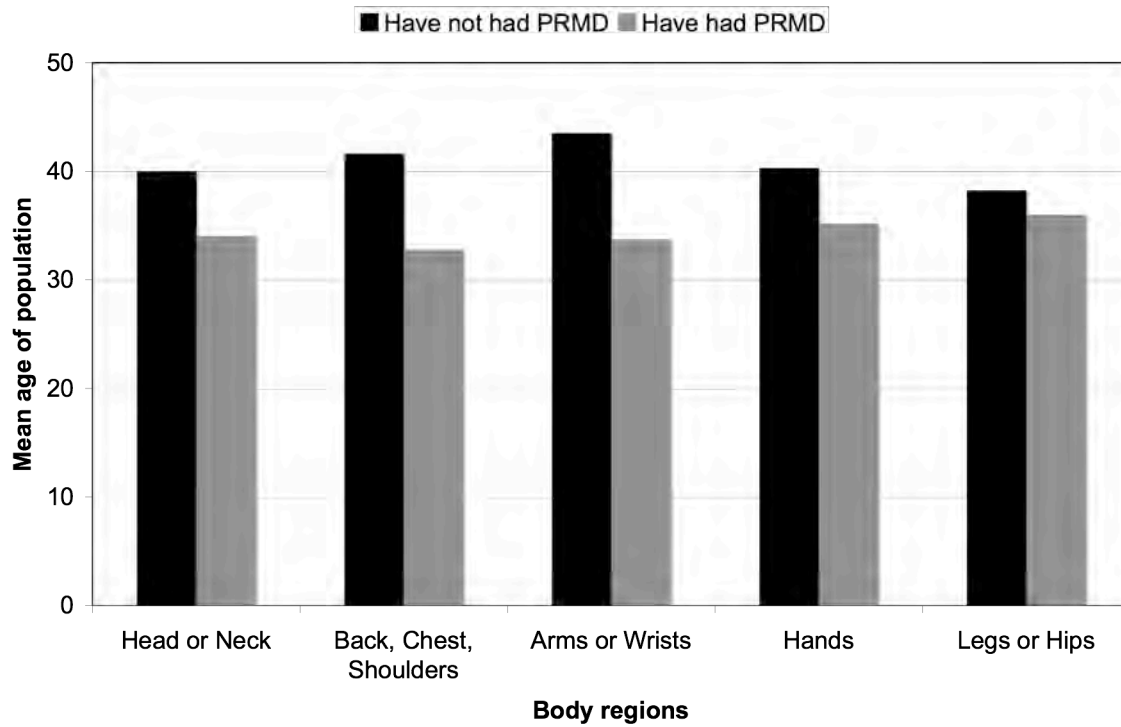
0.039]. The percentage of PRMDs reported in the hands differed by gender, with continuity correction [ $\chi^2(1, N = 166) = 11.97, p < 0.001$ ]. In both cases females reported higher occurrences of PRMDs. From a physiological standpoint this made sense, because females in general have smaller arms, wrists, and hands than males. The bassoon is a very large instrument and the reach may be more of a strain for those with smaller hands. The bassoon is a very heavy instrument. If a female is smaller than a male, the muscles used to support the instrument would also be smaller, therefore, it is possible that physiological differences between the two genders accounted for the difference in PRMDs experienced in these locations. Middlestadt and Fishbein noted that as the size of the string instrument grew, the frequency of injury to the hand and wrist among female players increased (Middlestadt and Fishbein 1989). The size of the instrument increasing the prevalence of injury among females was not limited to string instruments. According to the *IBQ* findings, female bassoon players were negatively affected by the size of the instrument and were at high risk for PRMDs in the hands and wrists.



**Figure 8: Percentage of each gender that reported PRMDs in each body region**

**\* Indicates  $p < 0.05$  for that body region**

Age also affected the frequency of PRMDs in this study. Figure 9 shows that the average age of a bassoonist reporting a PRMD was lower (younger) than the average age of a bassoonist without a PRMD. This was true for all body regions. This may indicate that bassoonists stopped playing the instrument if they were experiencing PRMDs. In other words, respondents who were older in age and still playing the instrument did not experience PRMDs and were therefore still active members of the bassoon community. Conversely, if someone had stopped playing at a younger age because of PRMDs, they were no longer active in the bassoon community and thus did not participate in the study.



**Figure 9: Mean age of players without and with PRMDs for each body region**

A notable age difference was identified in the number of PRMD symptoms that participants reported. Bassoon players that reported multiple PRMD symptoms were younger than those reporting few symptoms. Bassoon players that reported experience with all six PRMD symptoms had the lowest mean age ( $M = 37.33$ ,  $SD = 16.7$ ), while those that reported only one PRMD symptom had the highest mean age ( $M = 41.07$ ,  $SD = 18.8$ ). Table 3 shows the mean ages by the number of PRMD symptoms reported.

**Table 3: Mean age by the number of PRMD symptoms reported  
Including the standard deviation (SD)**

<b>Number of PRMD Symptoms</b>	<b>Mean Age</b>	<b>(SD)</b>
1 PRMD symptom	41.07	(18.8)
2 PRMD symptoms	39.45	(17.2)
3 PRMD symptoms	37.52	(18.4)
4 PRMD symptoms	38.23	(18.6)
5 PRMD symptoms	39.33	(21.9)
All 6 PRMD symptoms	37.33	(16.7)

The *IBQ* supports research (Warrington et al. 2002; Dawson 2006b) that found the younger population reported more PRMDs. Warrington et al. suggested that younger musicians experienced more PRMDs because they had a greater stress on their playing with school jury exams, solo recitals, and job auditions (Warrington et al. 2002). Although the *IBQ* did not investigate the direct cause, so cannot confirm or refute the above hypothesis, the *IBQ* clearly shows that the younger demographics reported more PRMD symptoms.

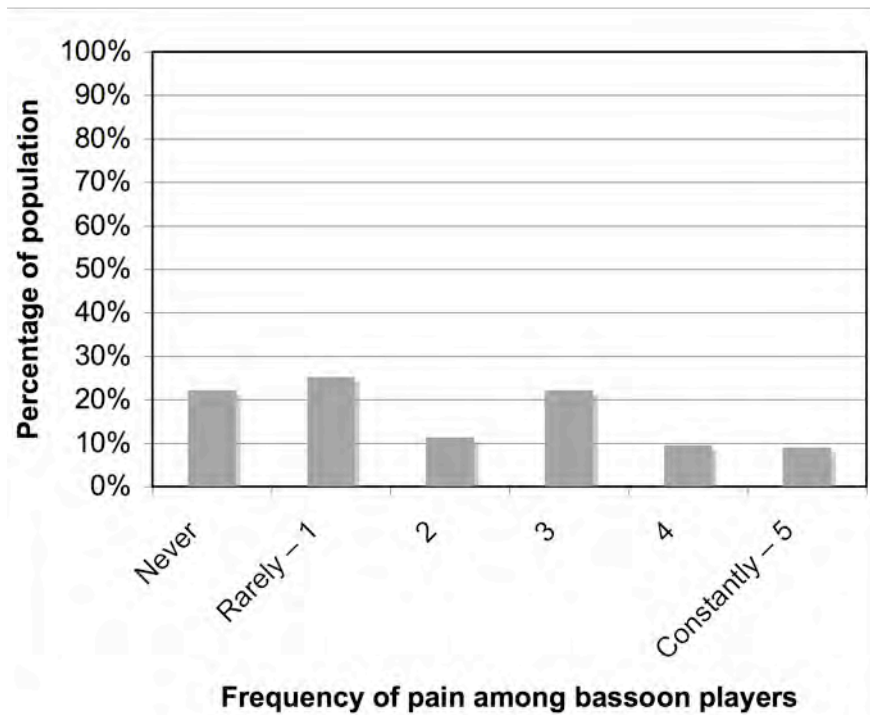
### **4.3 PRMD Symptoms**

Six PRMD symptoms were investigated in the *IBQ*: pain, weakness, numbness, tingling, loss of dexterity, and loss of flexibility. Page 5, question 13 of the *IBQ* (Appendix E) assessed the frequency and severity for each PRMD symptom. Participants were asked on page 5, question 14 (Appendix E), to self-report which locations of the body they had experienced each of the six PRMD symptoms. A shortcoming of the *IBQ* was that limited information was gathered on where each PRMD symptom occurred in the body. Detailed information was collected on what region of the body participants experienced PRMDs, along with the duration of the PRMD, but what specific type of injury or

PRMD symptom in each body area was not specified. The question ascertaining PRMD symptom location was placed before the body diagrams in the *IBQ*, so the scope of answers were not entirely complete. Many of the participants did not give enough detail in their short answers to generate detailed coding information. For example a participant may have written “hand,” but did not go into detail about right versus left or differentiate between fingers. Therefore, some information can be used from this question, but in future studies this should be corrected so each body area also has the type of PRMD symptom or diagnosed injury defined in addition to location and duration.

#### **4.3.1 PRMD – Pain**

Pain was the most frequently cited PRMD symptom among bassoon players. Of the six specified PRMD symptoms, pain was experienced almost twice as often as any other symptom. Figure 10 shows the entire frequency range where bassoonists reported experiencing pain. Twenty-two percent of players indicated never experiencing pain while 78% report experiencing pain. Pain frequency was investigated on a 1-5 scale; “1 = rarely less than three times per year,” while “5 = constantly, more than 4 times per week.” Of those that reported pain, 19% of participants indicated a frequency of 4 or 5, meaning that they were in pain very often.



**Figure 10: Percentage of bassoonists that reported pain**  
**A six-point scale including “never” and 1 (rarely) to 5 (constantly)**

Although pain was the most frequently reported PRMD, its severity was widely distributed. The severity of pain was measured on a ten-point scale, with “10 = the most severe imaginable.” Participants were asked to report on their last occurrence of the symptom. Of the bassoonists that reported experiencing pain, 53% reported pain severity between 2 and 5. The highest severity of pain reported was an 8, with no one reporting pain at a severity of 9 or 10. The average severity of pain experienced was 3.53 ( $SD = 1.8$ ) out of a possible 10.

Pain was self-reported in many areas. The area locations written most frequently by respondents were: right wrist, left wrist, right shoulder, forearms, and hands. The thumbs were specified more frequently than any other part of the hands. The back, neck, jaws, and arms were mentioned, but not as frequently. The tongue, back of throat, roof

of mouth, and soft pallet were also indicated; those areas were not an option in the detailed body region (page 6, question 16) unless participants included them with the embouchure. In future studies, a further break down of the mouth should be considered.

#### **4.3.1.1 Pain and Gender**

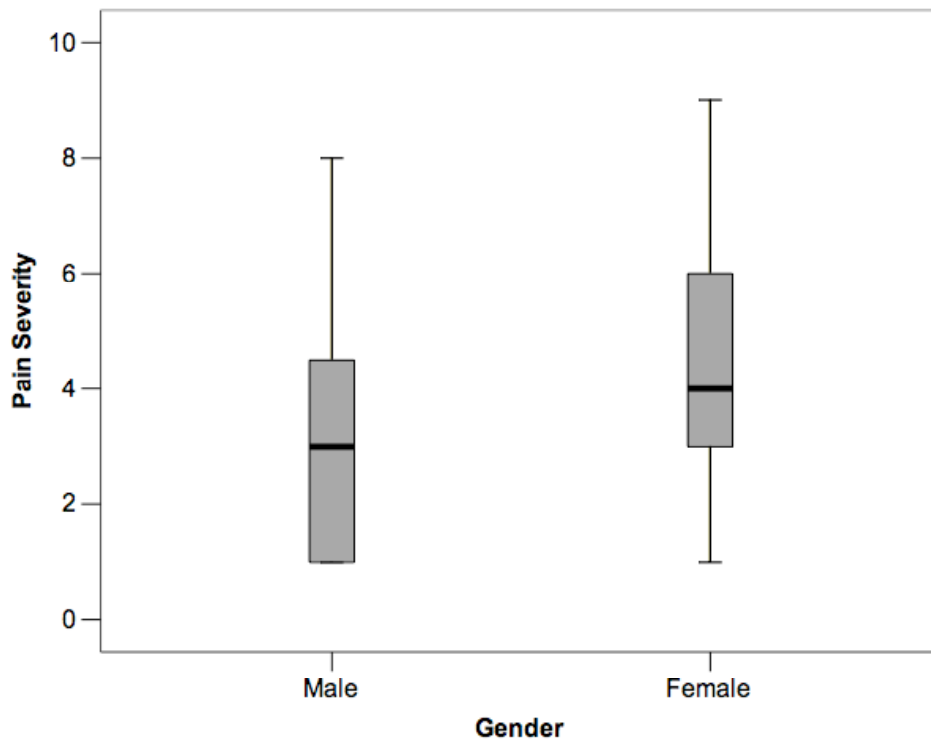
Females reported the occurrence of pain more frequently than males. A one-way between-groups of covariance (ANCOVA) was conducted to compare the frequency of pain experienced between genders. The independent variable was the gender of participants and the dependent variable was the frequency of pain experienced. The age of participants was used as the covariate in this analysis because of the strong relationship discovered previously between gender and age. After adjusting for age, there was a significant difference between genders in relation to the frequency of pain reported [ $F(1,163) = 9.4, p = 0.003, \text{partial eta squared} = 0.055$ ]. Females reported experiencing pain an average of 3.4 ( $SE = 0.18$ ) out of a six-point scale, while males only reported experiencing pain an average of 2.6 ( $SE = 0.15$ )<sup>2</sup>. Females reported experiencing pain significantly more frequently than males.

To evaluate if there was a difference in the severity of pain reported between genders, a one-way analysis of covariance (ANCOVA) was used. The independent variable was pain severity, with the dependant variable gender, and the covariate age. After adjusting for age, a significant difference in the severity of pain reported between genders was identified [ $F(1,123) = 4.01, p = 0.047, \text{partial eta squared} = 0.032$ ]. The average

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<sup>2</sup> Reporting standard error instead of standard deviation is permissible with this type of analysis (Wan 2005; Shevy 2008)

severity of pain experienced by females was 3.85 ( $SE= 0.22$ ) out of a ten-point scale, while males reported an average severity of pain at 3.21 ( $SE = 0.22$ ). Figure 11 is a visual representation of the difference in pain severity experienced by each gender.



**Figure 11: Mean and range of pain severity experienced by gender**

**The grey box represents 50% of responses for each gender, the black line in the box represents the median value, and the whiskers protruding from the boxes extend to the smallest and largest value for each gender**

#### **4.3.1.2 Pain and Age**

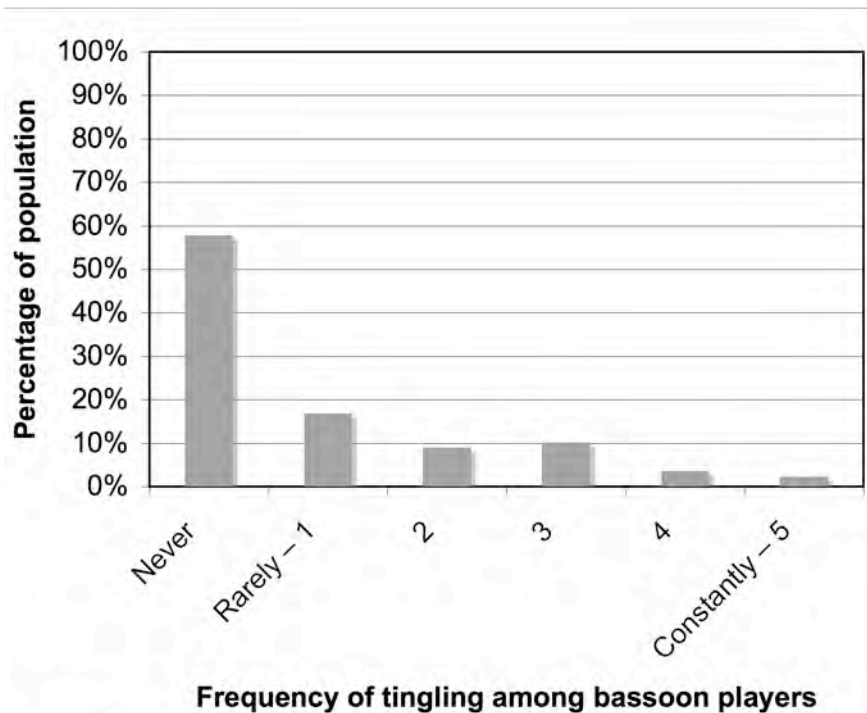
To investigate the relationship between age and the frequency of pain experienced, a one-way between-groups of covariance (ANCOVA) was conducted. The independent variable was the age group of participants and the dependent variable was the frequency of pain experienced. The gender of participants was used as the covariate in this

analysis. After adjusting for gender, there was a significant difference between age groups in relation to the frequency of pain reported [ $F(1,163) = 13.348, p < 0.000$ , partial eta squared = 0.076], the effect size was moderate. The younger age group (< 41) reported an average pain frequency of 3.36 ( $SE = 0.15$ ), while the older age group (> 42) reported an average pain frequency of 2.5 ( $SE = 0.18$ ). The younger group reported experiencing pain more frequently.

Pain severity was also compared between age groups with gender as the covariate. There was no significant statistical difference between age groups in relation to the severity of pain experienced, though the younger group reported a slightly higher mean at 3.7 ( $SE = 0.19$ ) over the older group at 3.2 ( $SE = 0.27$ ). Age did not have a strong influence on the severity of pain experienced. This indicates that participants who reported experiencing pain have similar severity and that the difference between ages occurs during the initial reporting of pain rather than the severity of the symptom.

#### **4.3.2 PRMD – Tingling**

Tingling was the second most commonly reported PRMD symptom experienced among bassoon players, 42% reported some tingling. Figure 12 shows the frequency of tingling reported by bassoonists. Of the 42% of participants that reported tingling, 85% reported a frequency of 3 or below on a five-point scale. Only 6% of respondents indicated tingling “5 = constantly, more than 4 times a week.”



