An investigation into performance related musculoskeletal disorders of professional orchestral string musicians in South Africa

By

Quinton Rolf Hohls

Dissertation submitted in partial compliance with the requirements for the Master's Degree in Technology: Chiropractic at the Durban University of Technology.

I, Quinton Rolf Hohls, do declare that this dissertation is representative of my own work, both in conception and execution (except where acknowledgements indicate to the contrary).

_____ _____.

Quinton Hohls **Date**

APPROVED FOR FINAL SUBMISSION

_____ _____

Dr. L. Wilson **Date**
M. Tech: Chiropractic C.C.E.P.

_____ _____

Dr. A. Ross **Date**
M.Tech: Homoeopathy, B. Mus. (Cum Laude)

Dedication:

If it were not for my family, I would be nothing.

To my parents, who allowed me to be a free thinker and explore the world with an open heart, giving constant guidance and words of encouragement; without whom, my life's journey thus far, would have been impossible. To my sisters, I could not have asked for better role models, your lives have been a constant inspiration in every aspect of mine; for this I am eternally grateful.

May we all continue to inspire each other…

Acknowledgements:

My deepest respect and thanks go out to the following:

Dr Laura Wilson; your patience and guidance throughout this experience has been unwavering. You allowed me great freedom and expression in very tight guidelines. It has been a privilege to work with you.

Dr Charmaine Korporaal; your constant support and silent contribution in those desperate times pulled me through when I thought I could no longer continue.

Dr Ashley Ross; for lending your musical ear and giving that specialist view from the orchestral side.

To my mentors, Professor Nirusha Lachman, Professor Hoosen Vawda and Dr Myron Schultz; you all drove me to be the best that I could be, and lead as examples in a challenging academic environment. May we continue to work together far into the future.

The Durban Chamber Choir and Dr L.M. Jakobs; for your assistance so early in this project.

To the KZNPO, CPO and JPO; your participation in this study is greatly appreciated.

Rolf and the rest of my Joburg family; for standing by me every step of the way, always calling for updates and offering a sympathetic ear. My times spent with all of you deeply enriched my view of the world, and allowed me to grow as a person.

“Zu meine liebe Nics”…words cannot describe what a profound effect you have had on every aspect of my life. May our path together in this world and others, never be far apart.

My music teachers, especially Tante Edeltraut Johannes and Annien van der Linde. My love for music was gained through your passion and love for teaching, and sharing the magic that is music.

Colin, Claire and Nannick; for being with me every step of the way, the many hours spent together around meals and laughing on the stoep, kept my brain constantly challenged and my drive to succeed even higher.

To all my Chiro, Homeo and Digs mates. It’s been one hell of a ride, filled with unbelievable memories and the development of incredible friendships. Durban became home purely through my experiences with all of you; the laughter, the tears and those moments we were surprised to come out alive, it has been awesome! You may be seated…

Abstract

Background:

Professional orchestral string musicians are exposed to many physical and psychological stressors due to demands placed on them from playing their instruments. The prevalence of performance-related musculoskeletal disorders (PRMD's) in this highly skilled group of individuals has been investigated internationally, consistently showing a high injury rate. There is however, a paucity of literature documenting the prevalence of musculoskeletal injuries in South African professional orchestral string players.

It is hypothesized that South African trained orchestral string musicians may be at a greater risk for PRMD development due to the unique training and performance environments encountered in this country.

Objectives:

This study aimed to determine the demographic and injury profile; prevalence rate of current injury and risk factors for musculoskeletal injury in South African professional orchestral string musicians.

Method:

The study utilized a self administered quantitative questionnaire distributed to all string players in the three professional orchestras in South African in a semi-supervised fashion. SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA) was used to analyze the data. A p value < 0.05 was considered as statistically significant.

Results:

There were 27 respondents, with the average participant being a Caucasian, right handed, non-smoking female, 37.11 years of age, 1.5631 meters tall, with a weight of 62.96 kilograms (BMI = 25.768) who exercised regularly (primarily in the gym). A bachelors degree in Music was the most commonly awarded qualification, obtained between the years 2000 and 2009, from a University outside of the Republic of South Africa.

The prevalence of PRMD's in the sample was 63% (n = 17), with a 95% confidence interval of 42.4% to 80.6%.In this study there was a high rate of injury (6.53 PRMD's per player over a 12 month period), equating to 111 reported injuries in a population of 27 string players. The upper back (defined as the area between the shoulder blades) was the most commonly injured part of the body (77.8%, n = 21), followed by the upper extremity, mainly the shoulder (70.4%, n = 19).

No statistically significant relationships were found in determining and confirming expected risk factors in the string players.

Conclusion:

Professional orchestral string musicians in South Africa suffer from a high rate of injury which is comparable to international studies of the same nature

Key Words:

string musicians, orchestral musician injuries, performance/playing related musculoskeletal disorders

Table of Contents:

Dedication i

Acknowledgements ii

Abstract iv

Table of Contents vi

List of Tables xv

List of Figures xvii

Lists of Appendices xix

Definition of Terms xx

Chapter One - Introduction

1.1 Introduction 1
1.2 Aims of the study 4
1.3 Objectives of the study 4
1.4 Rationale behind the study 4
1.5 Limitations of the study 6
1.6 Conclusion 6

Chapter Two – Literature Review

2.1 Performance related Musculoskeletal Disorders 7
2.2 String Musicians and Performance related musculoskeletal disorders 9
2.2.1 Prevalence of injury in the strings component of orchestras 9
2.2.2. Area of injury in professional performing string musicians 9

2.2.3 Common Diagnoses made in Professional Performing String Musicians 12
2.2.3.1. Overuse syndrome 12
2.2.3.2 Temperomandibular joint disorders 14
2.2.3.3 Entrapment Neuropathies 14
2.2.3.3.1 Median Nerve entrapment 14
2.2.3.3.2 Ulnar Nerve entrapment 15
2.2.3.3.3 Radial Nerve Entrapment 15
2.2.3.3.4. Cervical Radiculopathy 15
2.2.3.4 Thoracic Outlet Syndrome 15
2.2.3.5 Focal Motor Dystonia 16
2.2.3.6 Joint Hypermobility 16
2.2.3.7 Treatment of Injury 17
2.2.4 Instrument specific Performance Related Musculoskeletal Disorders 18
2.2.4.1 The Violin and performance-related musculoskeletal disorders 18
2.2.4.2 The Viola and performance-related musculoskeletal disorders 20
2.2.4.3 The Cello and performance-related musculoskeletal disorders 20
2.2.4.4 The Double Bass and performance-related musculoskeletal disorders 22
2.3 Risk Factors associated with Injury Development in the Professional Performing String Musician 23
2.3.1 Age 24
2.3.2 Age at which instrument is started and number of playing years 24
2.3.3 Gender 25
2.3.4 Smoking 26
2.3.5 Education 26
2.3.6 Specific education 29
2.3.7 Body habitus when practicing 29
2.3.8 Non-music related work 30

2.3.9 Professional Health Care 30
2.3.10 Stress 31
2.3.11 Warm-up and Cool Down 32
2.3.12 Carrying of the Instrument 32
2.4 Conclusion 33