**Figure 12: Percentage of bassoonists that reported tingling**  
**A six-point scale including “never” and 1 (rarely) to 5 (constantly)**

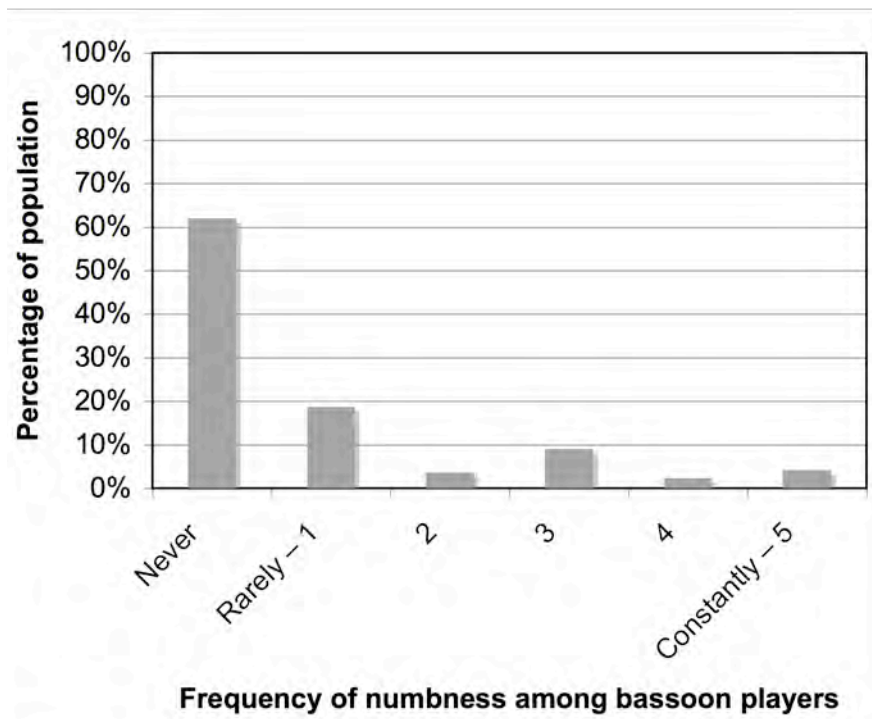
The severity of tingling was assessed on a ten-point scale. Unlike with pain, tingling encompasses the entire ten-point scale range. Despite the entire range being utilized, the vast majority of tingling experienced (81%) was a 4 or lower. Only one participant indicated “10 = the most severe imaginable.” The average severity of tingling experienced by bassoon players was 3.15 ( $SD = 2.12$ ) out of 10.

When participants were asked to write where they experienced tingling, the hands were the most common answer. Many did not differentiate between hands. Usually participants only specified the fingers in general and did not say which digits; however if digits were specified they were almost always the middle, ring, and little fingers. The wrists were written down with moderate frequency. The elbow, shoulders, and embouchure were also noted.

There were no significant statistical differences for the frequency or severity of tingling experienced between genders or between age groups.

### 4.3.3 PRMD – Numbness

Numbness was the third most common PRMD reported by survey participants. Figure 13 shows the frequency of numbness reported by bassoonists. Of the 166 participants, 38% reported experiencing numbness. Almost half (49%) of participants that reported experiencing numbness indicated a frequency of “1 = rarely, less than 3-times per year.” However, 4% indicated “constantly” experiencing numbness.



**Figure 13: Percentage of bassoonists that reported numbness**  
**A six-point scale including “never” and 1 (rarely) to 5 (constantly)**

The severity of numbness encompassed the entire ten-point scale range. Even though the entire range was indicated, the vast majority of responses for numbness severity were in

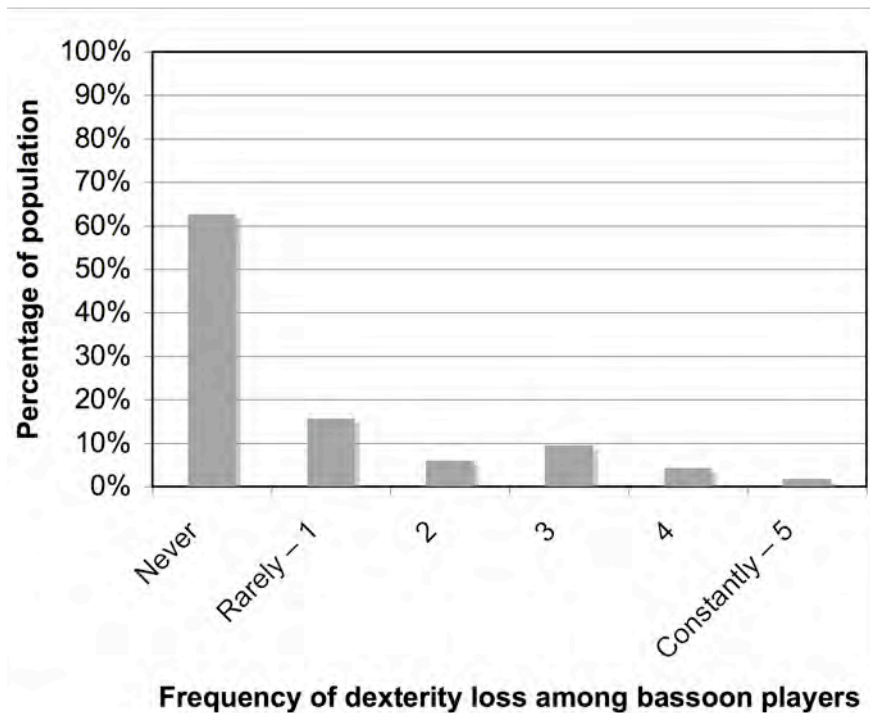
the bottom of the scale. Less than 1% of respondents indicate a severity of 9 or above. Most of the numbness reported (68%) was a severity of 3 or below. The average numbness experienced was 3.5 ( $SD = 2.3$ ) out of 10.

The most often self-reported locations for numbness included: left wrist, both hands, ring finger, little finger, and embouchure. Multiple bassoonists mentioned the forearm, thumb, shoulders, and neck. One respondent cited the tongue; which supports the need to make the head region more detailed in future studies. The right thigh was cited by one participant, but then was not recorded on the body image that followed in the survey.

There were no significant statistical differences between genders or between age groups for the frequency or severity of numbness experienced.

#### **4.3.4 PRMD – Loss of Dexterity**

Loss of dexterity was the fourth most common PRMD. Figure 14 shows the frequency of dexterity loss reported by bassoonists. Only 37% of *IBQ* respondents indicated losing dexterity. Of participants that indicated a loss of dexterity, 84% indicated a frequency of 3 or below. Most of the loss of dexterity occurring was not frequent; however, 2% experienced a loss of dexterity “constantly.”



**Figure 14: Percentage of bassoonists that reported loss of dexterity**  
**A six-point scale including “never” and 1 (rarely) to 5 (constantly)**

The severity of the loss of dexterity experienced was assessed on a ten-point scale; 8 was the highest severity reported out of 10. Like the other PRMDs, most of the severity reported was in the lower part of the scale; 68% of those experiencing loss of dexterity indicated a severity of 3 or below. Only 12% of bassoonists indicated a severity of 6 or above and of those, only one bassoonist indicated a severity of 8. The average severity for loss of dexterity was 3.0 ( $SD = 1.8$ ) out of a possible 10.

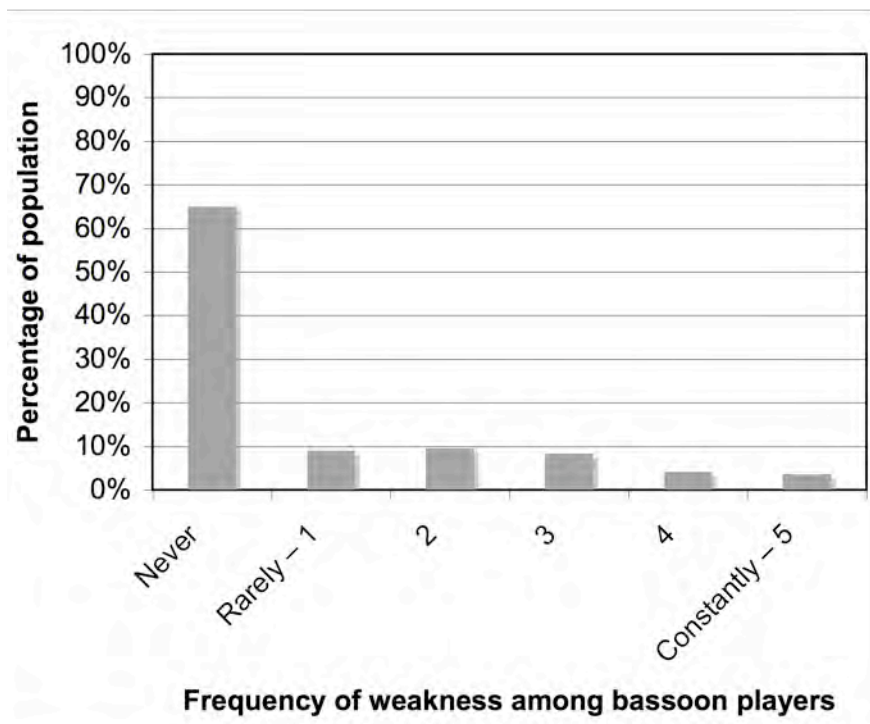
Loss of dexterity was self-reported in the hands and fingers. Most of the written-in responses were for those areas. The vast majority of respondents did not differentiate between the fingers; the few that did indicated that the ring fingers, little fingers, and thumbs were the most prone to dexterity loss. The wrists and embouchure were

mentioned, but less frequently. One bassoonist wrote “breath support” which requires further investigation.

There were no significant statistical differences for loss of dexterity between genders or between age groups.

#### 4.3.5 PRMD – Weakness

Weakness was one of the less prevalent PRMDs reported by bassoon players, according to the *IBQ*. Figure 15 shows the frequency that bassoonists reported weakness. Thirty-five percent of respondents reported experiencing weakness in relation to their bassoon playing. Most of the weakness experienced (78%) had a frequency of 3 or below. Only 4% reported experiencing weakness “constantly.”



**Figure 15: Percentage of bassoonists that reported weakness**  
A six-point scale including “never” and 1 (rarely) to 5 (constantly)

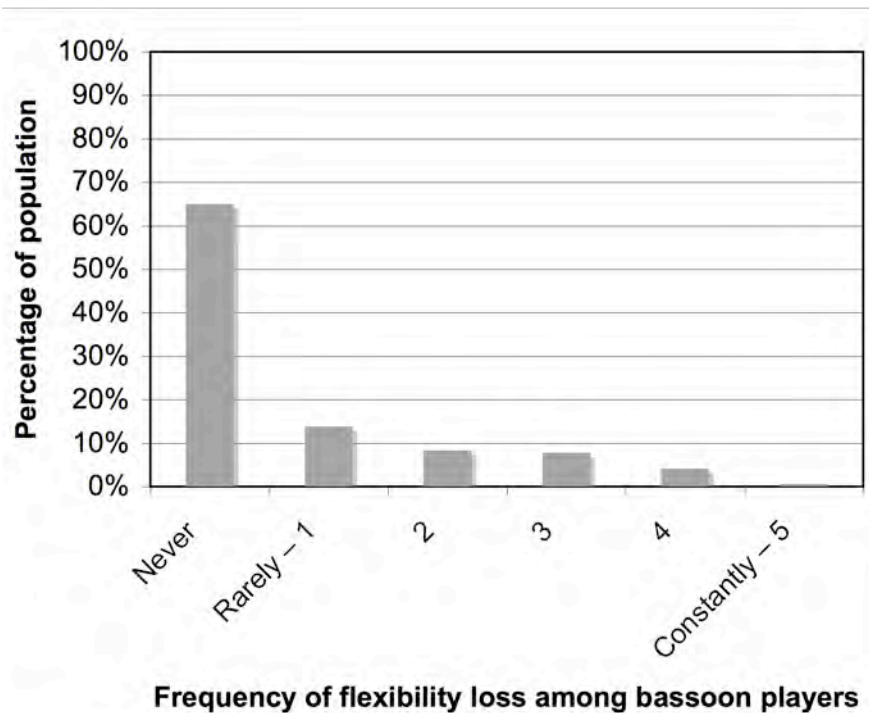
Weakness severity was assessed on a ten-point scale. The majority (60%) of the severity for weakness experienced was a 3 or below. There were no weakness severities reported above 7 on a ten-point scale, indicating that the severity of weakness experienced by bassoon players was less than most of the other PRMD symptoms. The average severity of the weakness experienced by bassoon players according to the *IBQ* was 3.33 ( $SD = 1.7$ ) out of a possible 10.

The upper extremities occupied the vast majority of self-reported locations. Bassoonists reported experiencing weakness mainly in their wrists and hands. Some participants indicated weakness in their embouchure and soft palate, reiterating the need for a more detailed study on this region of the body. The forearms, shoulders, and neck were also noted for having weakness, but the wrists and hands were by far the most commonly reported areas for experiencing weakness.

There were no significant statistical differences between genders or between age groups for the frequency or severity of weakness experienced.

#### **4.3.6 PRMD – Loss of Flexibility**

Loss of flexibility was the least common PRMD reported. Figure 16 shows the frequency which bassoon players reported loss of flexibility. Thirty-five percent of bassoon players experienced loss of flexibility. Of those experiencing loss of flexibility, 86% reported a frequency of 3 or below on a five-point scale. Only one participant reported experiencing loss of flexibility “constantly.” This frequency distribution is similar to the other PRMDs, except for pain which was experienced much more frequently.



**Figure 16: Percentage of bassoonists that reported loss of flexibility  
A six-point scale including “never” and 1 (rarely) to 5 (constantly)**

The severity of flexibility loss was assessed on a ten-point scale. Similar to tingling and numbness, loss of flexibility reported severities over the entire ten-point range. The vast majority (76%) of flexibility loss reported had a severity of 4 or below. Only one participant reported “10 = most severe imaginable.” The average severity for those losing flexibility was 3.4 ( $SD = 2.0$ ) out of a possible 10.

Bassoonists’ self-reported loss of flexibility most often in the wrists, hands, and fingers. Both sides were reported equally or the participant made no differentiation between sides of the body. The left thumb was the exception however and was noted many times singularly. The shoulders, jaw, embouchure, elbow, neck, and upper back were also mentioned.

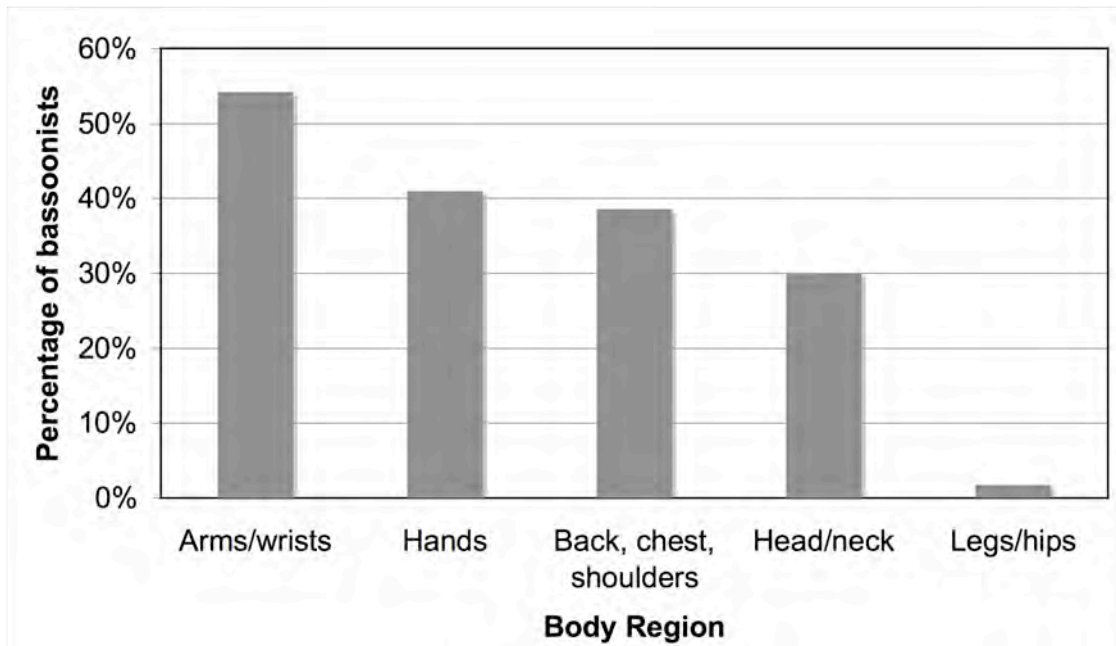
There were no significant statistical differences between genders or between age groups for the frequency or severity of flexibility loss experienced.

#### **4.4 Injury and PRMD Locations**

Injury and PRMD location statistics were ascertained by combining responses for each location of the body. The type of symptom(s) (pain, weakness, tendinitis, etc.) occurring in each body location was not recorded so no differentiation was made between a medically diagnosed injury and self-reported PRMDs. If a respondent indicated both a current and previous episode of a symptom in a location of the body, it was only counted once. Each percentage listed below (in sections 4.4.1, 4.4.2, and 4.4.3) is a general measure for the total population of the survey and does not differentiate between multiple occurrences of the same symptom or multiple symptoms present in a body location for one person. The words PRMD and injury were used interchangeably in this portion of the questionnaire.

##### **4.4.1 Body Regions**

The body was divided into five body regions to determine where bassoon players experienced injuries. The five regions were the: head and neck; back, chest, and shoulders; arms; hands; and hips, legs, and feet. Bassoonists reported injuries most frequently in the arms and wrists (54%). Bassoon players reported that the hands (41%) and the back, chest, and shoulders (39%) regions were also prone to injuries. Thirty percent of bassoon players had an injury in the head or neck. The legs, hips, and feet had negligible responses. Figure 17 shows the percentage of bassoonists that reported injuries or PRMDs in each of the five body regions.



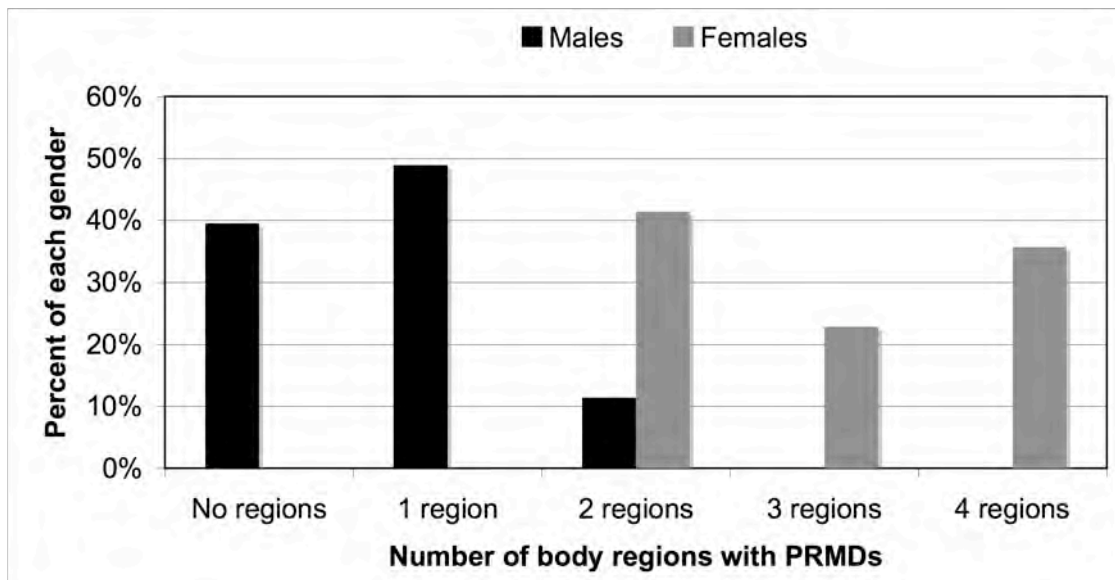
**Figure 17: Percentage of bassoonists that reported PRMDs in each body region**

Many bassoon players reported PRMDs in multiple body regions. Almost half (49%) of bassoon players reported a PRMD in two or more body regions. Table 4 shows the percentage of bassoon players that reported PRMDs in multiple body regions. Fifteen percent of bassoon players had PRMDs in four of the five body regions. No bassoon player reported PRMDs in all body regions.

**Table 4: Percentage of bassoonists that reported PRMDs in multiple body regions**

Number of Body Regions with PRMDs	Percentage
No regions	22.9%
1 region	28.3%
2 regions	24.1%
3 regions	9.6%
4 regions	15.1%
5 regions	0%

A very strong difference between genders was noted when investigating the number of body regions where PRMDs were reported. The number of body regions differed by gender significantly [ $\chi^2(4, N = 166) = 133.3, p < 0.0001$ ]. Males reported PRMDs in fewer body regions than females. Figure 18 shows the percentage of each gender that reported PRMDs in multiple body regions. The vast majority of males reported “no body regions” with PRMDs or only “one body region” with PRMDs. Some males experienced PRMDs in “two body regions,” but no males reported “3 regions” or “4 regions” with PRMDs. In contrast, no female reported “no body regions” or that only “one body region” had PRMDs. Females instead started reporting PRMDs at “two body regions” (41%). Many females reported “three body regions” (23%) and 36% of females reported PRMDs in “four body regions.” Females experienced PRMDs in significantly more regions of the body than males.



**Figure 18: Percentage of each gender that reported PRMDs in multiple body regions**

#### **4.4.2 Extent of Body Compromise**

The five body regions where bassoonists could report PRMDs were comprised of 48 specific body locations (Appendix J lists the specific locations that comprise each body region). For example, one bassoon player presented with the body region “arms/wrists” and reported six locations within that single region: right wrist, right thumb-side forearm, left wrist, left thumb-side forearm, left little-side forearm, and left elbow.

Four categories were made from the 48 specific locations: “one body location” indicated singular body involvement, “2-5 body locations” indicated limited body affliction, “6-10 body locations” indicated medium body affliction, and “11 or more body locations” indicated severe body compromise. Table 5 displays the percentage of bassoonists that reported PRMDs in each of the “number of body locations” categories. Of the bassoonists that reported a specific injury location ( $n = 128$ ), 87% reported more than one location. Twenty-two percent of bassoonists that reported PRMD locations indicated “11 or more body locations.” Eight percent of respondents indicated that they experienced PRMDs in over 20 body locations. One bassoon player reported PRMDs in 27 body locations. In relation to the five body regions previous discussed (head/neck, back/chest/shoulders, arms/wrists, hands, legs/hips), bassoon players experienced many injury locations within a body region.

**Table 5: Percentage of bassoonists for each “number of body locations” category**

<b>Number of Locations</b>	<b>Percentage</b>
One location	13%
2-5 locations	40%
6-10 locations	25%
11 or more locations	22%

Age was a factor in the number of locations reported. Those experiencing PRMDs in “6-10 body locations” had the lowest mean age ( $M = 32.63$ ,  $SD = 16.9$ ). The second lowest mean age was found in those that had “11 or more body locations” of PRMDs ( $M = 40.39$ ,  $SD = 19.5$ ). Table 6 shows the mean ages and standard deviations for the four “number of body locations” categories. Those with multiple injury locations, over 6, were younger than those with fewer injury locations.

**Table 6: Mean ages for the “number of body locations” categories  
Including the standard deviation (SD)**

<b>Number of Locations</b>	<b>Mean Age</b>	<b>(SD)</b>
One location	43.88	(17.8)
2-5 locations	42.37	(17.5)
6-10 locations	32.63	(16.9)
11 or more locations	40.39	(17.9)

The difference between genders extended to the willingness to report injury locations. Some females reported PRMD locations, but did not report a PRMD symptom or diagnosed injury. Ninety-six percent of females reported a symptom or diagnosis, but 100% of females reported a PRMD location. Males reported specific symptoms and locations opposite of females. Seventy-eight percent of males reported a symptom or diagnosis, but only 60% of males reported a PRMD location.

#### 4.4.3 Specific Locations

The 48 possible locations were analyzed to identify where bassoonists most frequently experienced PRMDs. In the *IBQ* the 48 locations were broken into five regions: head and neck; back, chest, and shoulders; arms; hands; hips, legs, and feet. Each location was color-coded within the region to ascertain PRMD information.

Figure 19 shows how head and neck locations were identified in the *IBQ*. Table 7 shows that there were small percentages of PRMDs reported in the head and neck. The back of the neck was of more concern for bassoon players than the front of the neck. Both sides of the back of the neck had many more bassoon players reporting PRMDs than the rest of the locations in this body region.

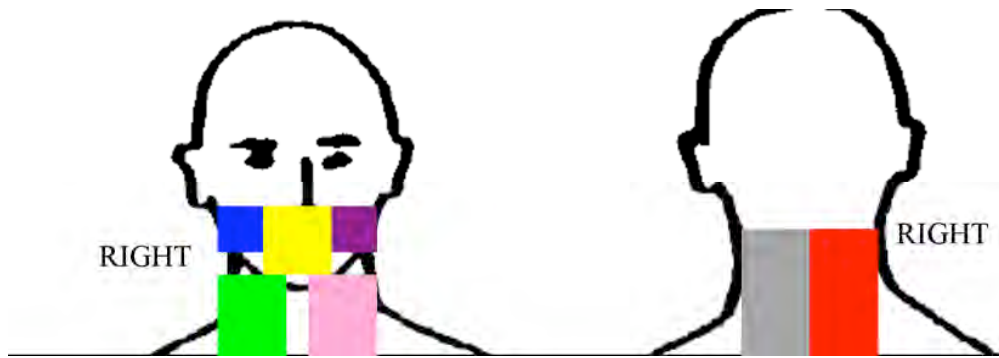


Figure 19: *IBQ* head and neck region

Table 7: Percentage of bassoonists that reported head and neck locations

Head and Neck	Percentage
Back neck right – red	19.9%
Back neck left – grey	18.1%
Embouchure – yellow	10.2%
Right jaw – blue	7.2%
Left jaw – purple	7.2%
Front neck left – pink	4.2%
Front neck right – green	3%

The embouchure had 10.2% of respondents reporting PRMDs, which was lower than anticipated. This could be because respondents did not attribute the tongue, soft pallet, and other internal problem areas to this region. Research on woodwind and brass instruments that also use the mouth excessively to form an embouchure indicate high rates of PRMDs (Howard and Lovrovich 1989; Wilson 1989; Fahn 1991; Hoppmann et al. 1991; Heuser and McNittgray 1993; Lederman 2001; Yeo et al. 2002). This does not seem to be as prevalent with bassoon players. It is possible that those with severe problems, such as dystonia, did not continue to play and therefore were not active in the bassoon community and so did not take the *IBQ*.

Figure 20 shows how back, chest, and shoulder locations were identified in the *IBQ*. Table 8 shows that bassoon players reported many PRMDs in the back, chest, and shoulders. The back and rear shoulders had a high occurrence of PRMD symptoms. Bassoonists did not report as many PRMDs in the chest and front of the shoulders as they did in the back and rear shoulders. Both the back and chest had higher percentages of PRMDs on the left side than on the right side. This indicates that the weight bearing left side was more susceptible to PRMD occurrence than the right. This preference for lateralization in bassoon players was noted previously (Thrasher and Chesky 2001).

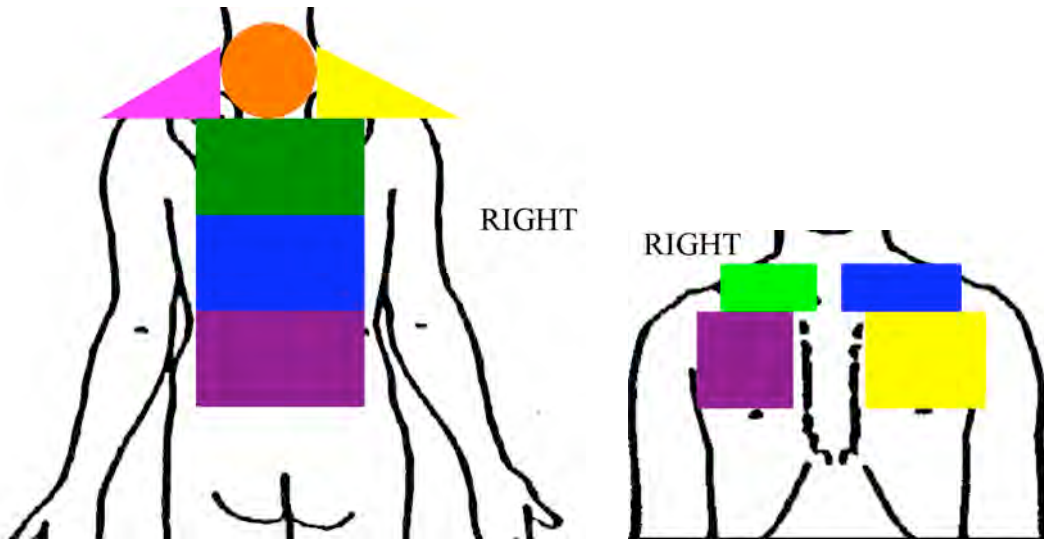


Figure 20: *IBQ* back, chest, and shoulders region

Table 8: Percentage of bassoonists that reported back, chest, and shoulder locations

Back, Chest, Shoulders	Percentage
Back left shoulder – pink	22.9%
Back right shoulder – yellow	21.7%
Upper back – green	21.7%
Between shoulders – orange	17.5%
Lower back – purple	16.9%
Middle back – blue	11.4%
Front left shoulder – blue	6%
Front right shoulder – green	5.4%
Left chest – yellow	4.8%
Right chest – purple	3.6%

The upper back and between the shoulders had a higher number of occurrences of PRMDs than the lower portions of the back. These locations connect directly to the back of the neck, which had high PRMD occurrences. Expectedly, both of the shoulders had high reports of PRMDs with the left shoulder reporting more incidences than the right.

A figure was not used for the arms in the *IBQ* because pilot surveys indicated figures were more confusing than just writing “right” and “left.” Table 9 shows the percentage of PRMDs reported in the right arm and table 10 shows the percentage of PRMDs reported in the left arm. Bassoon players reported high percentages of PRMD occurrences in both the right and left arms. Both arms exhibited the same decreasing frequency order for the locations: wrist, thumb-side forearm, little-side forearm, elbow, and upper arm. This may indicate a structural problem with the human body more than a problem with the design of the bassoon as both arms are in very different positions and have different movement requirements when playing the bassoon.

**Table 9: Percentage of bassoonists that reported right arm locations**

<b>Right Arm</b>	<b>Percentage</b>
Right wrist	33.1%
Right thumb-side forearm	21.1%
Right little-side forearm	15.7%
Right elbow	10.8%
Right upper arm	7.8%

**Table 10: Percentage of bassoonists that reported left arm locations**

<b>Left Arm</b>	<b>Percentage</b>
Left wrist	32.5%
Left thumb-side forearm	23.5%
Left little-side forearm	16.9%
Left elbow	9.6%
Left upper arm	7.2%

The wrist was a very vulnerable area; the right and left wrists had the two highest reported occurrences of PRMDs found throughout the entire body. The right wrist had

more occurrences of PRMDs than the left wrist, which bares some of the weight of the bassoon. This was contrary to previous research where the left wrist had a higher occurrence of PRMDs (Thrasher and Chesky 2001).

Bassoonists reported more PRMDs in the left forearm than the right forearm. The elbow, a very versatile but stress prone joint, was not reported as having a high percentage of PRMD occurrences. Flute players, who also support the weight of their instrument with highly bent elbow positions, reported high occurrences of elbow injuries (Wainapel and Cole 1988; Andersen 1990; Amadio 1993). The bassoon is heavier and supported with only one arm, so it was inferred that the left elbow of the bassoon player would experience high rates of PRMDs. This was not the case. The right elbow had a higher percentage of PRMD rates than the left.

A figure was not used for the hands in the *IBQ* because pilot surveys indicated figures were more confusing than just writing “right” and “left.” Table 11 shows the percentage of PRMDs reported in the right hand and table 12 shows the percentage of PRMDs reported in the left hand. There were many reports of PRMDs in both hands. Similar to the arms, the descending percentage of reported locations were in the same order for both the right and left hands: thumb, thumb-side palm, index finger, little finger, ring finger, middle finger, little-side palm. This may indicate a physiological reason for the development of PRMDs instead of a bassoon specific influence.

**Table 11: Percentage of bassoonists that reported right hand locations**

<b>Right Hand</b>	<b>Percentage</b>
Right thumb	21.1%
Right thumb-side palm	13.9%
Right index finger	10.8%
Right little finger	10.8%
Right ring finger	9.6%
Right middle finger	9%
Right little-side palm	6.6%

**Table 12: Percentage of bassoonists that reported left hand locations**

<b>Left Hand</b>	<b>Percentage</b>
Left thumb	24.7%
Left thumb-side palm	16.9%
Left index finger	15.7%
Left little finger	12%
Left ring finger	11.4%
Left middle finger	10.2%
Left little-side palm	8.4%

The left hand reported higher percentages of PRMDs for all areas than the right hand. This was anticipated as the left hand supports some of the weight of the instrument and must navigate nine keys with the left thumb, requiring a very wide range of motion. The left thumb had the third highest percentage of PRMDs reported throughout the entire body, after right and left wrists. As expected, both the left thumb and left thumb-side of the palm reported high occurrence of PRMDs. Range of motion could be a contributing factor to the development of PRMDs in the hands as both little fingers had higher PRMD rates than both middle and ring fingers. This could be attributed to the physiological

make-up of the hand. However, as with the thumbs, both little fingers have multiple keys to navigate while the other fingers do not.

Figure 21 shows how the hips, legs, and feet region was identified in the *IBQ*. Table 13 shows that negligible PRMDs were reported in the hips, legs, and feet. The bassoon is played sitting and standing so this was unexpected. No PRMDs were reported in the right upper leg where the bassoon rests; indicating that contact with the leg is insignificant. Many bassoon players use a strap on the chair on which they sit, to help support of the weight of the instrument, while it is held at an angle across the body. In many players this often results in leaning to the right, the strap and leg contact side. This “natural tilt” of many players would result in an uneven distribution of weight on the hips. The only person who reported hip PRMDs in relation to bassoon playing reported equal occurrence in both hips.

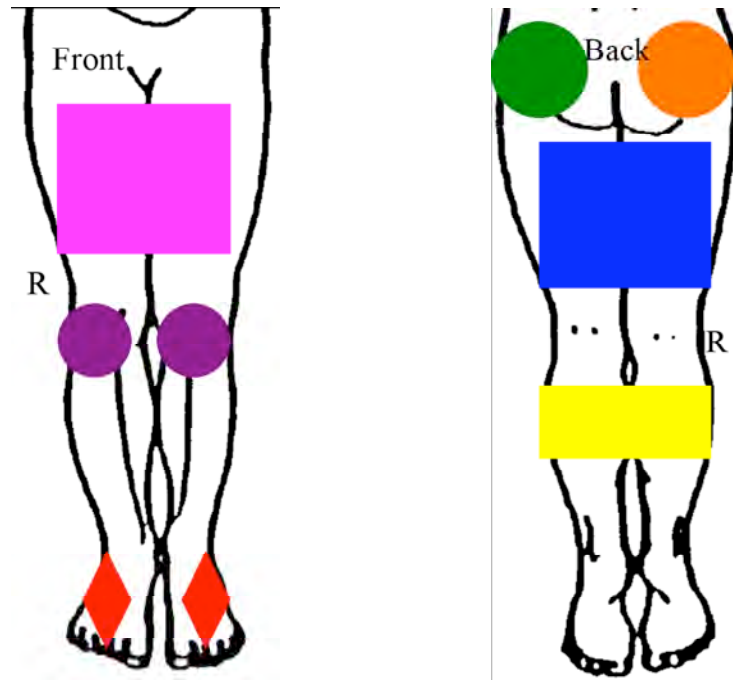


Figure 21: *IBQ* legs, hips, and feet region

Table 13: Percentage of bassoonists that reported legs, hips, and feet locations

Legs and Hips	Percentage
Left hip – green	< 1%
Right hip – orange	< 1%
Bottom leg – yellow	< 1%
Feet – red	< 1%
Upper leg front – pink	0%
Knees – purple	0%
Back upper leg – blue	0%

## 4.5 Conclusion

There was a high prevalence of injury and PRMDs among bassoon players. Bassoonists participating in the *IBQ* had a higher rate of injury or PRMD than previously reported; 86% of bassoon players reported some type of diagnosed injury or PRMD symptom. Thirty-one percent of respondents reported a specific diagnosed injury; tendinitis was the most common diagnosis (54%).