Chapter Three – Materials and Methods

3.1 Study design 34
3.2 Study protocol and procedures 34
3.2.1 Advertising 34
3.2.2 Sampling method 35
3.2.3 Participant sampling 35
3.2.3.1. Population size 35
3.2.3.2 Allocation 36
3.2.3.3 Method 36
3.2.3.4 Sample Characteristics 36
3.2.3.4.1 Inclusion criteria 36
3.2.3.4.2 Questionnaires 36
3.2.4 Research procedure 37
3.2.4.1 KwaZulu Natal and Cape Philharmonic Orchestras 37
3.2.4.2 Johannesburg Philharmonic Orchestra (JPO) 37
3.3 Research tool 38
3.3.1 Questionnaire Development 38
3.3.1.1 Questionnaire background 38
3.3.1.2 Questionnaire contextualisation 39
3.3.1.3 Focus group discussion 40
3.3.1.4 Content Validity 41
3.3.1.5 Final Questionnaire 41
3.3.2 Measurement frequency 42
3.4 Statistical Analysis 42
3.5 Conclusion 43

Chapter Four – Results and Discussion

4.1 Introduction 44

4.2 Definitions of terms and key for symbols utilised in this chapter 44

4.3 Data 44

4.3.1 Primary Data 44

4.3.2 Secondary Data 44

4.4 Response Rate 45

4.5 Results 47

4.5.1 Objective one 47

4.5.1.1 Section A: Description of Self 47

4.5.1.1.1 Gender 47

4.5.1.1.2 Age, weight and height distribution 48

4.5.1.1.2.1 Body Mass Index 48

4.5.1.1.3 Ethnicity of Respondents 48

4.5.1.1.4 Country of Origin 49

4.5.1.1.5 Qualification obtained at a South African Institute 49

4.5.1.1.6 Institution within South Africa from which qualification was obtained 50

4.5.1.1.7 Countries in which Foreign Qualifications were obtained 51

4.5.1.1.8 Foreign Institution from which qualification was obtained 51

4.5.1.1.9 Highest Musical Qualification obtained 52

4.5.1.1.10 Category of Institution from which the highest musical qualification was obtained 53

4.5.1.1.11 Year in which the highest musical Qualification was awarded 53

4.5.1.1.12 Handedness of Respondents 54

4.5.1.1.13 Smoking status of respondents 55

4.5.1.1.14 Respondents engaged in Regular Physical Activity 56

4.5.1.1.15 Demographic average 57
4.5.1.1.16 Discussion 57
4.5.1.2 Section B: Musical Background 59
4.5.1.2.1 Question 1: Age at which the string musicians began to play any instrument 59
4.5.1.2.2 Question 2: First instrument played by the string musicians 59
4.5.1.2.3 Question 3: String Instrument currently played in the professional orchestra 60
4.5.1.2.4 Question 4: Starting age of current string instrument 60
4.5.1.2.5 Question 5: Other instruments played professionally 60
4.5.1.2.6 Question 6: Specific instruction on preventing physical injury related to playing a String Instrument 61
4.5.1.2.6.1 Professional from whom instruction was received 62
4.5.1.2.6.2 Type of instruction received (including duration) 63
4.5.1.2.6.3 Specific Technique Name 63
4.5.1.2.6.4 Technique change due to Specific Instruction 63
4.5.1.2.7 Question 7: Carrying of the Instrument 64
4.5.1.2.8 Summary of Musical Background (Section B) 65
4.5.1.2.9 Discussion 65
4.5.1.3 Playing Technique (Subsection of Section B) 68
4.5.1.3.1 Question 1: Technique change in the last 6 months 68
4.5.1.3.2 Question 2: Finger Isolation exercises 68
4.5.1.3.3 Question 3: Body habitus when practicing 69
4.5.1.3.4 Question 4: Warm-up without instrument before a practice session 69

4.5.1.3.5 Question 5: Warm-up exercises with the instrument before a practice session 70
4.5.1.3.6 Question 6: Physical cool down after practice 71
4.5.1.3.7 Question 7: Most common activity during rehearsal breaks 71
4.5.1.3.8 Summary of Playing Technique 72
4.5.1.3.9 Discussion 72
4.5.1.4 Section C: Occupational information 75
4.5.1.4.1 Question 1: Main profession as considered by the string musicians 75
4.5.1.4.2 Question 2: Number of years working as a professional musician 75
4.5.1.4.3 Question 3: Music teaching by the musicians 75
4.5.1.4.4 Question 4: Practical teaching 76
4.5.1.4.5 Question 5: Performance in other Musical Contexts 76
4.5.1.4.5.1 Hours of Performance in other Musical Contexts 77
4.5.1.4.6 Question 6: Non-music related work 77
4.5.1.4.7 Financial situations of string players 78
4.5.1.4.7.1 Question 7: Orchestral salary sufficient to cover monthly expenses 78
4.5.1.4.7.2 Question 8: Orchestral salary in addition to other income as sufficient 78
4.5.1.4.7.3 Question 9: Financial stress 79
4.5.1.4.8 Summary of Occupational average 80
4.5.1.4.9 Discussion 80
4.5.1.5 Objective One: Conclusion 81

4.5.2 Objective Two 82
4.5.2.1 Discussion 82

4.5.3 Objective Three 83
4.5.3.1 Question 1: Part of the body in which a playing related musculoskeletal disorder was experienced during the preceding 12 month period (December 2008 – December 2009) period. 83
4.5.3.1.1 The Upper Back (area between the shoulder blades) 85
4.5.3.1.2 The Shoulder or Upper Arm 87
4.5.3.1.3 The Neck 88
4.5.3.1.4 The Lower Back (small of back) 89
4.5.3.1.5 The Elbows or Forearms 90
4.5.3.1.6 The Hand 92
4.5.3.1.7 The Fingers 93
4.5.3.1.8 The Jaw 94
4.5.3.1.9 The Wrist 95
4.5.3.1.10 The Hips, thighs and buttocks 96
4.5.3.1.11 The Face 97
4.5.3.2 Question 2: Current injury 98
4.5.3.2.1 Worry of getting an Injury 98
4.5.3.3 Question 3: Playing related injury in the past of their professional career 98
4.5.3.3.1 Diagnoses given of injuries in the past (including duration of the problem, and how recently it occurred). 99
4.5.3.4 Question 4: Severity of current (worst) playing related problem 100
4.5.3.5 Question 5: Frequency of playing related problem affecting daily living and playing 100
4.5.3.6 Question 6: Consultation with a Health Care Professional 101
4.5.3.6.1 Health Care Professional consulted 101

4.5.3.7 Question 7: Diagnoses given by the Health Care Professional 102
4.5.3.8 Question 8: Treatment given for the most severe current problem 103
4.5.3.8.1 Medication/Remedies prescribed for use in injury as an adjunct for treatment of the most severe current problem 104
4.5.3.8.2 Other Treatments received in treating the most severe current problem 105
4.5.3.9 Questions regarding treatment 105
4.5.3.9.1 Question 11: Duration of playing time stopped due to injury 106
4.5.3.9.2 Question 13: Aspect of playing technique changed due to current injury 106
4.5.3.10 Questions 14 and 15: Factors believed to contribute to injury development. 110
4.5.3.11 Stress level before injury development 111