Six specific PRMD symptoms were investigated: pain, weakness, numbness, tingling, loss of dexterity, and loss of flexibility. Sixty-five percent of bassoon players reported the occurrence of more than one PRMD symptom. Over 10% of bassoon players reported experiencing all six PRMD symptoms. Pain was by far the most common symptom impinging on bassoon playing; 78% of bassoonists reported pain. All of the other PRMDs had a similar, but lower, percentage of responses (between 30-42%). Pain was the most frequent PRMD experienced by bassoon players and it was also the most severe; however, all of the mean severities were similar regardless of PRMD type.

Bassoon players were experiencing injuries and PRMDs all over the body. Almost half (48.8%) of bassoon players reported a PRMD in two or more body regions. Of the bassoonists that reported a specific injury location, 88% reported PRMDs in more than one location. Twenty-two percent of bassoonists reporting PRMDs indicated PRMDs in “11 or more body locations.” Eight percent of respondents indicated that they experienced PRMDs in over 20 body locations.

Bassoon players reported PRMDs most frequently in the arms and wrists (54%). The most reported locations were the right wrist (33%), left wrist (32.5%), and left thumb (25%). The right wrist had more occurrences of PRMDs than the left wrist, which was contrary to previous research. Both hands had high occurrences of PRMDs. Both the back and chest had higher percentages of PRMDs reported on the left side than on the right side, indicating the left side was more susceptible to PRMDs than the right.

There were strong differences reported between genders in regards to bassoon injury. Females reported more injuries than males; 96% of females reported a diagnosed injury or PRMD symptom compared to 78% of males. Females were diagnosed with a specific injury more frequently (44%) than males (22%). Females reported more occurrences of PRMDs than males in all body regions. The hands and arms reported statistically significant differences between genders with females experiencing more PRMDs in those areas. Females reported the occurrence of pain more frequently than males and also reported a statistically significant higher pain severity. Males reported less body regions where PRMDs occurred than females; females had significantly higher levels of body region involvement than males. Male bassoon players did not report PRMDs as frequently as female bassoon players.

Younger bassoon players (< 41) reported PRMDs more frequently than older players (> 42). The average age of a bassoonist reporting a PRMD symptom was lower (younger) than a bassoonist who did not report a PRMD symptom. The average age of bassoonists that reported PRMDs in multiple body locations was lower (younger) than those that

reported few body locations. The younger group reported experiencing pain more frequently, but age did not have a strong influence on the severity of pain experienced.

## **5 Results – Treatments, Contributing Factors, Perceptions**

Chapter 4 investigated the types of diagnosed injuries and PRMD symptoms that occurred within the bassoon community, how frequently bassoon players experienced PRMDs, where PRMDs were most frequently reported in the body, and how gender or age affected PRMDs. Chapter 5 investigates what bassoonists were doing to treat PRMDs, what players believe contributed to the onset of PRMDs, and how the bassoon community perceives PRMDs. In chapter 5 the terms injury and PRMD are used interchangeably as no distinction was made in the survey between a medically diagnosed injury and a self-reported PRMD symptom in the treatment, contribution, and perception sections. All of the data discussed in this chapter was collected through the *International Bassoonist Questionnaire*; the demographic and grouping numbers are consistent to those presented in the chapter 4, section 4.1.

### **5.1 Treatments Used**

Bassoon players were using many treatment options for the management of PRMDs. The literature on PRMD treatment and prevention was examined and a list of 11 treatments, commonly used by musicians, were identified (Fishbein et al. 1988; Goodman and Staz 1989; Bengtson and Schutt 1992; Horvath 2002; Fortune 2007). Bassoonists were asked if they used any of the 11 common treatments. Table 14 shows the percentage of bassoonists that tried each of the treatments listed.

**Table 14: Percentage of bassoonists that tried common treatments**

<b>Treatments Tried</b>	<b>Percentage</b>
Rest	60%
Reduce playing time	53%
Stretching	53%
Take anti-inflammatory medication	37%
Seek professional help	31%
Exercise	29%
Apply ice	27%
Take pain killers	26%
Use a brace	26%
Apply heat	17%
Increase playing time	1%

Reducing time spent with the instrument, whether by resting or playing less, was the most frequent action bassoonists used to treat PRMDs. Rest was the most common treatment that bassoonists tried (60%) when they experienced a PRMD. Reducing playing time, a type of rest, was the second most common treatment that bassoonists tried (53%). Considering 86% of bassoonists experienced some type of injury or PRMD, the data suggested that a lot of bassoon players were playing through their PRMDs and trying other methods of treatment while continuing to play.

Stretching was the third most common treatment method that bassoonists used (53%) to alleviate their PRMDs. Stretching was as popular among bassoon players as reducing playing time. Current literature for instrumentalists on how to practice effectively has entire sections on how to stretch properly before, during, and after playing (Horvath 2002; Dawson 2007a; Rosset i Llobet and Odam 2007). Bassoon players were following the trend to stretch and used stretching to help control PRMDs.

The remaining treatment options were used by few bassoon players in the battle against PRMDs. Bassoon players were more inclined to take anti-inflammatory medication than to consult a medical doctor. Thirty-seven percent of bassoon players took anti-inflammatory medication to combat PRMDs. This result reinforces the long-time belief that PRMDs have some basis in inflammation (Hochberg et al. 1988; Dawson 2006b). Topical anti-inflammatory medication was a specific treatment tried by bassoonists. Two respondents differentiated between a cream application and the pill form, during the open response section. Anti-inflammatory medicines were used more often than painkillers. This implies that numbing the pain to continue playing was not the desire of the bassoonist. The bassoonist would rather try to cure the pain by taking an anti-inflammatory medication.

Only 31% of bassoon players sought professional help for the management of PRMDs. Bassoon players viewed the term “professional help” to mean medical doctors, but not non-medical practitioners, such as chiropractic or massage therapists. Negative perceptions (discussed in section 5.3) in the bassoon community regarding the skill of medical doctors to properly deal with PRMDs could factor into the reluctance of players to seek professional help.

Participants were given the chance to write-in any types of treatments they felt had been left off the treatment list. Eleven percent of participants wrote-in other treatments they used for the management of PRMDs. Most of the written responses did not offer new categories of PRMD treatment options. Instead, details about treatments were listed, such as going to a chiropractor, which would fall under the category of “seek

professional help.” Massage was the most frequently written-in treatment option, though massage was meant to be included in “seek professional help.” Some bassoonists specified different types of massage that they found beneficial: Swedish, Remedial, or Rolfing. Two other categories for treatment options were written-in: relaxation techniques and homeopathic medicines. Sadly, one respondent felt that a treatment option was to “just put up with it.”

### **5.1.1 Experimenting with Treatments**

Bassoon players reported trying many treatments to alleviate PRMDs. Only 12% of bassoon players had not tried at least one of the common treatments listed in table 14. Fourteen percent of bassoon players did not report PRMDs. So, some players that did not report PRMDs reported using at least one of the common treatments, perhaps as preventative measures. Table 15 shows the percentage of bassoonists that have used multiple common PRMD treatments. Seventeen percent of bassoon players had tried over half of the common treatments listed.

**Table 15: Percentage of bassoonists that tried multiple common treatments**

<b>Number of Treatments Tried</b>	<b>Percentage</b>
0 treatments tried	12.0%
1 treatment tried	11.4%
2 treatments tried	10.8%
3 treatments tried	21.1%
4 treatments tried	9.6%
5 treatments tried	10.2%
6 treatments tried	7.2%
7 treatments tried	8.4%
8 treatments tried	1.8%
9 treatments tried	4.8%
10 treatments tried	2.4%

Males were more likely to try common treatments than females. Eighty-nine percent of males tried at least one of the common treatments listed in table 14, even though only 78% of males reported an injury or PRMD. Females were less likely to use treatment options. Only 87% of females used one or more of the common treatments, even though 96% of females reported an injury or PRMD.

### **5.1.2 Professionals Consulted**

Bassoon players reported consulting numerous types of professionals for the treatment and management of their PRMD symptoms. Table 16 lists the percentage of bassoon players that reported consulting each of the 10 specified types of professionals for the treatment of PRMDs.

**Table 16: Percentage of bassoonists that consulted different types of professionals**

<b>Professional Consulted</b>	<b>Percentage</b>
Physical therapist or physiotherapist	32%
Instrumental teacher	32%
Medical doctor	31%
Massage therapist	23%
Chiropractor	21%
Alexander Technique teacher	11%
Osteopath	10%
Acupuncturist	7%
Pilates teacher	3%
Feldenkrais teacher	2%

The two highest ranked professionals consulted in the treatment and management of PRMDs were physical therapists/physiotherapists and instrumental teachers. Thirty-two percent of bassoon players went to a physical therapist for the treatment of PRMDs. Thirty-two percent of bassoon players reported discussing the management of PRMDs with an instrumental teacher.

Medical doctor was the third most frequently professional consulted (31%). Two bassoonists specified a hand surgeon as the medical practitioner they saw. Table 14 showed that 31% of bassoon players sought “professional help,” the same percentage that consulted a medical doctor in table 16. It would appear that bassoon players did not attribute all of the specialists listed in table 16 as “professionals” in table 14, instead they limited the term to “medical doctors.”

Non-MD practitioners, such as a chiropractor, osteopath, or acupuncturist were consulted, but not with the same frequency as the more traditional physical therapist and medical doctor. Bassoon players were more inclined to speak with “traditional” professionals when looking for PRMD relief. A major contributing factor to the types of practitioners consulted may be health insurance. Both physical therapists and medical doctors are often covered by insurance plans. Many non-MD treatments are only partially covered by health insurance companies and some are not covered at all (Chmelar 1990). If a musician chooses to consult a non-MD practitioner there may be an out-of-pocket expense. The affect of health plans on treatment options has not yet been defined in the bassoon community and warrants further investigation.

Much literature is available to bassoonists about “postural changing” methods such as the Alexander Technique and Feldenkrais (Feldenkrais 1981; Murray 1986; Spire 1989; Drake 1991; Alexander and Maisel 1995; Alcantara 1996; Conable and Conable 2000; Feldenkrais 2002). Yet despite all of the literature and perceived benefits, teaching methods that encourage “postural changing” were used by only a small percentage of bassoonists. The Alexander Technique was by far the most frequent “postural changing” treatment method used by bassoon players (11%). In addition, to the abundance of literature, many universities offer Alexander Technique classes and major cities have Alexander Technique instructors available. Accessibility would not be the reason bassoon players were not using this treatment option more frequently. Financial constraints were the most likely reason that Alexander Technique was not more prevalent in the bassoon community. Insurance companies rarely cover any type of

“postural changing” teachings like Alexander Technique or Feldenkrais. Surely this out-of-pocket expense contributes significantly to the choices bassoon players are making.

Stretching was the third most used common treatment as shown in table 14. Pilates practitioners were consulted for the management of PRMDs by 3% of bassoon players. Yoga was the most common written-in response, 3% of bassoonists consulted yoga teachers for the management of their PRMDs. Bassoon players seemed to be looking closely at overall body health and elasticity for the management of PRMDs.

Respondents were asked to write-in any professionals that they had consulted but not listed in table 16. Some bassoon players reported consulting dentists, orthodontists, and oral surgeons for the management of specific PRMD symptoms. Bassoon players also identified rheumatologists, homeopaths, and ophthalmologists as practitioners consulted for PRMD management. Two respondents wrote that they asked other woodwind players and bassoonists for advice about the management of PRMDs; because this was only mentioned twice it does not seem to be a common occurrence.

Although 31% reported that they “[sought] professional help” in table 14, 70% reported consulting at least one of the 10 professionals listed in table 16. Table 17 shows the percentage of bassoon players that consulted multiple professionals for their PRMD management. Thirty percent of bassoon players did not speak to any professional about their PRMD symptoms. The majority of bassoon players (54%) consulted three or fewer professionals for PRMD treatment.

**Table 17: Percentage of bassoonists that consulted multiple professionals**

<b>Number of Professionals Consulted</b>	<b>Percentage</b>
No professionals	30.1%
1 professional	24.1%
2 professionals	16.9%
3 professionals	12.7%
4 professionals	6.6%
5 professionals	5.4%
6 professionals	1.8%
7 professionals	1.8%
9 professionals	0.6%

The diverse range of treatment options used may be due to the individuality of PRMD symptoms. The bassoon presented many issues for the player to overcome (chapter 1, section 1.1) and therefore, there was a wide range of PRMDs among bassoon players. But given the multitude of treatment options and practitioners to consult, bassoon players were seeking help in relatively low numbers. Even with the high percentage of players experiencing symptoms, many players were not seeking help or were sticking to traditional approaches for treatment. More information must be provided on the benefit of various treatment options. With so many options, bassoon players did not have concrete information on what actually helps limit PRMD occurrence and so those players diligently searching for a cure had to try multiple treatments. Many bassoon players did not make the effort to try numerous treatment options or consult multiple practitioners. The effect of affordability on treatment options is another area to be investigated, as prohibitive costs may limit treatments that could be helpful.

## **5.2 Contributing Factors to PRMD Development**

From a list of 22 possibilities extracted from the literature (Dawson 2007a; Fortune 2007; Wu 2007), bassoon players were asked what they believed contributed to the onset and development of PRMDs. For each contributing factor, respondents could indicate no contribution by marking “not applicable” (NA) or could indicate a level of contribution on a scale of 1-5, “1 = minor contributor” and “5 = significant contributor.” Table 18 shows the mean and standard deviation (*SD*) for each of the contributing factors. Each of the contributing factors displayed a normal distribution clustered around the mean.

**Table 18: Factors believed to contribute to the development of PRMDs**  
**Mean score out of 6 (including NA and 1-5 scale) and standard deviation (SD)**

<b>Contributing Factor</b>	<b>Mean</b>	<b>(SD)</b>
Long hours of practice	3.34	(1.98)
Sudden increase in playing time	3.20	(2.04)
Insufficient rest breaks	2.86	(1.88)
Ignoring increasing intensity of pain	2.82	(1.90)
Poor posture	2.82	(1.88)
Inadequate chairs	2.30	(1.76)
Stress in life (not bassoon)	2.29	(1.63)
Technique flaws	2.14	(1.52)
Performance anxiety	2.06	(1.50)
Injury from non-music activity	2.05	(1.71)
Insufficient warm-up	2.04	(1.41)
Playing standing	1.94	(1.71)
Poor physical condition/fitness	1.89	(1.41)
Lack of sleep	1.87	(1.36)
Poor flexibility	1.84	(1.34)
Changed instrument set-up	1.78	(1.47)
Playing sitting	1.75	(1.35)
Travel strain/stress	1.73	(1.32)
Underlying medical condition	1.72	(1.41)
New technique tried/implemented	1.67	(1.26)
Alternating between standing and sitting	1.50	(1.19)
Poor diet	1.45	(1.00)

The top two factors that bassoonists reported contributed to the development of PRMDs were “long hours of practice” and “sudden increase in playing time.” Both of these contributing factors had a mean score above 3 indicating bassoon players considered them a major factor to PRMD development.

Bassoon players viewed “long hours of practice” ( $M = 3.34$ ,  $SD = 1.98$ ) as the most significant contributing factor to the development of PRMDs. Twenty-five percent of bassoon players rated “long hours of practice” at the highest ranking, “5 = significant contributor.” The *IBQ* reinforced the idea that constant, consistent playing contributes strongly to PRMD development (Rosset i Llobet and Odam 2007). This was contrary to some previous research where it was believed that a sudden increase in playing time was the main predisposing factor for a musician to develop a PRMD (Newmark and Lederman 1987; Manchester 2006). In the *IBQ*, bassoonists thought that usual wear and tear from playing the instrument, in other words practicing, was the most important contributor to the development of PRMDs. Subsequently, bassoonists identified “rest” as the first line of defense for treating PRMD.

Bassoon players reported that a “sudden increase in playing time” ( $M = 3.2$ ,  $SD = 2.04$ ) was the second highest contributing factor to the onset of PRMDs. The *IBQ* supported previous literature that indicated a “sudden increase in playing time” was very important in the onset of PRMDs (Schuele and Lederman 2004). Although “sudden increase in playing time” ranked second to “long hours of practice” as a contributing factor, 20% of bassoon players reported it was a “significant contributor” to the development of PRMDs. The *IBQ* confirmed research indicating a “sudden increase in playing time” exacerbated PRMDs. The data also encourages investigating the importance of constant, consistent practice as an influential factor to PRMD occurrence.

Nine of the possible 22 contributing factors had a mean between 2 and 3 indicating many bassoon players felt they contributed to the onset of PRMDs. Bassoonists reported that

“insufficient rest breaks,” “ignoring increasing intensity of pain,” “poor posture,” “inadequate chairs,” “stress in life (not bassoon),” “technique flaws,” “performance anxiety,” “injury from non-music activity,” and “insufficient warm-up” all contributed to the development of PRMDs. The wide variations in these contributing factors show the individuality of the PRMD experience. Every bassoonist had different ideas on what caused or exacerbated their PRMDs.

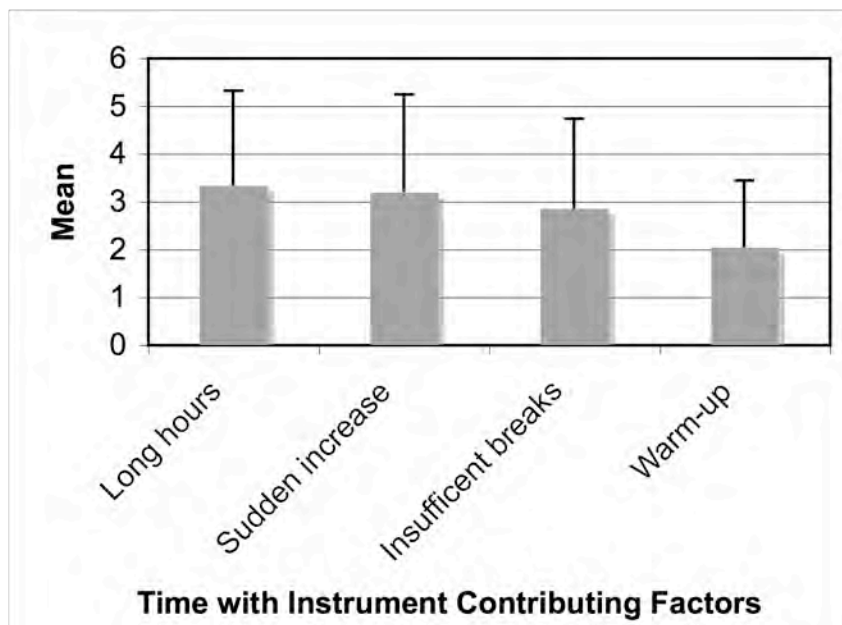
The 11 remaining possible contributing factors had a mean score below 2 indicating the vast majority of bassoon players believed they were only a minor contributor, if any, to the development of PRMDs. The lowest ranked contributing factor to the development of PRMDs was a “poor diet.” Yet 24% of bassoonists still felt “poor diet” contributed to the development of PRMDs in some way and two bassoonists indicated “poor diet” was a “significant contributing” factor.

After rating the 22 contributing factors, participants were able to write-in any other factors they believed contributed to the development of PRMDs. Very few bassoonists wrote-in other contributing factors. Written-in by more than one bassoonist were: the weight of the instrument, insufficient/bad neck or shoulder harnesses, and switching between contrabassoon and bassoon. Some respondents felt that working on a computer contributed to PRMDs.

### **5.2.1 Contributing Factor Categories**

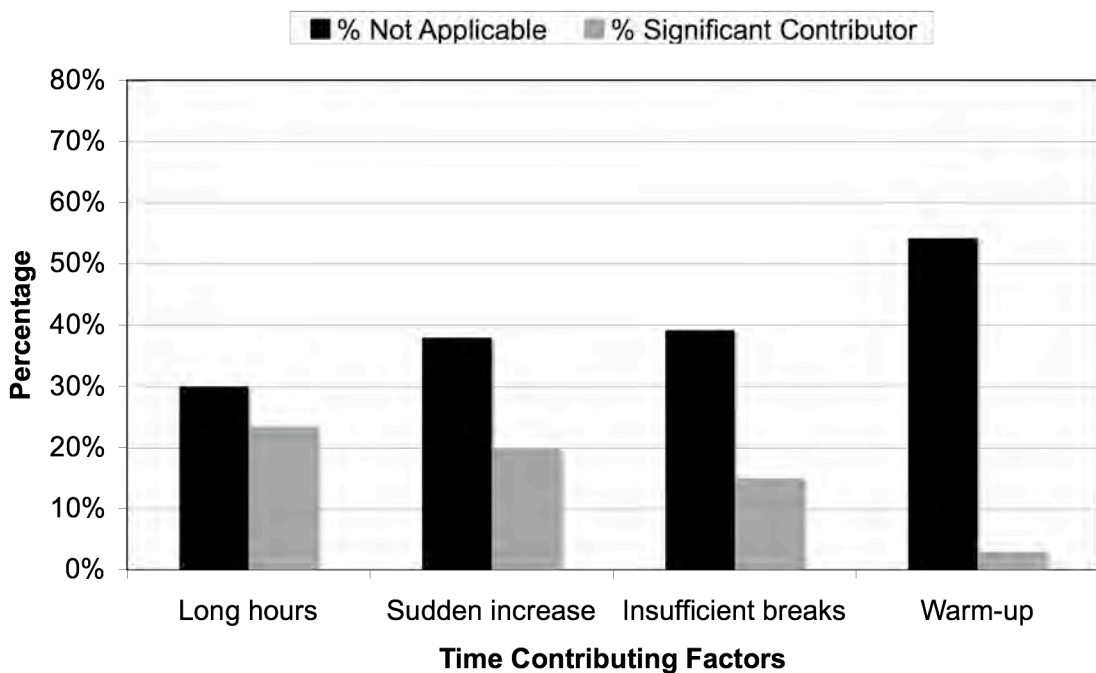
The 22 contributing factors addressed four areas in bassoon playing: “time” spent with the instrument, the “physicality” of playing, “technical” aspects of playing, and “life” away from bassoon negatively affecting playing.

Bassoon players reported that “time” spent with the instrument was by far the most influential aspect on PRMD development. “Time” spent with the instrument had four contributing factors associated with it: “long hours of practice,” “sudden increase in playing time,” “insufficient rest breaks,” and “insufficient warm-up.” “Time” spent with the instrument included the top three highest means, confirming that “time” spent with the bassoon was the most significant feature to PRMD development. Each of the contributing factors associated with “time” spent playing the instrument are shown in figure 22. Figure 22 displays the mean with whiskers for the standard deviation for each “time” factor. The rating scale was between 1 and 6; 1 indicated a “not applicable” response, 2-6 was a “1-5 rating scale,” 6 indicated a “significant contributor.” Therefore, the highest possible mean was 6.



**Figure 22: Means for “time” contributing factors  
Including whisker for standard deviation**

Figure 23 shows the percentage of bassoonists that reported whether each of the “time” spent with the instrument factors was “not applicable” to PRMD development or if it was a “significant contributor” to the development of PRMDs. Only the extreme responses are listed on the figure. In figure 23, the lower the black bar (“not applicable” percentage responses), the more bassoon players reported the factor contributed in some way to PRMDs; the higher the grey bar (“significant contributor” percentage responses), the more adamant bassoon players felt it was a contributing factor. Figure 23 shows a comparison of the extreme responses on the scale, therefore, they do not add up to 100% as 1, 2, 3, and 4 were also reported, but are not shown here.



**Figure 23: Contribution percentages for “time” factors**

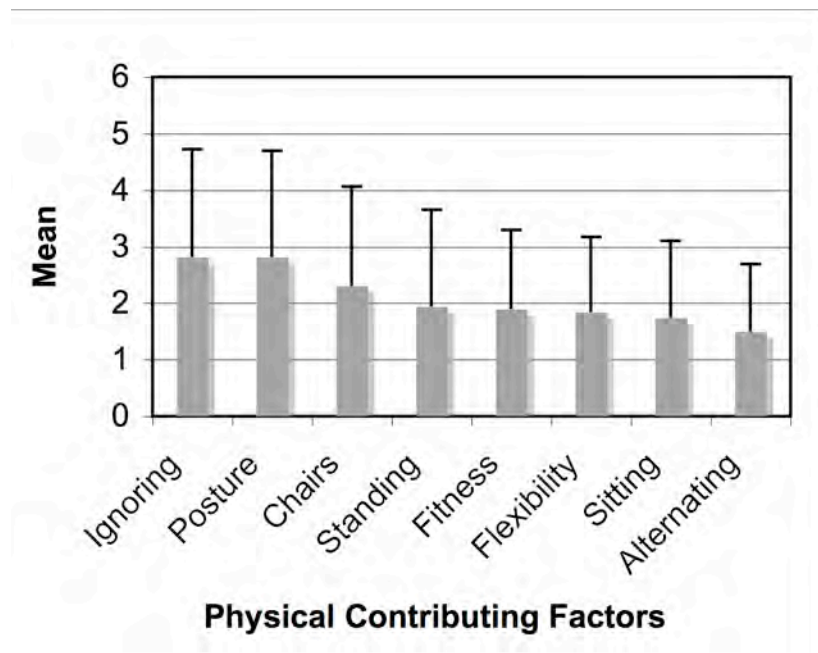
“Long hours of practice” had the highest overall mean and had the largest percentage of bassoonists reporting it was a “significant” contributing factor to PRMD development

(24%). “Long hours of practice” also had the smallest percentage of bassoonists indicating it was “not applicable” to PRMD development (30%).

The middle two factors in the “time” category, “sudden increase in playing time” and “insufficient rest breaks,” had similar percentages of not applicable response (respectively 38% and 39%). The difference in the means can be attributed to more bassoon players reporting that a “sudden increase in playing time” was a “significant contributor” to PRMDs (20%) than those reporting “insufficient rest breaks” was a “significant contributor” (15%).

Many bassoon players (54%) reported that “insufficient warm-up” was not a factor in PRMD onset. Only 3% percent of bassoon players thought an “insufficient warm-up” would “significantly” increase the likelihood of a PRMD. “Insufficient warm-up” was the least important factor related to “time” spent playing the instrument. Three of the four factors related to “time” were reported by bassoonists as key contributors to PRMDs development.

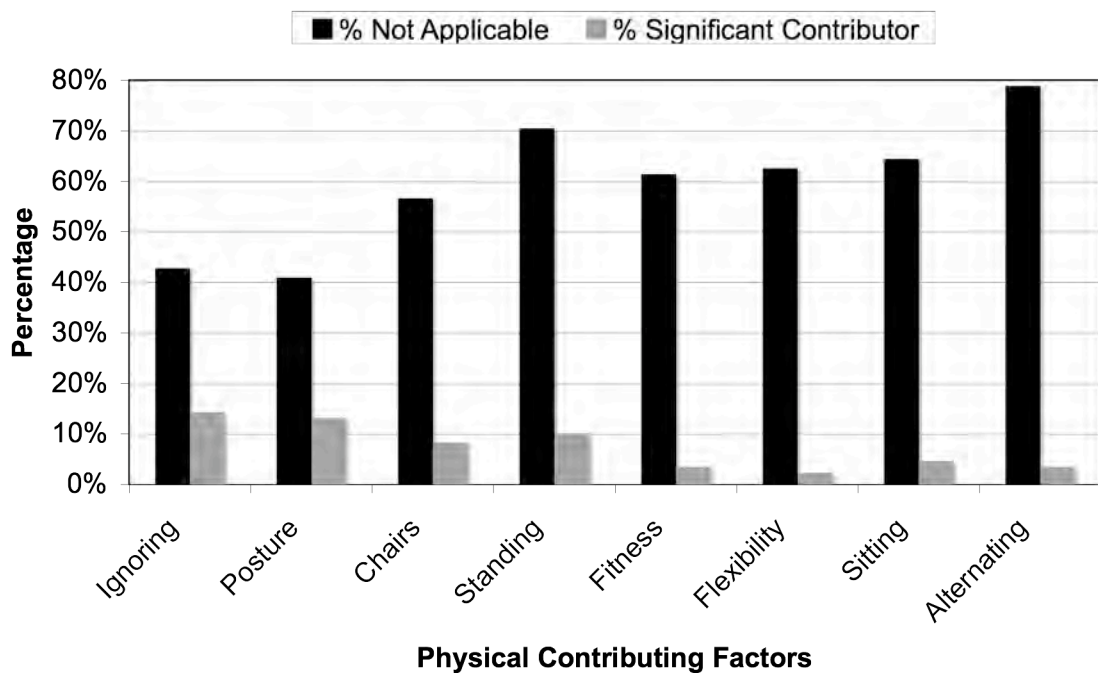
The “physicality” associated with bassoon playing was the second most influential aspect to PRMD development. There were 8 contributing factors associated with the “physicality” of playing: “ignoring increasing intensity of pain,” “poor posture,” “poor physical condition/fitness,” “poor flexibility,” “inadequate chairs,” “playing sitting,” “playing standing,” and “alternating between standing and sitting.” The means for each of the “physical” contributing factors are shown in figure 24 with standard deviation whiskers.



**Figure 24: Means for “physicality” contributing factors  
Including whiskers for standard deviation**

Bassoon players reported that “ignoring increasing intensity of pain” was the most critical “physical” factor in PRMD development ( $M = 2.82$ ,  $SD = 1.88$ ). “Poor posture” had the same mean, but a higher standard deviation ( $SD = 1.9$ ) making it only slightly less important as a contributing factor. Bassoon players reported that the type of chair they used was a larger contributor to PRMD development than if they were required to play sitting, standing, or alternating between the two positions. There was a substantial drop off in the reported contribution for the remaining “physical” factors (“poor physical condition/fitness,” “poor flexibility,” “playing sitting,” “playing standing,” and “alternating between standing and sitting”) with means reported below 2, indicating a marginal contribution to the development of PRMDs.

Figure 25 shows the percentage of bassoonists that reported whether each of the “physical” factors was “not applicable” to PRMD development or if it was a “significant contributor” to the development of PRMDs. Only the extreme responses are listed on the figure. Many bassoon players (43%) reported that “ignoring increasing intensity of pain” was “not applicable” to the development of PRMDs, but 15% reported it was a “significant contributor.” Fewer players reported “poor posture” was “not applicable” (41%), but fewer also reported “poor posture” was a “significant contributor” (13%). More bassoon players felt that “ignoring increasing intensity of pain” was a stronger contributing factor than “poor posture,” even though overall “poor posture” had more bassoon players reporting that it contributed in some way to PRMDs.

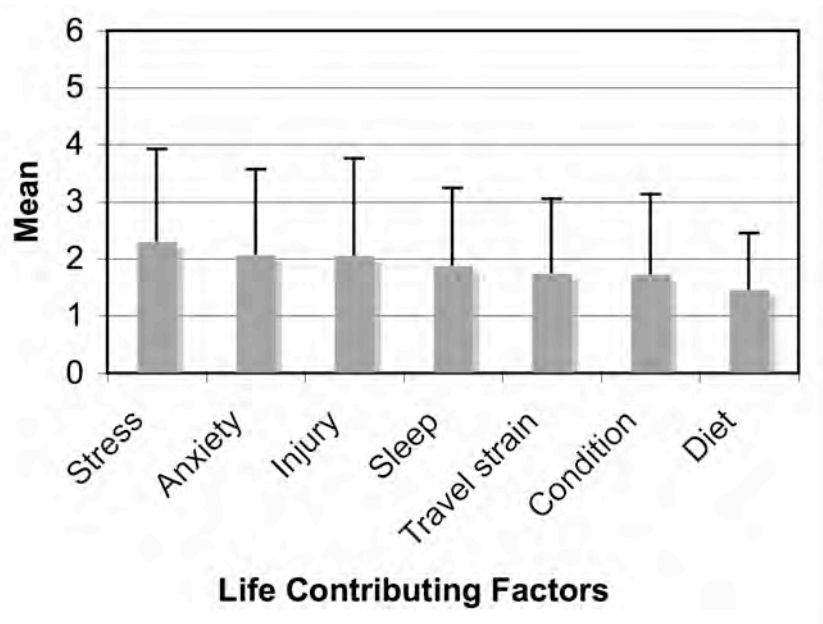


**Figure 25: Contribution percentages for “physicality” factors**

More bassoon players reported that “playing standing” was a “significant contributor” to PRMD development (10%) than “inadequate chairs” (8%). Drastically more players

(70%) reported that “playing standing” was “not applicable” to PRMD development versus 57% reported that chairs were “not applicable.” Only “ignoring increasing intensity of pain” and “poor posture” had more than 50% of bassoon players reporting it as a contributing factor because “not applicable” reporting was below 50%. The rest of the “physical” aspects of playing reported at least 50% of the bassoon population did not attribute them to PRMD development.

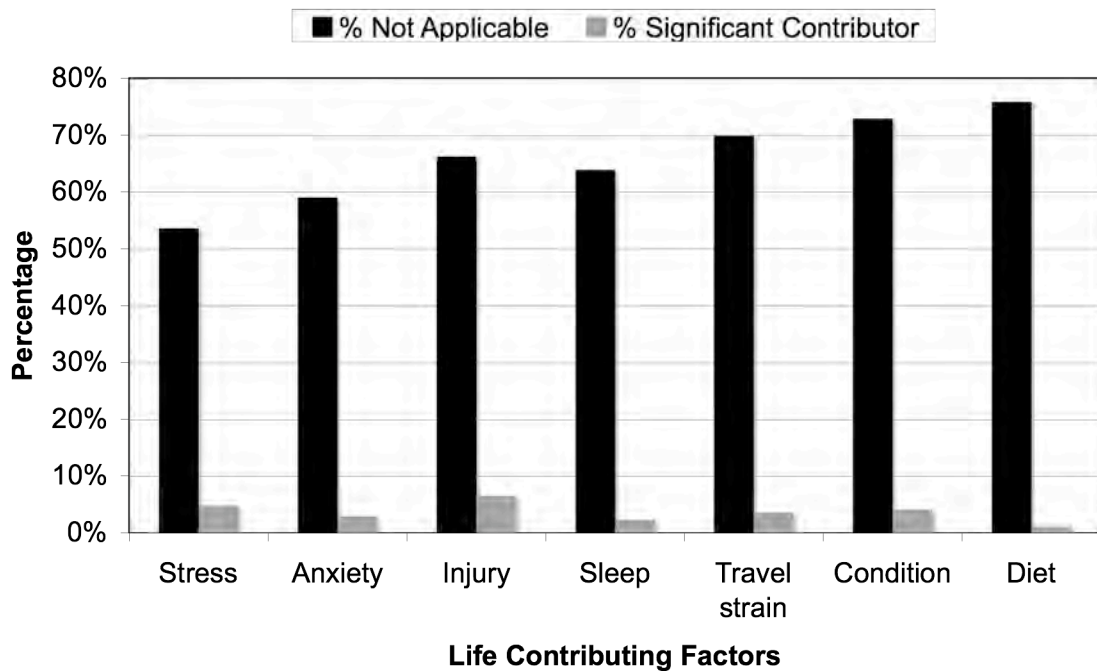
“Life” away from bassoon affecting playing was the third most relevant area for contribution to PRMD development. Seven factors were associated with “life:” “stress in life (not bassoon),” “performance anxiety,” “injury from non-music activity,” “lack of sleep,” “travel strain/stress,” “underlying medical condition,” and “poor diet.” The mean for each of the “life” contributing factors are shown in figure 26 with standard deviation whiskers.