4.5.4 Objective Four 113
4.5.4.1 The average demographic profile of an injured professional string player in South African orchestras 113
4.5.4.1.1 Means of age, weight and height of respondents with current injuries 113
4.5.4.1.2Categorical demographic characteristics of respondents with Current injury 114
4.5.4.1.3 Average demographic profile of a string player with injury 117
4.5.4.2 Comparison of variables and current injury 117
4.5.4.2.1 Demographic means between those with current injury and those without. 118
4.5.4.2.2 Comparison of locally trained musicians to musicians trained at a foreign institute, and current injury. 119

4.5.4.2.3 Comparison of instrument played in the orchestra and current injury. 120
4.5.4.2.4 Comparison of how instrument is carried and current injury 121
4.5.4.2.5 Musical teaching in comparison to current injury 122
4.6 Conclusion 122

Chapter Five – Conclusions and Recommendations

5.1 Introduction 123
5.2 Conclusions 123
5.3 Recommendations 125

References 127

Appendices

List of Tables:

Table 2.1: Area of Injury in professional string musicians

Table 3.1: Total sample

Table 4.1: Age, weight and height minimum and maximum values for the respondents
Table 4.2: Race of respondents
Table 4.3: Country of origin
Table 4.4: Percentage of Respondants who qualified at a South African Institute
Table 4.5: Countries in which Foreign Qualifications were obtained
Table 4.6**:** Foreign Institution from which qualification was obtained
Table 4.7: Category of Institution
Table 4.8: Smoking status of respondents
Table 4.9: Number of cigarettes smoked per day
Table 4.10: Respondants engaged in Regular Physical Activity
Table 4.11: First Instrument played
Table 4.12: Significant change of technique in the last 6 months
Table 4.13: Areas of the body injured in the last 12 months
Table 4.14: Current Injury (including the last 3 months)
Table 4.15: Frequency of thought about developing an injury, if there is currently none
Table 4.16: Playing related injury in the past
Table 4.17: Past Injuries
Table 4.18: Severity rating of current (worst) playing related problem
Table 4.19: Frequency rating of playing related problems affecting daily living and playing
Table 4.20: Consultation with a Health Care professional regarding injury
Table 4.21: Diagnoses given by Health Care Professionals
Table 4.22: Treatment received for the most severe current problem
Table 4.23: Medication/Remedy
Table 4.24: Other Treatments

Table 4.25: Questions regarding treatment received
Table 4.26: Factors contributing to injury development
Table 4.27: Means of quantitative demographic variables in participants with current injuries
Table 4.28: Categorical demographic characteristics with Current injury
Table 4.29: Sports played by those with Current injury
Table 4.30: Comparison of means between those with current injury and those without
Table 4.31: Comparison of locally trained musicians to musicians trained at a foreign institute, and current injury
Table 4.32: Instrument played and current injury
Table 4.33: Comparison of how instrument is carried and current injury
Table 4.34: Musical teaching in comparison to current injury

List of Figures

Figure 4.1: Gender distribution of respondents
Figure 4.2: Institution in South Africa from which qualifications were obtained
Figure 4.3: Highest Musical Qualification obtained
Figure 4.4: Year of Qualification
Figure 4.5: Handedness of Respondents
Figure 4.6: Exercise types performed by respondants
Figure 4.7: Instrument currently played in the orchestra by frequency
Figure 4.8: Instruction on preventing physical injury related to playing a String Instrument
Figure 4.9: Comparison of locally trained musicians and musicians trained at overseas institutes with regard to education on injury prevention
Figure 4.10: Professional (in frequency) from whom instruction was received
Figure 4.11: Type of Instruction received (including duration)
Figure 4.12 Carrying of the Instrument
Figure 4.13: Practice of technical exercises specifically for Finger Independence
Figure 4.14: Warm-up without instrument before a practice session
Figure 4.15: Warm-up exercises performed on instrument before practice (by number of musicians)
Figure 4.16: Physical cool down after practice
Figure 4.17: Most common activity during Rehearsal Breaks
Figure 4.18: Number of hours per week engaged in Practical teaching
Figure 4.19: Number of hours per week performed in other Musical Contexts
Figure 4.20: Orchestral salary sufficient to cover monthly expenses
Figure 4.21: Orchestral salary in addition to other income as sufficient
Figure 4.22: Level of Financial Stress experienced by the musicians
Figure 4.23: Area of PRMD's in the body
Figure 4.24: Upper Back Injury by Instrument and Side
Figure 4.25: Shoulder or Upper Arm Injury by Instrument and Side
Figure 4.26: Neck Injury by Instrument and Side
Figure 4.27: Lower Back Injury by Instrument and Side
Figure 4.28: Elbow or Forearm Injury by Instrument and Side

Figure 4.29: Hand Injury by Instrument and Side
Figure 4.30: Finger Injury by Instrument and Side
Figure 4.31: Jaw Injury and Pain by Instrument and Side
Figure 4.32: Wrist Injury by Instrument and Side
Figure 4.33: Hip, Thigh or Buttock Injury by Instrument and Side
Figure 4.34: Facial Injury or Pain by Instrument and Side
Figure 4.35: Health Care Professionals consulted by the injured string player
Figure 4.36: Change in Technique due to current injury
Figure 4.37: Level of stress before injury development

List of Appendices:

Appendix A1 - Letters of Request and Response, KZNPO
Appendix A2 - Letters of Request and Response, JPO
Appendix A3 - Letters of Request and Response, CPO
Appendix B1 - Letter or Request and Response, Dr Christine Zaza
Appendix B2 - Playing-related Health Questionnaire, Dr Christine Zaza
Appendix B3 - Playing Related Musculoskeletal Questionnaire, Focus Group
Appendix C1 - Letter of information and Informed Consent, Focus Group
Appendix C2 - Focus Group Code of Conduct
Appendix C3 - Focus Group DVD
Appendix C4 - Summarised Focus Group Transcript
Appendix D1 - Post Focus Group Questionnaire
Appendix D2 - Post Ethics and Final Questionnaire
Appendix D3 - Letter of information (KZNPO and CPO)
Appendix D4 - Letter of information (JPO)
Appendix D5 - Ethics clearance certificate

Appendix E – Tables of no statistical significance:
Table E1: Comparison of demographic characteristics with Current injury
Table E2: Comparison of regular activity with current injury
Table E3: Comparison of instrument played in the orchestra and site of injury
Table E4: Comparison of musical background and current injury
Table E5: Aspects of playing that were changed after instruction
Table E6: Comparison of Playing Technique and Current Injury
Table E7: Comparison of Warm-up exercises performed before a practice session and current injury
Table E8: Comparison of performing a physical cool down after practice and current injury
Table E9: Comparison of the most common activity during rehearsal breaks and current injury
Table E10: Comparison of occupational information and current injury
Table E11: Comparison of means between those with current injury and those without

Definition of Terms:

Arpeggio:

A broken chord where the notes are played or sung in sequence, one after the other, rather than ringing out simultaneously (Kennedy and Bourne, 1996).

Bow:

A rod (usually wooden) with strung horsehair, stretched from end to end and is used in playing the violin, viola, cello and double bass (Kennedy and Bourne, 1996).

Bowed:

The most common method used in playing a string instrument, in which the horsehair of the bow is drawn across the strings of the instrument to produce a sound (Kennedy and Bourne, 1996). An up bow requires the bow to be drawn across the strings such that the frog nears the instruments strings, with a down bow resulting in the frog being pulled back away from the strings.

Chorister:

A musician who uses vocals to make music, as opposed to an instrument, and sings in a choir composed of groups of voices of varying pitch (viz. soprano, alto, tenor and bass) (Kennedy and Bourne, 1996)

Extrinsic hand muscles:

Muscles which have their origin distal to the hand region, however, their distal tendons attach to the hand, and result in movement of the hand (and occasionally wrist) joints (Moore and Dally, 1999)

Fifths:

Five whole tones apart, set at a specific frequency above middle C (440 Hz), a mathematically determined figure (Van der Linde, 2009).

Fingerboard:

Area on the neck of the instrument against which the strings are held down using the fingers, to produce differently pitched notes, according to the finger positioning (Kennedy and Bourne, 1996).

Finger Isolation Techniques:

Finger independence exercises are considered to be warm-up exercises, in which every combination of fingering and finger frames are repetitively done on every string. The exercises are done to stretch the interossei and lumbricals of the hand, as well as the tendons of the hand and fingers. The exercises additionally train the fingers to move quickly whilst maintaining flexibility (Van der Linde, 2010).

Frog:

The wooden base of the bow, in which the base of the horsehair is attached; and the area held by the musician when playing a string instrument (Kennedy and Bourne, 1996).

Harmonic:

Lightly touching the string with a fingertip at a harmonic node creates harmonics. Instead of the normal tone, a higher pitched note sounds. Each node is at an integer division of the string, for example half-way or one-third along the length of the string (Kennedy and Bourne, 1996).

Instrumental musician:

A musician who plays an instrument to make music, as opposed to using vocals (Kennedy and Bourne, 1996)

Intrinsic hand muscles:

Muscles which have their origin and insertion in the hand region (Moore and Dally, 1999).

Legato:

Music played in a smooth, flowing manner (Kennedy and Bourne, 1996).

Long Tone:

The use of the full bow in playing a note of extended duration (Kennedy and Bourne, 1996).

Musician:

A person skilled in the practice of music (Kennedy and Bourne, 1996)

Myofascial trigger point:

A hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction and autonomic phenomena (Travell and Simons, 1999).

Overuse syndrome:

“A painful condition brought about by long, hard use of a limb that is excessive for the individual affected, taking the tissues beyond their biological tolerance and causing some subsequent change or as a condition caused by tissues being stressed beyond their anatomic and physiological limits. The muscles are primarily affected, but some ligaments that take high loading may become involved, as well as the joint capsule and synovium. The predominant symptom is pain, which may be diffuse, and tenderness in a particular muscle group. There may be swelling, which will be localized to the muscle or musculotendinous unit. There may be weakness, and loss of fine motor control, but sensory changes are absent. The symptoms may be short-lived and only exacerbated by playing.” (Bejjani, 1996:407).

Performance-related musculoskeletal disorders (PRMD's):

The term PRMD's is used to refer to a host of musculoskeletal problems, and is defined as "pain, weakness, numbness, tingling or other symptoms from playing that interfere with [their] ability to play the instrument at the level [they] are accustomed to" (Zaza *et al.*, 1998). This excludes non-playing related injuries and mild aches and pains (Zaza *et al.*, 1998). For the purpose of this study the terms "performance related" and "playing related" will be used to describe the same PRMD's as defined above.

Phrase:

A musical phrase is a unit of musical meter that has a complete musical sense of its own, and combining to form melodies, periods and larger sections or the length in which a singer or instrumentalist can play in one breath (Kennedy and Bourne, 1996).

Pitch:

Degree of highness or lowness of a tone, determined by the vibrational frequency (Kennedy and Bourne, 1996).

Plucked:

A methodological variant of playing a stringed instrument, in which the bow is not drawn across the strings to produce sound, instead the strings are tugged at or snatched using the left hand, resulting in a distinct sound (Kennedy and Bourne, 1996).

Prevalence:

The number of cases of a disease existing at a particular time within a given population. (Razak, 2005)

Professional musicians:

Defined as musicians who play in professional orchestras that conduct regular practices, and public performances, as well as receiving professional remuneration (Yeung *et al.,* 1999).

Scale:

A group of musical notes collected in ascending and descending order, which provides material for, or is used to conveniently represent part or all of a musical work including melody and/or harmony. Scales are ordered in pitch or pitch class, with their ordering providing a measure of musical distance (Kennedy and Bourne, 1996).

Semitone:

Half a full tone (Kennedy and Bourne, 1996).

Shadow-playing:

A term introduced by Menuhin and relates to going through the physical motions of playing a piece without the instrument (Menuhin, 1986).

Shifting:

Changing position of the fingering (left) hand along the neck of the violin (Kennedy and Bourne, 1996).

String musicians:

Will be considered as the string musicians who play the violin, viola, cello and double bass. For purposes of this study, harp players will be excluded from the study as Wu (2007) recommends that studies of musicians should classify instruments by their broad nature of repetitive movements, and conduct separate analyses for each of these classifications.

Timbre:

Distinctive character of musical sound or voice, apart from its pitch and volume (Kennedy and Bourne, 1996).

Tremolo:

Very rapid repetition (typically of a single note, but occasionally of multiple notes), usually played at the tip of the bow (Kennedy and Bourne, 1996).

Vibrato:

This is a technique of the left hand and arm in which the pitch of a note varies in a pulsating rhythm. While various parts of the left hand or arm may be involved in the motion, the end result is a movement of the fingertip bringing about a slight change in vibrating string length (Kennedy and Bourne, 1996).

Visualization exercises:

They are designed to literally visualize the musical score without looking and may include the practice of writing down the musical score from memory (Dommerholt, 2009).

Musician:

A person skilled in the practice of music (Kennedy and Bourne, 1996)

Complementary and Alternative Medicine (CAM):

"Medical interventions not taught widely at U.S. medical schools or generally available at U.S. hospitals" (Eisenberg *et al*., 1993) or "those forms of treatment which are not widely used by the orthodox health care professions, and the skills of which are not taught as part of the undergraduate curriculum of orthodox medical and paramedical health care courses." (British Medical Association, 1993).

Chapter One: Introduction

The discussion in this chapter includes the background to the study, the rationale for the study, the aims, objectives, hypotheses and study limitations.

1.1 Introduction

“Musicians are the quintessential small-muscle athletes. To create the beauty that is music, musicians must decode complex symbolic representations of movement (notations), move primarily small muscles in exact and highly coordinated ways, time their movements with great precision, and monitor pitch, tone, blend, balance, timbre and volume” (Roehmann, 1991).