**Figure 26: Means for “life” contributing factors  
Including whiskers for standard deviation**

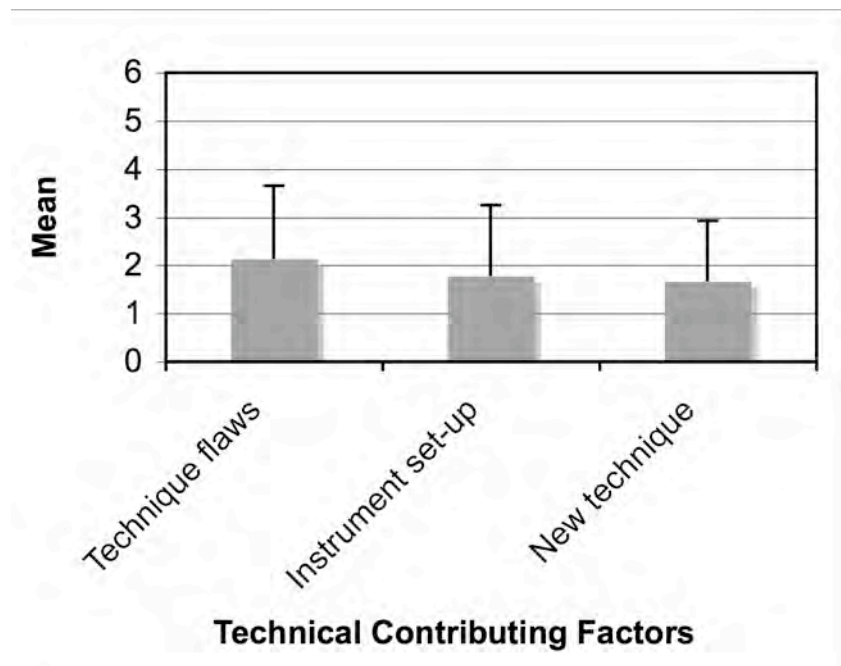
Bassoon players reported that “stress in life (not bassoon)” was the most critical “life” factor that increased the risk of PRMDs ( $M = 2.29$ ,  $SD = 1.63$ ). “Performance anxiety” was the second most reported influential “life” factor ( $M = 2.06$ ,  $SD = 1.50$ ). “Injury from non-music activity” reported a mean above 2 ( $M = 2.05$ ,  $SD = 1.71$ ) indicating a moderate level of influence on PRMD development. The other “life” factors (“lack of sleep,” “travel strain/stress,” “underlying medical condition,” and “poor diet”) all reported means below 2, indicating few bassoon players reported them as a strong contributing factor to PRMD development.

Figure 27 shows the percentage of bassoonists that reported whether each of the “life” factors was “not applicable” to PRMD development or if it was a “significant contributor” to the development of PRMDs. Only the extreme responses are listed on the figure. None of the “life” factors had a “significant” contribution percentage above 10% of the bassoon population. Additionally, all of the “life” factors reported a “not applicable” response above 50%. Even though “life” factors were the third most important contributor to PRMD development, most bassoon players considered them a negligible factor.



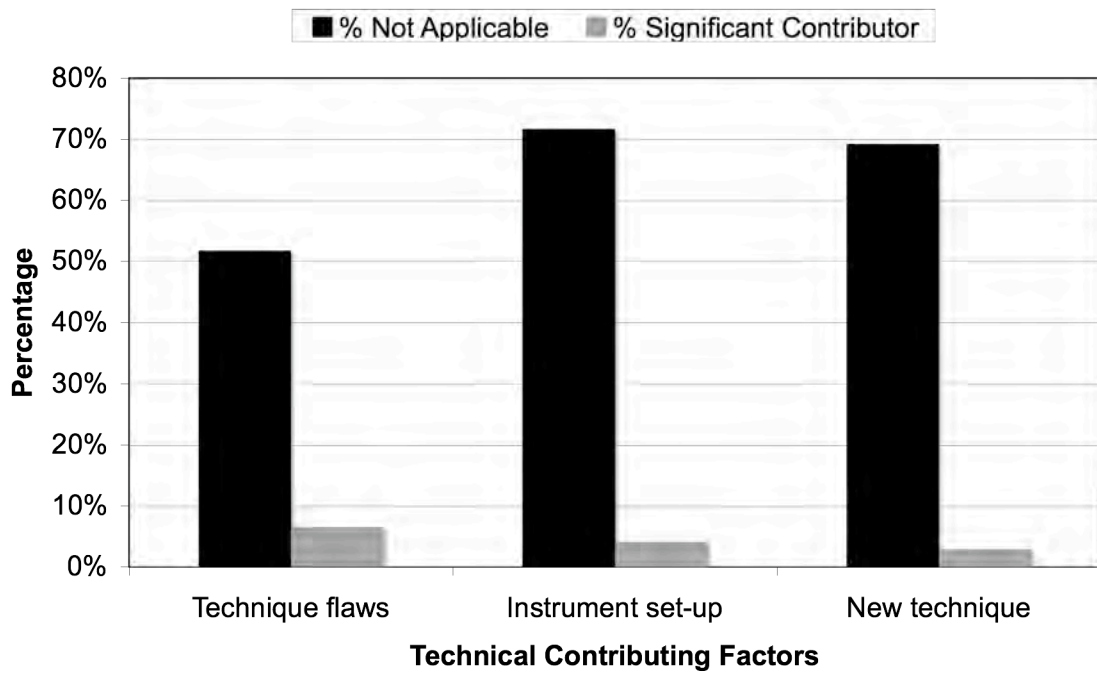
**Figure 27: Contribution percentages for “life” factors**

The “technical” side of bassoon playing was the least attributed area for contribution to PRMD development. Three contributing factors were associated with “technical:” “technique flaws,” “changed instrument set-up,” and “new technique tried/implemented.” Even with fewer factors in the overall category, bassoon players ranked none of the “technical” factors high. “Technique flaws” ( $M = 2.14$ ,  $SD = 1.52$ ) was the highest ranked for this category, but were 8<sup>th</sup> overall. The mean for each of the “technical” contributing factors are shown in figure 28 with standard deviation whiskers.



**Figure 28: Means for “technical” contributing factors  
Including whiskers for standard deviation**

Figure 29 shows the percentage of bassoonists that reported whether each of the “technical” factors was “not applicable” to PRMD development or if it was a “significant contributor” to the development of PRMDs. Only the extreme responses are listed on the figure. None of the technical factors reported more than 10% of bassoon players recognizing them as a “significant contributor.” “Technique flaws” was the strongest of the “technical” considerations, but only 7% of bassoon players reported flaws as a “significant contributor” to PRMD development. All of the “technical” factors had over 50% of bassoon players reporting that they were “not applicable” to PRMD development.



**Figure 29: Contribution percentages for “technical” factors**

### **5.2.2 Impact of Gender on Contributing Factors**

Females reported more factors contributed to the development of PRMDs than males. Females reported higher means for 19 of the 22 contributing factors than males, 9 had statistically significant higher means. Table 19 shows the mean scores and standard deviations by gender for each of the 22 factors. If there was a statistically significant difference between genders, the gender with the higher mean score is in bold. The level of statistical significance is indicated with \* for  $p < 0.05$  and \*\* for  $p < 0.001$ .

**Table 19: Gender differences for contributing factors**

Table shows the mean and standard deviation (*SD*) with bold numbers highlighting the higher mean where significant, \* indicates  $p < 0.05$ , \*\* indicates  $p < 0.001$

Contributing Factor	Male		Female	
Long hours of practice*	3.00	(1.98)	<b>3.80</b>	(1.90)
Sudden increase in playing time*	2.83	(1.99)	<b>3.70</b>	(2.01)
Insufficient rest breaks*	2.58	(1.74)	<b>3.24</b>	(2.02)
Ignoring increasing intensity of pain*	2.46	(1.80)	<b>3.31</b>	(1.94)
Poor posture	2.77	(1.93)	2.89	(1.83)
Inadequate chairs	2.08	(1.66)	2.60	(1.85)
Stress in life (not bassoon)	2.13	(1.61)	2.51	(1.65)
Technique flaws	2.06	(1.53)	2.26	(1.51)
Performance anxiety**	1.74	(1.23)	<b>2.50</b>	(1.73)
Injury from non-music activity	2.08	(1.75)	2.00	(1.68)
Insufficient warm-up	2.00	(1.45)	2.10	(1.36)
Playing standing	1.72	(1.52)	2.24	(1.91)
Poor physical condition/fitness	1.85	(1.41)	1.94	(1.41)
Lack of sleep**	1.56	(1.05)	<b>2.29</b>	(1.61)
Poor flexibility	1.88	(1.42)	1.80	(1.22)
Changed instrument set-up*	1.56	(1.27)	<b>2.07</b>	(1.67)
Playing sitting	1.59	(1.24)	1.97	(1.46)
Travel strain/stress*	1.55	(1.16)	<b>1.97</b>	(1.49)
Underlying medical condition*	1.53	(1.27)	<b>1.97</b>	(1.56)
New technique tried/implemented	1.56	(1.17)	1.83	(1.37)
Alternating between standing and sitting	1.35	(0.87)	1.70	(1.51)
Poor diet	1.48	(1.07)	1.41	(0.91)

Females reported statistically significant higher means for: “long hours of practice,” “sudden increase in playing time,” “insufficient rest breaks,” “ignoring increasing intensity of pain,” “performance anxiety,” “lack of sleep,” “changed instrument set-up,” “travel strain/stress,” and “underlying medical condition.” By reporting higher means,

females indicated a larger belief in contribution. The most significant differences between genders were reported for “performance anxiety” and “lack of sleep.” Females had higher means for both with  $p < 0.001$ , indicating a very strong difference between genders in the amount of contribution “performance anxiety” and “lack of sleep” have on PRMDs. “Lack of sleep” has been reported to increase the likelihood of an injury (Kaneko et al. 2005). Females reported higher PRMD rates and also reported that “lack of sleep” contributed, supporting the current literature.

“Long hours of practice” had the highest mean for both genders. Both genders felt that “long hours of practice” was the most important contributing factor to the development of PRMDs, even though females reported a statistically significant higher means. This supports the previously reported result that bassoon players believed “long hours of practice” contributed most to PRMD development. Both genders also agreed that “sudden increase in playing time” was the second highest contributing factor to PRMDs.

Males reported “poor posture” was the third most influential factor to PRMDs. While females ranked “poor posture” the fifth overall contributor to PRMDs. Conversely, females reported “ignoring increasing intensity of pain” as the third most influential factor to PRMD development, while males ranked “ignoring increasing intensity of pain” as the fifth most influential factor to PRMD development. Both genders ranked “insufficient rest breaks” as the fourth highest contributor to PRMD development.

Females were more likely to rank “life” factors higher than males; three of the eight “life” factors were rated in the top-ten for females, while only two were in the top-ten for

males. Conversely, males ranked three “life” factors at the bottom: “travel strain/stress,” “underlying medical condition,” and “poor diet.” Males were more inclined than females to believe “time” spent playing the instrument contributed to PRMDs. Males had all four “time” factors reported in the male top-ten list; females only had three of the four “time” playing factors in the top-ten: “long hours of practice,” “sudden increase in playing time,” and “insufficient rest breaks.”

Males reported higher means for three contributing factors: “injury from non-music activity,” “poor flexibility,” and “poor diet.” None of these differences were statistically significant. “Injury from a non-music activity” could be attributed to the predisposition of males to play more contact sports where they may become injured. Trauma from sports negatively impacting playing has been identified in previous literature (Dawson 2007c) and was more frequent in males (Dawson 2001a).

The literature shows that females were more likely to report injuries and PRMDs than males (Lockwood 1989; Manchester and Lustik 1989; Larsson et al. 1993; Lederman 2003). The *IBQ* results concurred with the literature and reported 96% of females incurring an injury or PRMD compared to 78% of males. With a greater occurrence of PRMDs, the female population has probably thought more about what contributes to PRMDs, which would reflect the higher means shown for most factors. We know from previous studies that females were more likely to report PRMDs. We know from this study that females were better at articulating contributing factors to PRMD development.

### 5.2.3 Impact of Age on Contributing Factors

Age had a great affect on contributing factors. The young group (< 41) rated 17 of 22 factors higher than the older group (< 42). The young group reported more factors contributed to the development of PRMDs. Table 20 shows the mean scores and standard deviations for each age group for the 22 factors. If there was a statistically significant difference between age groups, the one with the higher mean score is bolded. The level of statistical significance is indicated with \* for  $p < 0.05$  and \*\* for  $p < 0.001$ .

**Table 20: Age group differences for contributing factors**

Table shows the mean and standard deviation (*SD*) with bold numbers highlighting the higher mean where significant, \* indicates  $p < 0.05$ , \*\* indicates  $p < 0.001$

<b>Contributing Factor</b>	<b>&lt;41</b>		<b>&gt;42</b>	
Long hours of practice**	<b>3.99</b>	(1.93)	2.48	(1.71)
Sudden increase in playing time**	<b>3.36</b>	(1.97)	2.20	(1.91)
Insufficient rest breaks**	<b>3.75</b>	(1.87)	2.46	(1.69)
Ignoring increasing intensity of pain*	<b>3.07</b>	(1.93)	2.48	(1.83)
Poor posture*	<b>3.09</b>	(1.87)	2.45	(1.85)
Inadequate chairs*	<b>2.62</b>	(1.84)	1.87	(1.57)
Stress in life (not bassoon)**	<b>2.66</b>	(1.76)	1.79	(1.29)
Technique flaws**	<b>2.55</b>	(1.62)	1.61	(1.18)
Performance anxiety*	<b>2.27</b>	(1.61)	1.77	(1.31)
Injury from non-music activity	2.09	(1.76)	1.99	(1.66)
Insufficient warm-up**	<b>2.40</b>	(1.56)	1.56	(1.01)
Playing standing**	<b>2.37</b>	(1.95)	1.37	(1.09)
Poor physical condition/fitness*	<b>2.13</b>	(1.50)	1.58	(1.22)
Lack of sleep**	<b>2.16</b>	(1.53)	1.48	(0.98)
Poor flexibility	1.94	(1.30)	1.72	(1.38)
Changed instrument set-up	1.94	(1.56)	1.56	(1.32)
Playing sitting	1.82	(1.40)	1.66	(1.29)
Travel strain/stress*	<b>1.97</b>	(1.53)	1.41	(0.90)
Underlying medical condition*	1.49	(1.08)	<b>2.01</b>	(1.73)
New technique tried/implemented**	<b>2.05</b>	(1.50)	1.17	(0.51)
Alternating between standing and sitting**	<b>1.82</b>	(1.48)	1.07	(0.26)
Poor diet*	<b>1.59</b>	(1.11)	1.27	(0.81)

The younger group had higher means for 21 of the 22 contributing factors. Seventeen had significantly higher means for the younger group: “long hours of practice,” “sudden increase in playing time,” “insufficient rest breaks,” “ignoring increasing intensity of pain,” “poor posture,” “inadequate chairs,” “stress in life,” “technique flaws,”

“performance anxiety,” “insufficient warm-up,” “playing standing,” “poor physical condition/fitness,” “lack of sleep,” “travel strain/stress,” “new technique tried/implemented,” “alternating between standing and sitting,” and “poor diet.” Nine of the 17 had  $p$  values below 0.001, indicating a great deal of statistical significance: “long hours of practice,” “sudden increase in playing time,” “insufficient rest breaks,” “stress in life (not bassoon),” “insufficient warm-up,” “playing standing,” “lack of sleep,” “net technique tried/implemented,” and “alternating between standing and sitting.”

The younger demographic reported that “time” spent playing was the most influential contributor to PRMD development. “Long hours of practice,” “insufficient rest breaks,” and “sudden increase in playing time” were ranked first, second, and third by the younger demographic. The older group agreed that “long hours of practice” was the most significant contributing factor, but rated “ignoring increasing intensity of pain” second and “insufficient rest breaks” third. Both groups attributed “poor posture” as the fourth most influential contributing factor to PRMD development. The older group was more inclined to report that “life” factors influence PRMD development; four “life” factors were in the older group’s top-ten, while only one “life” factor was in the younger group’s top-ten. The younger group instead felt that “technical” factors, “time” spent playing the instrument, and the “physicality” of playing the instrument were more influential to PRMD development than “life” factors.

“Underlying medical condition” was the only contributing factor that presented with a higher mean for the older group ( $p = 0.019$ ). This difference may be attributed to the onset of arthritis in later years and its negative affect on playing an instrument

(Hoppmann and Ekman 1999; Warrington et al. 2002). According to Dawson (Dawson 2001a), 47% of those reporting arthritis in the upper extremity reported it in the thumb carpometacarpal joint. All bassoon players need great flexibility and range of motion in their thumbs in order to navigate around a minimum of eight, usually nine, thumb keys on the left and a minimum of four, usually five, thumb keys on the right. It is probable that arthritis would negatively impact bassoon playing. It is a possibility that the onset of arthritis later in life could account for the belief by the older population that an “underlying medical condition” was increasing the likelihood of PRMDs.

This study supports literature that shows that younger musicians reported PRMDs more frequently (Warrington et al. 2002). With a greater occurrence of PRMDs, it is possible that the younger population has thought more about what contributes to PRMDs, which would reflect in higher means for most factors.