The high rates of physical movement required to execute a piece of music necessitate physical and physiological endurance, and high stress levels (Brandfonbrener, 1991). The capabilities and limits of each instrument are relatively constant, and are therefore, generally predictable. However, the musicians themselves are the most important and unpredictable variable because individuals are subject to many tangible as well as intangible stressors (Brandfonbrener, 1991).

A professional performing orchestral musician endures repetitive movements, static muscle loads, awkward playing postures, intense practice routines, demanding performance schedules, competitive pressures and exhausting travel schedules placing the musician at risk for injury (Yeung *et al*., 1999; Burkholder and Brandfonbrener, 2004). Thus, injury may result in a loss of practice, performance time and income (Yeung *et al.*, 1999).

In this context, a systemic review of the literature by Zaza (1998) found that the prevalence of playing-related musculoskeletal disorders (PRMD’s) in adult classical musicians is comparable to the prevalence of work-related musculoskeletal disorders for other occupational groups, with the prevalence of PRMD’s ranging from 39% to 87%, between 1980 and 1996. Yeung *et al*. (1999)

found a PRMD's prevalence of 64% amongst professional orchestral musicians in Hong Kong.

Wu (2007) recommended that studies of musicians should classify the instruments played by their broad nature of repetitive movements, and conduct separate analyses for each of these classifications, such as the strings, woodwinds and percussion instrument sections. In a study by Fishbein *et al.* (1988) on the International Conference of Symphony and Opera Musicians (ICSOM), it was found that string players had the highest prevalence of PRMD's (66%), with the neck and shoulder being the primary sites affected. Larsson *et al.,* (1993) similarly found that string players in music conservatories were especially vulnerable to injury, with 77% of participants reporting problems during playing. This was confirmed by Črnivec (2004) in a study on the Slovene Philharmonic Orchestra in which cellists and double bassists were most frequently affected by PRMD's, followed by violinists and violists.

String players are especially prone to injury due to the unnatural positions required for playing the instruments (Rush, 2003). This is stated in a comical way by Owen (1986) cited in Grindea (1987), "If someone walked around with his left shoulder raised, his neck twisted to the left and chin tilted down, and his left arm outstretched, palm upward, for six to eight hours a day for 20 years, he would assuredly develop marked and permanent postural deformities – even if he never played the violin!"

Although there are basic principles for positioning the instrument during string playing, the players are so varied, that general positioning guidelines do not apply to everyone. Players often contort their bodies to the instrument, instead of adapting the instrument to their own shape and size (Rush, 2003).

According to Wu (2007) a number of risk factors have been implicated in the development of PRMD's in professional orchestral musicians, of which the most statistically significant were gender (female), number of years playing experience, the type of instrument played, playing-related physical (long hours/over-practicing) and psychological stressors (self-pressure/academic), lack of

preventive wellness behaviours (taking breaks), and previous trauma. Zaza and Farewell (1997) noted that the best predictors of playing-related health problems were lack of warm-ups and break-taking, technically challenging pieces and preparing for performance.

Manchester and Park's (1996) case-controlled study found that the total hours of playing time per week and participation in Alexander-Feldenkrais lessons were both significant factors in increasing and decreasing the development of PRMD's, respectively. Yeung *et al.* (1999) found evidence that a change in playing habits and rest helped to ease the musician's discomfort.

To compound the increased risk for injury, musicians are also reluctant patients and fear treatment as they feel they risk temporary loss of income, or loss of employment, and worse, they feel treatment may threaten their ability to perform or result in impossible changes to their refined technique (Brandfonbrener, 1991). In general, there are strong contra-indications to operating on musicians, as the finesse required by an instrumentalist is hard to preserve (Kampmeier, 2000).

Kaneko *et al.* (2005) found that 53% of Brazilian symphonic orchestral musicians had received some type of orientation by way of education regarding the potential for playing related injuries as a professional musician. An informal interview was conducted by the researcher with the Durban Chamber Choir to determine the extent of such education in South Africa. The choristers had received their professional music training (Bachelor and Master in Music) at South African tertiary institutes between 1970 and 1995, with the exception of a PhD candidate, whose qualification was obtained at an American University. Of interest, was that none of the South African qualified musicians had received any training or information on work related injuries; however, the PhD candidate had receive such preventative training and information at the American institute.

This sentiment concurs with that of Dr. L.M. Jakobs who acknowledged that South African tertiary institutes provide little, if any, education in preventative techniques during their training. Dr. Jakobs further stated that South African institutes "coach rather than teach" their students, resulting in not enough

attention being paid to technique adaptation or poor technique, which could potentially result in injury. Dr. Jakobs concluded that “South African musicians struggle to compete on an international level, as they are not taught how to practise correctly; therefore they lack the all-round skills acquired abroad”. South African trained orchestral string musicians thus could be at a greater risk for injury and PRMD’s.

1.2 Aims of the study

The aims of this study were to determine the prevalence of performance-related musculoskeletal disorders and occupational risk factors in professional orchestral string musicians in South Africa.

1.3 Objectives of the study

Objective One: To determine the demographic profile of string players in South African Philharmonic orchestras.

Objective Two: To determine the prevalence of musculoskeletal injuries amongst the string players in South African Philharmonic orchestras

Objective Three: To determine the profile of musculoskeletal injuries amongst the string players in South African Philharmonic orchestras.

Objective Four: To determine the association of occupational history, risk factors and prevalence of injury amongst the string players in South African Philharmonic orchestras.

1.4 Rationale behind the study

Performing arts medicine deals with both the prevention and treatment of injuries and illness among performers (Brandfonbrener, 1991). Although performing arts medicine is a growing field, as noted by the establishment of the Medical

Problems of Performing Artists peer reviewed journal in 1986, the health problems of musicians remain under-recognized and under-researched (Zaza, 1998). There is currently a paucity of literature regarding PRMD's in South African musicians and it cannot be assumed that all populations are the same, (World Health Organisation, 2008) thus necessitating research of this nature in South Africa.

According to Ms A. Van der Linde, there is an existing shortage of professional string musicians in South Africa, therefore current professionals are not only involved in playing within a professional orchestral capacity, but also in teaching, private recitals as well as performing in other forms of musical entertainment.

Furthermore, Ms Van der Linde stated that in South African tertiary institutes, string players are required to become proficient in more than one field of performance, such as opera, symphonic music and solo performance, which is not the case in international institutes where individuals will be trained in one field of performance only, thus lessening the risk of repetitive strain injuries. This highlights the demands and stress that are placed on South African string musicians which may potentially make them more vulnerable to PRMD's.

According to Dr. L.M. Jakobs the curricula of South African musical tertiary institutes does not place much focus on performance related musculoskeletal disorders or their prevention. This study aims to determine if South African trained musicians have a higher rate of injury prevalence than those who are internationally trained.

Musculoskeletal injuries can affect the career and financial positions of active members of an orchestra (Bejjani *et al.*, 1996). Musculoskeletal conditions are potentially treatable by a number of medical professionals, including chiropractors, who have been recommended by Rush (2003) as providing relief for many musicians. This study will profile the injuries experienced by South African musicians and determine their risk factors, allowing clinical management of these patients to be informed and occupation orientated.

1.5 Limitations of the study

This study was limited to those injuries that were performance-related (defined by Zaza *et al*. 1998), and indicated as such in the distributed questionnaire. Therefore, it excluded musculoskeletal conditions from organic, systemic or traumatic causes.

The nature of a survey type questionnaire required that participants answered the questionnaire in an open and honest fashion, reflecting their reality at the time of completing the questionnaire. It is further assumed that respondents understand the questionnaire and the information that is required from them, as well as their honesty in answering the questions.

1.6 Conclusion

No instrumental musicians have been found to be protected from the possibility of performance related injury (Brusky, 2009). The researcher has been unable to identify literature regarding the prevalence of performance-related musculoskeletal injury amongst South African professional orchestral string musicians. Therefore this study aims to address the paucity in literature by determining the prevalence and risk factors of PRMD's in South African professional orchestral string musicians.

This chapter presented the background to the study as well as the aims and objectives. Following this, Chapter Two presents a review of the relevant literature, with Chapter Three presenting the materials and methods utilized in the study. Thereafter, Chapter Four presents the results obtained from the study, as well as a discussion of each result and how they compare with the results of other studies. Chapter Five presents conclusions drawn from the study, and provides recommendations for future studies.

Chapter Two: Literature Review

This chapter aims to provide the reader with information regarding the development of performance related musculoskeletal disorders (PRMD's) in professional orchestral string musicians, including associated risk factors and current trends in the literature relevant to PRMD's.

2.1 Performance related Musculoskeletal Disorders

Musculoskeletal disorders currently constitute the most frequently reported work related illness amongst all occupations (Pascarelli and Hsu, 2001). Zaza (1998) found that the prevalence of playing-related musculoskeletal disorders (PRMD's) in adult classical musicians is comparable to the prevalence of work-related musculoskeletal disorders for other occupational groups. Bejjani *et al.* (1996) noted that musculoskeletal conditions found in musicians were nearly all the same general cumulative disorders as in the general work force. However, their occurrence patterns as well as the impact on the life and livelihood of the professional musician was unique.

According to Bejjani (1993) musicians are generally a very highly motivated, goal orientated group of individuals for whom art takes precedence over their physical condition. Sadeghi *et al. (*2004) found that there was a high rate of cumulative traumatic disorders found in traditional Iranian instrumentalists, indicating that all musicians, whether trained in classical western instruments or traditional ethnic instruments are all at risk for developing musculoskeletal injuries.

Brusky (2009) stated that no instrumental musician has been found to be immune to the possibility of performance related injuries. When comparing professional and non-professional musicians (including students), Roset-Llobert *et al.* (2000) found that professional musicians had a greater injury prevalence (89.3%) than the non-professional musicians (72.1%). This indicates that all although all musicians are at risk for developing an injury, professional musicians are more at risk.

The term performance related musculoskeletal disorders (PRMD's) is used to refer to a host of musculoskeletal problems, and is defined by Zaza *et al.* (1998) as "pain, weakness, numbness, tingling or other symptoms from playing that interfere with [their] ability to play the instrument at the level [they] are accustomed to". This definition excludes non-playing related injuries and mild aches and pains (Zaza *et al.*, 1998). Their research also found that PRMD's may result in the development of chronic and disabling health problems that affect the whole person, physically, emotionally, occupationally, and socially (Zaza *et al.*, 1998).

The prevalence of PRMD's was found by Zaza (1998) to fluctuate from 39% to 87% between 1980 and 1996. Yeung *et al*. (1999) reported the prevalence of PRMD's amongst professional orchestral musicians in Hong Kong to be 64%. Roset-Llobert *et al.* (2000) found that of those Spanish Catalonian musicians who responded as having had a health related problem, 87.7% reported that the musculoskeletal system was the most frequently affected system. Therefore one can see that there is a high prevalence of PRMD's in geographically different orchestral populations.

When looking at the primary site for PRMD's to occur in general orchestral musicians, Hagberg *et al*. (2005) found, in recently qualified musical students (n= 407), the highest incidence rates of injury were reported for the neck (4.4) and the left shoulder (4.6) per 1 000 years of instrumental practice. Kaneko *et al*. (2005) studied professional orchestral musicians (n = 241) and found that the most common injury was to the left shoulder (14%) and the low back area (11.4%), with 6.6% complaining of neck pain.

When comparing musculoskeletal disorders amongst office workers to musicians, Schäcke *et al*. (1986) found that musicians had twice as many cervical spine problems as non-musicians. Schäcke *et al.* (1986) further found the lumbar spine (44%), shoulder and arms (28.5%), and thoracic spine (22%) as common sites of injury in a population of Berlin opera musicians. It can be extracted that the spinal column, followed by the upper extremity, were the most affected area amongst the general musician population.

2.2 String Musicians and Performance related musculoskeletal disorders

The string section of the 'standard' symphony orchestra consists of violin, viola, cello, double bass and harp. For the purposes of this study, string musicians will be considered as the musicians who play the violin, viola, cello and double bass. Harp players (and the rarely included guitar) will be excluded from the study as Wu (2007) recommends that studies of musicians should classify instruments by their broad nature of repetitive movements, and conduct separate analyses for each of these classifications. Both the harp and guitar are exclusively 'plucked' string instruments, whereas the string instruments included in the study are predominantly 'bowed' instruments.

2.2.1 Prevalence of injury in the strings component of orchestras

Several authors (Caldron *et al*. (1986), Lockwood (1988), Manchester (1988), Fishbein *et al.* (1989) and Manchester and Flieder (1991)) found that the string section in an orchestra was the most vulnerable to injury. Larson *et al.* (1993) found that 77% of string players in music conservatories reported problems during playing. This was confirmed by Črnivec (2004) in a study on the Slovene Philharmonic Orchestra in which cellists, double bass and harpists were most frequently affected by PRMD's, followed by violinists and violists. Heming (2004) however found that in a general musician population (n = 59) the upper strings (the violin and viola) were more commonly affected.

The current literature therefore indicates that, in comparison to other instrumental groups, string players are most often affected by PRMD's.

2.2.2. Area of injury in professional performing string musicians

Several studies, as represented by Table 2.1, have addressed the area of injury in musicians, some of the studies looked only at string musicians whereas others

looked at general musical populations and the string information has been extracted for representation in the table.