The demographic that reported higher rates for PRMD symptoms also reported more contributing factors. This relationship was exhibited between genders; females reported experiencing more PRMDs and displayed higher means for many contributing factors. Those dealing with PRMDs more frequently believed more factors contributed to their onset. Those who had PRMD symptoms may need to believe there were many contributing factors because it gives them reasons for their condition, rather than having the negative belief that their body was just “bad.” Another explanation may be that those with difficulties wanted to find a cure and were therefore looking for influencing factors. Bassoonists who were dealing with PRMDs may have paid more attention, in hopes of understanding the cause of their symptoms, with the ultimate goal of alleviating them.

Dawson supported this idea by writing that PRMD prevention “requires...that the musician take a critical backwards look at the original problem, identifying its causes and contributing factors” (Dawson 2007a, p.116).

Not all bassoonists have experience with PRMDs. If a player has not had PRMDs they did not identify contributing factors because they did not display the symptoms. Additionally, if someone has not had a problem with PRMDs, he or she has probably not paid attention to contributing factors and therefore did not believe as many factors contributed. If a bassoon player had more difficulty with PRMDs he or she could surmise that more factors contributed to exacerbate the condition. Therefore, it was not surprising that females and the younger demographic believed more factors contributed to the development of PRMDs.

### **5.3 Perceptions of PRMDs**

A number of statements were asked to gain information on what bassoon players think about injuries and PRMDs. Participants ranked their level of agreement for each statement on a 1-4 scale, “1 = strongly disagree” and “4 = strongly agree.” There was no “neutral” positions, respondents had to either disagree or agree with each statement. Table 21 presents each statement with the mean, standard deviation, percent of bassoonists that strongly agreed, and the percent of bassoonists that strongly disagreed.

**Table 21: Bassoon players level of agreement to perception statements**

Each statement displays the mean, standard deviation (SD), the percentage of bassoonists that strongly agreed to the statement (StAgr) and the percentage of bassoonists that strongly disagreed to the statement (StDis)

<b>Statement</b>	<b>Mean</b>	<b>(SD)</b>	<b>StAgr</b>	<b>StDis</b>
It is important for teachers to address injury prevention in lessons	3.37	(0.62)	43%	< 1%
Tensions while playing leads to injury	3.27	(0.57)	32%	< 1%
Some people are more prone to injury than others	3.17	(0.53)	23%	< 1%
A teacher can decrease a student's likelihood of being injured	3.12	(0.57)	21%	2%
I feel comfortable talking to my teacher about injury	2.94	(0.74)	19%	4%
I know the difference between healthy and unsafe tension	2.86	(0.69)	14%	4%
My teacher is prepared to offer assistance with injury	2.65	(0.77)	10%	7%
Students hide their injuries from their teachers	2.63	(0.65)	6%	3%
Taking time off will solve most injuries	2.45	(0.66)	4%	5%
Worrying will increase your chances of getting an injury	2.28	(0.75)	5%	13%
I have enough information about PRMDs available to me	2.26	(0.73)	4%	13%
I hide my PRMDs/injuries from my colleagues	2.16	(0.74)	3%	17%
I was taught injury prevention	2.09	(0.84)	5%	25%
Medical practitioners are knowledgeable about musical injuries	2.04	(0.72)	1%	21%
Playing with pain is part of being a musician	2.02	(0.77)	2%	27%
Once injured your career is over	1.42	(0.52)	1%	58%

“Proper teaching” has been cited in the literature as something musicians feel strongly can decrease the likelihood of PRMD development (Brandfonbrener and Lederman 2002). Bassoon players concurred with the need for teachers to address injury prevention; 43% strongly agreed with the statement “it is important for teachers to address PRMD/injury prevention” and it had the highest mean ( $M = 3.37$ ,  $SD = 0.62$ ). Bassoon players also felt that teachers could “decrease a student’s likelihood of being injured,” the fourth most believed statement ( $M = 3.12$ ,  $SD = 0.57$ ).

Given the perceived importance of teaching to PRMD prevention, most bassoonists felt they had not been taught injury prevent; 25% strongly disagreed with the statement “I was taught injury prevention in my bassoon lessons.” Being taught injury prevention had the fourth lowest overall mean ( $M = 2.09$ ,  $SD = 0.84$ ) indicating a very strong belief in the bassoon community that injury prevention was not taught. This is of great concern considering how important bassoon players felt a teacher was in the onset of PRMDs. Perhaps the reason for the strong belief that “proper teaching” would limit PRMD occurrence was because bassoon players were not taught injury prevention and then became injured. Subsequently, they blamed teachers for the injury. They felt that had they had “proper teaching” the injury would not have occurred. With high injury rates, bassoonists may feel that their teacher should have taken a more active role in injury prevention and therefore their current perceptions support this view.

Another disconcerting observation into the student-teacher injury relationship was that most bassoonists felt that even though it was important for a teacher to help prevent injury, most felt that teachers were not “prepared to offer assistance [with an] injury” ( $M$

= 2.65,  $SD = 0.77$ ). In other words, a teacher has to help but may not have the tools or knowledge to do so. The contributing factors indicated that “technical” considerations of bassoon playing were the least influential to PRMD development. Teachers have the most impact over “technical” aspects of playing. “Time” spent with the instrument was the leading contributing factor to PRMD development. A teacher does not have that much impact on the “time” a student spends playing; a teacher can only limit “time” by teaching effective practice habits. Bassoon players reported that teaching was important for PRMD prevention, but also reported the “technical” aspects of bassoon playing (where teaching usually focuses) were the least contributing factors to PRMDs. The idea that teachers, who focus on technicality, can prevent PRMDs and that the technical aspects of playing do not cause PRMDs, are in conflict.

If a teacher has to help, but does not have the tools, the next logical person to contact would be a medical professional. Most bassoon players felt strongly that the medical profession did not know how to treat a bassoon related injury. The statement “medical professionals know how to treat PRMD/injuries associated with bassoon playing” received the third lowest level of agreement ( $M = 2.04$ ,  $SD = 0.72$ ). Twenty-one percent of bassoonists strongly disagreed with this statement, indicating a perception among the bassoon community that the medical professional was not helpful for the treatment of PRMDs. This perception has influenced where bassoon players go for treatment, with only 31% of the population consulting a medical doctor for the management of PRMDs. In the ICSOM study, it was reported that the success rate for musicians consulting a medical professional was “very low” (Fishbein et al. 1988, p.7). The belief that a

medical doctor could not help a musical injury was still prevalent and may be why so few bassoon players consulted medical practitioners.

If it was important for teachers to help, but they were not prepared to do so and the medical profession did not know how to treat PRMDs, where should bassoonists go for assistance? The statement “I have enough information about PRMDs available to me” had the fourth lowest mean ( $M = 2.26$ ,  $SD = 0.73$ ). Bassoon players did not feel they had enough information available to them about PRMD prevention. More research needs to be done into PRMDs in the bassoon population. Bassoon players would like more information about PRMD prevention and maintenance.

Most bassoon players felt that “tension while playing lead[s] to injury,” which had the second highest level of agreement ( $M = 3.27$ ,  $SD = 0.57$ ). Only one respondent strongly disagreed with this statement, while 32% strongly agreed. Fourteen percent of bassoonists felt comfortable in their knowledge of the “difference between healthy and unsafe tension.” This leaves many bassoon players believing that unhealthy tension could lead to injury, but not knowing if they were playing with unsafe tension, which may increase their likelihood of PRMDs. Also, if the bassoonist believed that tension caused PRMDs and did not know if they were playing with unsafe tension, the worry could lead to stress, which would cause more tension.

Bassoon players had a strong level of agreement (23%) that “some players are more prone to injury than others” ( $M = 3.17$ ,  $SD = 0.53$ ). This perception corresponds with the PRMD location questions where very few players listed only one complaint, while most

indicated numerous locations for PRMDs. A diverse individual PRMD history most likely fueled the belief that some players were more prone to injury.

Bassoon players strongly disagreed that once a player was injured “his or her career [was] over” ( $M = 1.42$ ,  $SD = 0.52$ ), the strongest level of disagreement of any of the statements. This was not surprising because 86% of the respondents had a PRMD history and they would not want to believe their career was over. Furthermore, participants may have overcome their injuries and were able to continue playing, so those bassoonists knew that an injury was not the end of a career.

Gender did not significantly affect many of the perception statements. Independent-sample t-tests were conducted to compare the perception statements between the genders. Males felt more strongly ( $M = 2.36$ ,  $SD = 0.71$ ) that they had “enough information on PRMDs available,” versus females who did not feel they had enough information [ $M = 2.12$ ,  $SD = 0.74$ ;  $t(162) = 2.11$ ,  $p < 0.04$ ]. Males reported fewer injuries, possibly explaining the difference in gender beliefs over the amount of information available. Because males experienced fewer injuries, they did not feel as much information about prevention was needed. Therefore, males felt that they had enough information available because they did not require as much information in the first place. Females on the other hand, felt they needed more information because they experienced PRMDs more frequently.

Females felt a greater need to “hide [their] PRMDs from [their] colleagues” than males. For the statement “I hide my PRMDs/injuries from my colleagues” females had a mean

of 2.36 ( $SD = 0.74$ ), while males exhibited a mean of 2.00 [ $SD = 0.7$ ;  $t(159) = -3.13$ ,  $p = 0.002$ ]. This gender difference could be attributed to females experiencing PRMDs more frequently and therefore felt the need to hide them more frequently. But it could also be attributed to females feeling the need to hide injuries to appear “equal” in a male dominated field (Allmendinger and Hackman 1995).

Age did not significantly alter the perceptions of bassoon players for most statements. Independent-sample t-tests were conducted to compare the perceptions of the two age groups. A significant difference between age groups was reported for the statement “worrying will increase your chances of getting an injury.” The older age ( $> 42$ ) group felt more strongly ( $M = 2.43$ ,  $SD = 0.70$ ) that worry was a factor to the development of PRMDs, while the younger group ( $< 41$ ) was not as convinced [ $M = 2.17$ ,  $SD = 0.77$ ;  $t(163) = -2.24$ ,  $p = 0.026$ ].

The younger age group ( $M = 3.46$ ,  $SD = 0.62$ ) felt it was more “important for teachers to address injury prevention in lessons” than the older age group [ $M = 3.24$ ,  $SD = 0.60$ ;  $t(163) = 2.3$ ,  $p = 0.023$ ]. The younger group was more confident that their “teacher was prepared to offer assistance” with injury ( $M = 2.84$ ,  $SD = 0.76$ ) than older players [ $M = 2.36$ ,  $SD = 0.71$ ;  $t(151) = 3.9$ ,  $p = 0.0001$ ]. In other words, the younger group felt more strongly that teachers needed to help in the prevention of PRMDs, but they also felt that their teachers were prepared to offer assistance. If we infer that the older players were not currently studying and the younger players were in lessons, this could be a very encouraging perception. Perhaps recent research into injury and PRMDs was giving

teachers more knowledge and that has been filtering to the students and altering perceptions among bassoon players.

## **5.4 Conclusion**

Bassoon players were seeking many treatment options for the management of PRMDs. Reducing time spent with the instrument, whether by resting (60%) or reducing playing time (53%), was the most frequent action bassoonists considered to treat PRMDs. Stretching was the third most common treatment method that bassoonists tried (53%) to alleviate their PRMDs. Males were more willing to treat PRMDs (89%) than females were (87%) even though females were injured much more frequently.

Only 70% of bassoon players sought any type of professional help for the management of PRMDs. The two highest ranked professionals consulted in the treatment and management of PRMDs were physical therapists/physiotherapists (32%) and instrumental teachers (32%). Medical doctor was the third most frequent professional consulted (31%). Teaching methods that encourage “postural changing” were used by only a small percentage of bassoonists. The Alexander Technique was by far the most frequent “postural changing” treatment method used (11%).

Bassoon players reported that numerous factors contributed to the development of PRMDs. The top two factors were “long hours of practice” and “sudden increase in playing time.” Bassoon players indicated that the amount of “time” spent with the instrument was by far the most influential aspect on PRMD development. The “physicality” associated with bassoon playing was the second most influential aspect to PRMD development, which included “ignoring increasing intensity of pain” and “poor

posture.” “Life” away from the bassoon was the third most relevant area contributing to PRMDs. Bassoon players reported that “stress in life (not bassoon)” was the most critical life factor that increased the risk of PRMDs. The “technical” side of bassoon playing was the least attributed PRMD development. “Technique flaws” had an overall ranking of 8<sup>th</sup> out of 22 factors.

Females reported that more factors contributed to the development of PRMDs than males. Females reported higher means for 19 of the 22 contributing factors than males, nine factors had statistically significant higher means. Females felt a greater need for PRMD prevention information than males.

The affect of age on contributing factors was great. The young group (< 41) reported that more factors contributed to the development of PRMDs than the older group (> 42). The younger group felt more strongly than the older group that teachers needed to help in the prevention of PRMDs. The younger group felt their teachers were prepared to offer assistance, while the older group was not as confident.

Most bassoon players felt strongly that the medical profession did not know how to treat a bassoon related injury. The statement “medical professionals know how to treat PRMD/injuries associated with bassoon playing” received the third lowest level of agreement. Bassoon players strongly disagreed (58%) with the statement “once injured your career is over.” It is a good sign that bassoonists wanted to keep fighting their PRMDs to continue playing. Bassoon players did not feel they had enough information available to them about PRMD treatment and prevention.

Bassoon players believed that a knowledgeable teacher was the best defense against the onset of PRMDs. Bassoon players strongly agreed (43%) in the need for teachers to address injury prevention. Bassoon players also felt that teachers could decrease a student's chances of becoming injured. However, 25% of bassoonists strongly disagreed with the statement "I was taught injury prevention in my bassoon lessons." Bassoon players were not getting the information about PRMD prevention from their teachers despite the strong belief that a teacher should be addressing PRMDs. The bassoon pedagogy needs to be altered to meet this need.

## APPENDIX J: SPECIFIC LOCATIONS COMPRISING BODY REGIONS

### **Head and Neck Region:**

- Back neck left
- Back neck right
- Embouchure
- Front neck left
- Front neck right
- Left jaw
- Right jaw

### **Back, Chest, Shoulders Region**

- Back left shoulder
- Back right shoulder
- Between shoulders
- Front left shoulder
- Front right shoulder
- Left chest
- Lower back
- Middle back
- Right chest
- Upper back

### **Arm Region (for both right and left)**

- Elbow
- Little-side forearm
- Thumb-side forearm
- Upper arm
- Wrist

### **Hand Region (for both right and left)**

- Index finger
- Little finger
- Little-side palm
- Middle finger
- Ring finger
- Thumb
- Thumb-side palm

### **Legs, Hips, and Feet Region**

- Back upper leg
- Bottom leg
- Feet
- Knees
- Left hip
- Right hip
- Upper leg front

## 6 Discussion and Conclusion

The previous two chapters reported the results from the *International Bassoonist Questionnaire (IBQ)*. This chapter will discuss the findings in greater detail. Limitations of the study and directions for future research will also be discussed.

### 6.1 Discussion on Injury and PRMD Symptoms

The *IBQ* found that 86% of bassoon players reported an injury or PRMD symptom. This was higher than any earlier study on bassoon players. Previously, bassoon players reported injury rates between 5.1% (Cayea and Manchester 1998) and 80% (Thrasher and Chesky 2001), a very large range. There may have been factors that encouraged the higher injury numbers reported in the *IBQ*. First, there is evidence that musicians who have injuries are more inclined to take part in PRMD research (Ackermann et al. 2002). With an Internet based survey this may be even more true as the respondents had to take the time to go to the website and fill out the survey, rather than doing it during an orchestra rehearsal or as part of a university health care visit. The UNT study also felt this phenomenon may have influenced their results, but still believed the overall validity of the Internet survey outweighed this negative possibility (Thrasher and Chesky 2001). Second, the researcher who conducted the *IBQ* is a bassoonist. The website, [www.paulabrusky.com](http://www.paulabrusky.com), was intentionally created to foster a caring, sympathetic bassoon environment. The possibility exists that bassoon players felt more comfortable talking to another bassoon player about their PRMDs. The email communications from some of the respondents after they submitted the questionnaire indicated that this level of commonality was important to them. Regardless of these two factors possibly

influencing participants, the numbers from the *IBQ* are relevant. Bassoon players are experiencing PRMDs at alarmingly high rates.

Normal activities should not be expected to produce deleterious physical changes unless they are performed at an unusual level of speed, intensity, and/or duration, which we would then consider to be ‘abnormal’ (Dawson et al. 1998, p.46).

Given this definition of “normal” activity, is playing a musical instrument ever normal? The rate of PRMDs in all instrumental musicians fluctuates from 37% to 87% in the literature (Zaza 1998). According to the data from the *IBQ*, the bassoon player has one of the highest rates of injuries among all musicians. This supports the idea presented by other researchers that the larger the instrument, the more likely the player will incur PRMDs (Fry et al. 1988; Lockwood 1988; Middlestadt and Fishbein 1989). The bassoon is a heavy instrument held at an oblique angle. The instrument’s position, diagonally across the body, puts the vast majority of the weight of the instrument on the player’s neck, shoulders, and the left arm of the performer while possibly creating a sharp right wrist angle. The bassoon player uses all 10 fingers to navigate keywork. Bassoon players are required to play in both a sitting and standing position. The angle of the instrument, wrist position, hand position, and amount of weight transferred to the body from the instrument all change dramatically depending which playing position is used. Bassoon players are incurring injuries more frequently than most other instrumentalists. It would seem that playing the bassoon is not a “normal” activity for the body.

Bassoon players reported injury in many areas of the body. Eighty-eight percent of bassoon players that reported an injury reported an injury in more than one location. The most common areas that bassoon players experienced PRMDs were the right wrist (33%), left wrist (32.5%) and left thumb (25%). The right wrist ranking as the number one location for PRMDs in bassoon players was surprising. In previous studies, regarding injury location in bassoon players, the left wrist was always higher ranked than the right (Thrasher and Chesky 2001). The difference between the two wrists in this study was statistically insignificant and it should not be interpreted that the right wrist was more afflicted, but instead that both wrists of bassoon players are highly vulnerable to injury.