Table 2.1 Area of Injury (by percentage) in professional string musicians, as reported in prevalence studies:

Reference	Instrument groups	Sample	Upper extremity	Lower extremity	Axial skeleton
Fishbein *et al*. (1988)	Strings only	n = 1378	Shoulder: 30 Elbow: 12 Forearm: 11 Wrist: 14 Hand: 18 Fingers: 16	3	Neck: 28 Thoracic: 31 Low back: 26
Manchester and Flieder (1991)	General orchestral population with strings extracted	n = 114	Shoulder: 22.2[1] and 20.6[2] Elbow: 5.6[1] and 13.2[2] Forearm: 22.2[1] and 19.1[2] Wrist and Hand: 44.4[1] and 40.9[2]		
Yeung *et al*. (1999)	Strings only	n = 25	Shoulder/Upper arm: 52 Elbow/Forearm: 20 Wrist/Hand/Fingers: 20		Jaw: 8 Neck: 32 Thoracic: 28 Low back: 16
Roset – Llobert *et al*. (2000)	Strings extracted (professional and amateur)	'n' for strings not given	Upper Extremity: Left: 51.9 Right: 38.3 Trapezius muscle: Left: 30.6 Right: 27.9		Cervical: 7.5 Thoracic: 34.4 Lumbar: 27.9
Črnivec (2005)	Strings only	n = 70	Shoulder: 33[1] Forearm: 3[1] Wrist: 13[1]		Neck: 27[2] Thoracic: 9[2] Low Back: 30[1]
Abreu-Ramos and Micheo (2007)	Strings only	n = 83	Shoulder: 43[1] and 52[2] Elbow: 7[1] and 17[2] Wrist: 14[1] and 28[2] Hand: 29[1] and 24[2] Fingers: 15[1] and 28[2]		Mouth: 8[2] Neck: 29[1] and 66[2] Thoracic & Low Back: 93[1] and 76[2]

[1]Cellists and Double Bassists
[2]Violinists and Violists

In Table 2.1 the regional areas assessed were the upper extremity, lower extremity, the spine and the head and neck area, with the most common area of injury being the upper extremity and the spine.

Abréu-Ramos and Micheo (2007) and Bejjani *et al*. (1984) found back pain to be the most common complaint amongst all string players, with both studies having found the highest prevalence rate of back disorders amongst the cello players.

Črnivec (2004) found that cellist and double bassists were more frequently affected in the shoulder and low back, with violinists and violists having more pain in the neck. Similarly, Zaza and Farewell (1997) found that musicians with a string instrument as main instrument had 1.96 times higher incidence for cervical pain when compared to pianists. The position of the head and neck required to play the violin and viola (discussed in section 2.2.4.1) predisposes the musicians to pain in this region of the body.

In contrast, Burkholder and Brandfonbrener (2004) and Miller *et al*. (2002) found the upper extremity as the most common injury location. Hagberg *et al.* (2005) also found a high incidence of pain in the right shoulder in string players. Hagberg *et al*. (2005) additionally found that musicians with a string instrument as their main instrument had four times the incidence of right elbow/ forearm disorders and twice the incidence left elbow/forearm disorders compared to musicians who had piano as the main instrument.

Bejjani *et al.* (1984), found a 77.5% prevalence of upper extremity disorders in professional musicians serious enough to significantly impair performance. The lowest prevalence of upper extremity disorders was found in violin players, with the highest prevalence of upper extremity disorders found in double bass players.

Fry (1986) found that in the general musician population, pain was experienced most frequently in the hand and wrist (41%). Dawson (2005) mentions that in the case of plucked strings and upper bowed strings, making music requires multiple rapid, repetitive, and often forceful movements by many small hand muscles whose strength and power are significantly less than the larger muscles, thus placing intrinsic muscles at risk for injury. An incidence study by Manchester and Flieder (1991), revealed 8.5 hand injuries per 100 students majoring in performance, with a greater incidence being found amongst string players

The left fingers are involved with making the various notes by compression of the string onto the fingerboard. Thus the fingers are moved at very high speeds and in a repetitive manner, potentially placing them at risk for injury. This was confirmed by Fishbein and Middlestadt (1988), Fry (1988) and Manchester (1988).

It can thus be seen that the literature varies with regards to the most common area of injury; with the upper extremity (especially the shoulder) and the spine (neck in violin and viola players; and low back in cello and double bass players) being the most commonly reported areas of injury in the string component of an orchestra.

2.2.3. Common Diagnoses made in Professional Performing String Musicians

PRMD's can present with the following diagnosis:

2.2.3.1. Overuse syndrome

This is the most prevalent medical problem among musicians, due to the repetitive movements of playing, coupled with the prolonged effort of bearing the weight of the instrument in an awkward position (Bejjani *et al.*, 1996). Heming (2004:56) defined it as episodes of micro-trauma to muscle and joint ligaments, resulting in chronic inflammation and fibrosis as connective tissue is slowly taken beyond its biomechanical and physiological limits resulting from overload and repetition of movements.

Overuse syndrome is prevalent in up to 50% of professional symphony orchestra musicians, of which the most severely affected are the string instrumentalists (Fry, 1986). Patterns of involvement however, vary with the size, weight, and playing position of the instrument, and the technical demands of the repertoire (Bejjani *et al.*, 1996).

Fry (1986) noted that the overuse syndrome is often misdiagnosed as a tendonitis or tenosynovitis, which Davies (2002) points out, may involve symptomatic myofascial trigger points that can develop even after brief periods of playing.

Moore *et al.* (1991) explained that there are two different mechanisms that have been theorised which highlight why string players are more at risk of developing or being diagnosed with overuse syndrome. The first considers injury to muscle under static (low-level repetition) low-level loads. This is common in the proximal joints of the upper limb as they work as essential fixators, holding the hands, fingers and instrument in the correct position. For the majority of string instrumentalists, the weight of the instrument is supported in whole or part by their left shoulder, in a relatively static position.

The second proposed mechanism is injury to other structures, such as tendon sheaths, under high repetition activities (Moore *et al.*, 1991). This occurs directly in the fingers and the muscles that move them. Playing stringed instruments requires strength and force to hold down the string, followed by rapid release to move to the next note position. This often involves a change in wrist position as well as movement up and down the neck of the instrument, initiated at the elbow joint (Van der Linde, 2009).

According to Bejjani *et al.* (1996) the only effective treatment for the overuse syndrome, since its recognition in the 19th century, has been rest from aggravating activities. This method of treatment was confirmed by Roset-Llobert *et al.* (2000) as the principal remedy employed in treating musicians in Catalonia (Spain). However, a regimen of extended total rest is not only unrealistic (financially and in terms of performance) but it also predisposes the musician to a recurrence of injury (once playing is resumed) or the development of secondary injury, such as muscle atrophy and bone wasting (Bird, 1992).

2.2.3.2 Temperomandibular joint disorders

Temporomandibular disorders are most prevalent among players of the violin and viola as the instrument is held between the left supraclavicular fossa and the chin, using a shoulder rest and chin pad. This may result in an overuse syndrome or myofascial pain dysfunction with or without articular derangements (Taddey, 1992). This is due to the effects of pressure on the mandible, clenching of the muscles of mastication, and transmitted vibrations from the instrument.

2.2.3.3 Entrapment Neuropathies

Musicians are at a high risk for developing entrapment neuropathies, with prevalence rates between 15% (Hochberg *et al*., 1983) and 22% (Lederman, 1993). This is of concern because musicians are especially sensitive to neurological dysfunction, even to mild deficits, as their ability to perform becomes affected (Bejjani *et al.*, 1996).