The wrist was a part of a larger body region at risk. The “arms and wrists” was the body region where bassoon players reported PRMDs most frequently (54%). The strain on the arms and wrists from the weight of the bassoon and the angle at which it was held seemed to encourage PRMDs in this region.

Overall the left side of a bassoon player’s body was more susceptible to PRMDs, especially in the shoulders, arms, hands, and back. A definite pattern of overuse was prevalent on the left side of the body in bassoon players. The instrument design distributes the majority of the weight from the instrument on the left arm of the performer. The overall areas with the highest rates of injury were those that were used to support the instrument.

Bassoon players reported that the hands (41%) were also prone to injuries. The hands of the bassoon player require: a great range of motion, complicated dexterity, and (for the left side) to support some of the weight of the bassoon. In addition to executing complex keywork, the hands position the bassoon and influence the angle of the instrument. Depending on the keys being depressed the hand position will change to accommodate a wide and varied reach, while still controlling the position of the instrument. Playing and holding the instrument simultaneously places stress on both hands. The antiquated design of the bassoon fosters the development of PRMDs in the arms, wrists, and hands.

The *IBQ* reported that bassoon players experienced PRMDs in numerous body locations. One player reported experiencing PRMDs in 27 body locations. It is unknown if those with multiple locations have any commonalities in their instrument set-up such as the type of bocal used (“German” or “English” bend) or the type of support used (seat strap, floor peg, shoulder harness). Is there a set-up that is less harmful to bassoon players? With the wide variety of options bassoon players have to support the instrument, any study into “set-up” would be very complicated. The high rate of PRMDs in bassoon players warrants addressing this difficulty to identify the playing position(s) that cause the least PRMDs. Finding the least intrusive set-up and having it become “standard” would be beneficial for the bassoon community and could possibly decrease the prevalence of PRMDs in the bassoon player population.

## **6.2 Detailed Future Studies**

In future studies, the type of PRMD symptom(s) in each body location should be recorded. The *IBQ* did not record the symptom type because that level of detail would have made the online questionnaire overly complicated, especially since one location can

have more than one symptom. It was more important to gain a large sample size and establish a good base for future research. However by not having the type of symptom (or symptoms) reported in each location the information gained is limited.

The limitation of not having the symptom reported alongside the location was noticeable in the mouth region. Only 10% of bassoon players reported embouchure PRMDs. In a free-response question in the *IBQ* some players wrote-in the diagnosed condition of “non-occlusion of soft palate.” It is unknown if these respondents marked locations for this symptom on the body part diagrams. Respondents may not have attributed the internal working of the mouth with the embouchure area. In future studies it would be beneficial to have a more detailed head region to account for internal issues like the soft palate and tongue.

If symptom and location information were recorded together PRMD rates would be clearer. In the *IBQ* some respondents reported a symptom, but no location or (less frequently) only a location and no symptom. Because the two were separated on the questionnaire, this confusion was possible. The result was two different sets of PRMD data. Eighty-six percent of bassoon players reported diagnosed injuries or PRMD symptoms while only 77% of bassoon players reported specific locations. Providing location information was detailed, time consuming and later in the questionnaire. It is probable that since players wrote in where they experienced PRMDs (question 14, page 5), they did not take the time to provide location information (questions 15-26), which also included a lengthy duration component (Appendix E). The symptom data, including frequency and severity, is believed to be more accurate because it was acquired from

questions that were at the beginning of the lengthy survey. The symptom data was also obtained through questions that were easier to answer, because they were simpler. Respondents were asked if they had “pain” and had the choice of “yes” or “no.” The location questions were a lot more complicated with six possible durations to consider for each of the 48 locations. This difficulty was not illuminated in the pilot tests. Any future studies should take heed from the *IBQ* that separating symptom and location might cause analysis difficulty. In this thesis the PRMD symptoms (including frequency and severity) are used throughout as the defining statistics.

### **6.3 Gender Inequity**

Middlestadt and Fishbein reported that:

As the size of the string instrument increases from violin to viola to cello, so does the vulnerability of women with respect to severe musculoskeletal problems at the hand and wrist (Middlestadt and Fishbein 1989, p.46).

Middlestadt and Fishbein’s conclusion applies to other instruments as well. As the size of the instrument increases, female performers are more vulnerable to injury. Bassoon is the largest woodwind instrument; female bassoon players presented with PRMDs in overwhelming numbers (96%). Female bassoon players reported more PRMDs in all body areas than males, but the statistically significant regions were the hands and arms/wrists. As Middlestadt and Fishbein reported in string players, the hands and wrists were most affected by the size of the instrument. The prevalence of PRMDs in the hands and arms/wrists of female bassoon players illustrates that the increase in PRMDs in females, in relation to an increase in instrument size, may not be limited to string instrumentalists.

Female bassoon players are at greater risk for injury. Females reported more diagnosed conditions (44%) than males (22%). Females reported a higher occurrence and severity of pain than males. Not only were females reporting more occurrences of PRMDs, females also experienced PRMDs in more body regions than males. In the literature, males have been diagnosed with more specific injuries, such as carpal tunnel and tendinitis (Burkholder and Brandfonbrener 2004). The *IBQ* disputes this with females reporting more diagnosed injuries. The *IBQ* does support an aspect of the previous research showing that males presented with single region condition while females present with wider region PRMDs. Diagnosed conditions are usually located in one body area (such as the wrist/arm area for carpal tunnel), whereas PRMDs are not location specific. Females reported multiple body regions meaning they were not just exhibiting one injury, like carpal tunnel, in a specific area, but were instead experiencing widespread PRMDs. The bassoon has traditionally been viewed as a male instrument (Zervoudakes 1994; Green 1997); given the alarming rate of injury among female bassoonists perhaps there may be a physical reason for males to populate the field.

Females hid some of their injury history when responding to the *IBQ*. Only 96% of female bassoon players reported a specific injury diagnosis or PRMD symptom but 100% of female bassoon players reported a location where a PRMD occurred. Even though the female players had difficulty in a specific body location, which they disclosed, they did not consider it a symptom and report pain or any other PRMD type. Males on the other hand reported more symptoms (78%) than locations (60%). The *IBQ* reported that females felt the need to “hide [their] PRMDs/injuries from [their] colleagues” more frequently than males did. If females are hiding injuries from their

colleagues, are they also not disclosing the full extent of PRMDs to researchers? If that is the case, the rate at which female bassoon players experience PRMDs may be terrifyingly high.

Despite the alarmingly high PRMD rates females reported in the *IBQ*, males are more willing to try treatments. More males tried treatments (89%) than reported injuries (78%). Females reported more injuries (96%) than tried treatments (87%). The lack of treatment in the female bassoon population shows an unwillingness to fully disclose the condition and address it.

#### **6.4 Age Considerations**

The younger population (< 41) reported more PRMDs than older (> 42) players. The average age was younger for those experiencing PRMDs in all possible body locations. This information supports what other researchers have concluded: the younger demographic is more at risk to PRMDs (Fishbein et al. 1988; Dawson 2001b; Warrington et al. 2002; Abréu-Ramos and Micheo 2007). Though this is true, it must be treated with caution, as there was evidence in the *IBQ* suggesting that many of the older players who participated were enthusiastic amateurs and not professionals. Most of those participating in the *IBQ* were not professional symphony orchestra musicians, because few players reported over 50% of their income was from bassoon playing. An amateur may not have the same pressure to perform as a professional player. An amateur may not have to spend the time practicing. Time spent with the instrument was the most important contributing factor to PRMD development, so without knowing the number of hours spent with the instrument in a week, and in what context, this age difference must be treated cautiously. In future studies it is imperative to establish the

number of hours spent playing in a week, context of those hours, level of playing, stress/pressure while playing, and stage of the performer's career in order to more accurately assess an age difference in PRMD rates.

Bassoonists that reported multiple PRMD locations were younger than those that reported few locations. This could be because a player with multiple PRMDs locations in their younger years did not continue with the instrument and therefore did not participate in the study. The effect of PRMDs on musician attrition rate has not been widely investigated. Further studies should be conducted on the impact of PRMDs on those who chose to stop playing the bassoon.

A bassoonist's age influenced what he or she believed contributed to the development of PRMDs. The factors that bassoonists felt contributed to their PRMD development directly influenced how they rated the PRMD perception statements. For example, the older group (< 42) was more inclined to report that "life" factors influenced PRMD development. This corresponds with the older group also reporting a higher mean for "worrying will increase your chances of getting an injury," which would fall under the contributing factor of "stress in life (not bassoon)." A bassoon player's age influenced the contributing factors, which impacted on the perception statements.

## **6.5 PRMD Individuality**

PRMDs manifest as a different combination of symptom, location, and intensity for each bassoon player. One of the greatest difficulties in creating PRMD prevention strategies is addressing the individuality of the problem. Nowhere is this individuality clearer than in what bassoon players believe contribute to the development of PRMDs. Every one of

the 22 possible contributing factors had at least one bassoon player believing it was a “significant contributor” to the development of PRMDs. Conversely, every factor also had a least one player reporting it was “not applicable” to the development of PRMDs. If the survey included another 50 factors, the outcome would probably be similar. Each individual bassoon player had unique experiences that influenced what he or she perceived caused their PRMD. Bassoon players believed there are many contributing factors leading to the development of PRMDs.

The individuality of the PRMD experience can also be seen in the treatment options tried by bassoon players. Bassoon players were experimenting with multiple treatments. The bassoon playing community used no single treatment or practitioner overwhelmingly to alleviate PRMDs. Seventy-seven percent of bassoon players tried more than one treatment for PRMDs. Forty-six percent of bassoon players consulted with more than one professional for their PRMDs. When one treatment did not work, they would try another. The number of bassoon players that utilized multiple recovery options indicates that some practitioners and common treatments must not be successful with bassoon related PRMDs.

## **6.6 Treatment Shortcomings**

Bassoon players were not seeking professional medical help. With 86% of players reporting a PRMD, only 31% of bassoon players consulted with a medical doctor for assistance with their PRMDs. Overall, bassoon players reported that they did not feel that medical doctors had the knowledge to assist with PRMDs. Despite the growth in the field of performing arts medicine, bassoon players still believed the medical community was not addressing their needs. Back in Graffman’s time, doctors did not have much

information on PRMDs so musicians were often told to stop practicing until they felt better. Much has been learned about PRMDs since then. Outreach should be a focus of the performing arts medicine field to increase musician awareness of medical advances and the availability of assistance. The journal articles and textbook chapters illustrating the advances in the field are not reaching the average bassoon player. The Performing Arts Medicine Association should take the lead to expand outreach, so every bassoon player is aware of all the resources available in the fight against PRMDs.

Bassoon players are not taking advantage of the help that is available. Only 10% of bassoon players consulted more than four of the ten possible practitioners listed for PRMD management. Consulting only one practitioner was the most popular (24%). Each practitioner has a different paradigm to assist in the treatment of PRMDs. Therefore consultation with several practitioners may be of great benefit. Yet bassoon players were not spending the time or money to seek various professional opinions, which may help alleviate PRMDs.

Young musicians, who reported the highest rates of injuries, need to be encouraged to use alternative treatments. In the *IBQ*, the Alexander Technique was only being used by 11% of bassoon players even though “poor posture” was ranked as the 5<sup>th</sup> highest contributing factor to PRMDs. Ample information is available about the benefits of the Alexander Technique to musicians. The Alexander Technique is offered at many universities. However, some student musicians may neglect learning Alexander Technique because it requires time away from studying for their large class load. Students need to realize that PRMD prevention techniques are just as important as

practicing their instrument and getting a degree; this requires a shift in perception. Young musicians need to learn the importance of health and body maintenance to curb the large number of PRMDs in the early years. Establishing healthy patterns early in life may also increase the likelihood of a long-playing career.

There are numerous options available to musicians in the treatment, management and prevention of PRMDs. Because bassoon players experience such a wide range of PRMDs, there is not one option that works for all. Instead each bassoon player is going to have to try a multitude of treatment combinations, to find the one that works best for his or her body. Financial constraints may play a large role in why bassoonists are not using multiple options for the treatment and prevention of PRMDs. The most frequently consulted practitioners were the ones usually covered by health insurance. Yet some bassoon players are finding relief with non-medical practitioners. It is essential that musicians have health care plans that allow for the treatment of PRMDs outside of the traditional medical fields.

Bassoon players need to have more information about which treatments or practitioners are available to best meet their needs. They need to know more about what has worked for fellow bassoon players. They also need to know which treatments have been successful for other instrumentalists. In addition, knowledge of treatments that were effective for other instrumentalists, but were not successful in bassoonists would be beneficial. With the multitude of options available, bassoonists may have difficulty trying to find the correct treatment combination for their PRMDs. Without more

information guiding the road to recovery, a lot of time and money could be wasted. Bassoon players need more information when selecting treatments.

## **6.7 New Perspectives**

“No pain, no gain” has been the attitude of musicians (Shoup 1995). Pain was overwhelmingly the most common PRMD reported by bassoon players (78%). Pain was also the most severe PRMD reported. Despite the relevance of pain among bassoon players, many do not believe that “playing in pain is part of being a musician” ( $M = 2.02$ ,  $SD = 0.77$ ). Only 2% of bassoon players accepted the “no pain, no gain” philosophy, while 27% “strongly” disagreed with it. This old misconception is being replaced by a healthier perspective, that pain is not a necessity in a musician’s life.

It has been suggested that musicians may not have taken part in research and reported PRMDs because they felt responsible for their own injury (Brandfonbrener 1991). The musician felt that if they were a better player and had better technique, they would not be injured. On the contrary, the *IBQ* found that bassoon players were not blaming themselves for their injuries. The *IBQ* found that bassoon players thought “technical” considerations, such as poor technique, were the least influential overall factors to PRMD development. Instead they felt that “time” spent with the instrument, “physicality” of the instrument, and “life” stressors were more influential. Bassoon players felt that “inadequate chairs” were more influential to PRMD development than “technique flaws.” The bassoon community did not blame themselves for injuries, but looked for other factors that contributed to the development of their PRMDs.

The “technical” side of bassoon playing was reported as the least influential to PRMD development. Bassoon players reported that the other three aspects of playing (“time” spent with the instrument, the “physicality” of playing, and “life” aspects) were more influential than “technical” factors. The bassoon pedagogy mainly focuses on the technical side of bassoon playing. Yet, bassoon players agreed that “proper teaching” was a solution to PRMDs. The ideas that the “technical” side was least influential and that teachers could solve the PRMD crisis are in conflict with current practice.

Bassoonists were not the only musicians who felt “proper teaching” could solve their PRMD problems (Brandfonbrener and Lederman 2002). Bassoonists felt that how they were taught to play influenced their chance of incurring injury. They also felt that injury prevention was not properly taught. This may explain the high rates of PRMDs among bassoon players. The top seven contributing factors to PRMD development (“long hours of practice,” “sudden increase in playing time,” “insufficient rest breaks,” “ignoring increasing intensity of pain,” “poor posture,” “in adequate chairs,” and “stress in life”) are not currently a pedagogical focus.

The number one agreed upon statement by bassoon players was “it is important for teachers to address injury prevention in lessons.” The initial interpretation of this statement is for the teacher to address the technical side of playing and thus decrease tension. Technique and tension are important for a teacher to address, but the contributing factors reported in the *IBQ* encourage a new approach in teaching. Teachers need to spend more time instructing their students how to practice effectively. Effective practice habits that will limit the overall time spent with the instrument must be

emphasized. Requiring students to read books on proper practice habits may highlight the importance of “time” on PRMD prevention. Students practice routines need to be analyzed and adjusted to incorporate more time resting, stretching, and mentally practicing. Teachers need to enlighten their students on the benefits of slow practice, limiting needless repetition, and practicing only when fully concentrating. Finally, teachers need to do all of these things themselves and lead by example. The results from the *IBQ* encourage a shift in the pedagogy of the bassoon; with greater emphasis on effective practice habits limiting the overall time spent playing the bassoon.

Younger bassoon players reported more injuries. Younger bassoon players in the “learning” phase of their development are most influenced by a teacher. The younger demographic of bassoon players may not yet have learned how to practice effectively, so they spent more time with the instrument. This may be why they incurred PRMDs at a higher rate. Professional musicians usually figure out the best practice techniques over time; they had to learn how to most effectively use their practice time or they would not make it to the elite level. Those who have yet to discover their own most effective practice habits, are most at risk to PRMDs. Young players are most in need of a shift in bassoon pedagogy to emphasize proper practice techniques.

## **6.8 Conclusion**

Bassoon players experienced PRMDs at an alarmingly high rate. String and piano players can no longer be singled out as the “high injury rate” instrumentalists. The bassoon has many characteristics that make those playing it susceptible to injury. Bassoon players experienced a high rate of PRMDs and reported PRMDs in numerous body locations. Bassoonists experienced PRMDs in multiple body regions.

The difference in PRMD rates between male and female bassoonists was dramatic. Female bassoon players were experiencing PRMDs at an overwhelming rate. Females had more occurrences, higher severity, and experienced PRMDs in more body regions than male players.

Younger bassoon players reported PRMDs more frequently. The younger demographic also reported experiencing more types of PRMD symptoms and in more body locations than older bassoon players. Young bassoon players need more information about PRMD prevention earlier in their playing careers.

“Time” spent playing the bassoon was the factor believed to contribute most to PRMDs. Bassoon players considered “long hours” of practice to be the primary cause of their PRMDs. “Technical flaws” were no longer considered influential to PRMD development. This means bassoonists’ injuries are caused less by misuse and instead their injuries are occurring because of overuse. The bassoon pedagogy must shift in response to this change. Bassoon players need more information on how to practice in a way that is least damaging to the body. Teachers need to spend as much time addressing practice habits as they do addressing technical flaws. PRMDs are a staggering reality in the bassoon playing community. Bassoon players need to increase their knowledge about PRMDs and establish preventative strategies to curb the epidemic.

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