2.2.3.3.1 Median Nerve Entrapment

The most common area of median nerve entrapment occurs in the carpal tunnel resulting in Carpal tunnel syndrome (Hochberg *et al.*, 1983). Other sites of median nerve entrapment include the pronator teres or the fibrous arch forming the proximal edge of the flexor digitorum superficialis (the pronator syndrome). This is common in musicians due to the repetitive pronation required in playing an instrument (Lederman, 1986). Anterior interosseous nerve compression can occur due to over-developed forearm musculature; and specifically in string players, the digital nerves may become entrapped by gripping the bow too tightly (Lederman, 1986)

2.2.3.3.2 Ulnar Nerve Entrapment

The second most common entrapment neuropathy amongst musicians, involves the ulnar nerve (Lederman, 1986). Nerve damage can be sustained due to the repeated flexion and extension of the elbow as it passes through the two heads of the flexor carpi ulnaris in the cubital tunnel, or in the bony sulcus between the medial humeral epicondyle and the ulnar olecranon process. Lederman (1993) found this to be confined to the fingering arm of string players. Lambert (1992), however, found this in the bowing arm of string players.

2.2.3.3.3 Radial Nerve Entrapment

The posterior interosseous branch of the radial nerve may become entrapped in the Arcade of Frohse, causing symptoms in the left extensor forearm of violinists (Maffulli, 1991). Repeated forced supination may also compress the sensory recurrent epicondylar branch of the radial nerve, as well as the deep branch, resulting in a syndrome appearing as lateral epicondylitis with wrist drop (Sandin, 1989).

2.2.3.3.4. Cervical Radiculopathy

Lederman (1986) found a cervical radiculopathy prevalence of 3% in instrumentalists with performance related symptoms. This is found primarily on the left side of violin players (Rozmaryn, 1993) due to the position of the head when playing.

2.2.3.4 Thoracic Outlet Syndrome

Lederman (1986) found a 12% prevalence of thoracic outlet syndrome, in which the patients had primarily sensory symptoms, with minimal or absent motor or sensory signs or electrodiagnostic findings. There was no correlation found between diagnosis and the instrument played.

2.2.3.5 Focal Motor Dystonia

Focal motor dystonia, commonly referred to as musician's dystonia, is a task-specific movement disorder, which manifests itself as a loss of voluntary motor control in extensively trained movements, also called violinist's cramp, but may occur in other musicians. This involuntary muscular contraction may become apparent only during playing, but in advanced cases may occur at rest (Lederman, 1988). In many cases, the disorder terminates the careers of affected musicians. Approximately 1% of all professional musicians are affected (Altenmueller and Jabusch, 2009).

Altenmueller and Jabusch, (2009) stated that previously, focal motor dystonia was classified as a psychological disorder. Over time, the problem was classified as a neurological problem. Although the specific pathophysiology of the disorder is still unclear, it appears the etiology is multifactoral.

2.2.3.6 Joint Hypermobility

Bejjani *et al.* (1984) examined whole-body joint mobility in musicians and non-musicians and found joint hypermobility to be similar between instrumental musicians and non-musicians. However, Lederman (1988) found that 21% of musicians with laxity of one or more hand joints presented with technical problems while playing.

Excessive joint laxity results in instability of a loaded joint, and can contribute to the development of traumatic synovitis in instrumentalists (Lambert, 1992). In musicians this most often occurs at the metacarpophalangeal (MCP), interphalangeal (IP), and wrist joints (Hoppman and Patrone, 1989). Capsular laxity can lead to recurrent joint subluxation, which is disruptive to performance (Lambert, 1992).This is common at the temporomandibular joint of hypermobile violinists and violists (Sataloff *et al.*, 1991).

Nolan (1989) describes acquired ligamentous laxity, due to chronic ligamentous stress, in the first MCP and carpometacarpal (CMC) joints of upright string player. It is noted that the mechanical disadvantage of the thumb placement in string playing, transmits twelve times the force from the tip to the CMC joint. As laxity

develops, greater reliance is placed upon the intrinsic thenar muscles to provide dynamic stabilization of the joint, leading to fatigue, pain and spasm.

In the available literature, most studies focus on the upper extremity as an area of injury. There appears to be a literary paucity regarding injury of the neck, upper back, lower back, and lower extremity studies despite the prevalence of injuries in these areas.

2.2.3.7 Treatment of Injury

For the treatment of musculoskeletal conditions in musicians, Fry (1986) developed a regimen of strict rest from any physical activity, followed by extremely slow and gradual rehabilitation. However, total treatment and rehabilitation time may take 6 to 18 months. Norris (1993) recommended relative rest and relief from the stresses of activities of daily living, also noting that adjustment to the instrument (shoulder and chin rest, instrument position) could relieve playing stressors. Chong *et al*. (1989) cited rest and splinting, supplemented with the use of ice, and non-steroidal anti-inflammatory agents in anti-inflammatory doses.

Techniques which reported the greatest pain reduction, as reported by musicians in the Kaneko *et al*. (2005) study included stretching, rest, massage and use of medication. Abréu-Ramos and Micheo (2007) found that rest, posture change, and stretching were the most commonly reported alleviating factors after development of musculoskeletal symptoms.

2.2.4 Instrument specific Performance Related Musculoskeletal Disorders

The violin (played by first and second violin players) is an instrument with four strings tuned in perfect fifths and it is the smallest and highest-pitched member of the violin family of string instruments (Katz, 2006). The viola is the middle voice of the violin family, between the violin and the cello. The viola is tuned to a perfect fifth below the violin, and has a nearly identical playing position (Lamb-Cook and Lamb, 2001). A "full-size" viola's body is longer than the body of a full-size violin; and viola bows are also heavier than violin bows (Lamb-Cook and Lamb, 2001).

The cello is the lowest-pitched instrument of the violin family and the second largest bowed string instrument in the modern symphony orchestra (Mattlin, 2007). An average cello bow is shorter than a violin or viola bow and slightly heavier than a viola bow (Mattlin, 2007). The double bass is the largest and lowest-pitched bowed string instrument (Lamb-Cook and Lamb, 2001).

2.2.4.1 The Violin and performance-related musculoskeletal disorders

For a violinist to play one of Handel's Messiah movements, the musician is required to bow 740 times in two minutes; this indicates the high level of stress placed on the musicians body when performing or rehearsing (US Department of Labour, 2007).

The violin can be played in the seated or standing position. The instrument is placed onto a raised left shoulder, with the instrument supported on the left supraclavicular fossa. There is left rotation and lateral-flexion of the head, abduction and full external rotation of the left arm, left forearm supination with finger flexion at the metacarpal and interphalangeal joints (Berque and Gray, 2002).

The right shoulder is dropped, with internal rotation and abduction of the bowing arm with forearm pronation (Berque and Gray, 2002). The bow grip requires the thumb to be bent in the small area between the frog and the winding of the bow. The other fingers are spread somewhat evenly across the top part of the bow in relaxed flexion (Lamb-Cook and Lamb, 2001).

When playing the violin the left shoulder is often elevated for long periods with the left chin and jaw bearing down on the instrument to allow the left hand to move freely over the finger board. This state of static contraction promotes myofascial neck pain, dysfunction of the temporomandibular joint and thoracic outlet syndrome (Travell, Simons and Simons, 1999). Also, the tendency to look at the fingers causes increased neck tension on the left side and can contribute to these problems (Chong *et al.*, 1989, Berque and Gray, 2002).

The tilting of the head to the left, accompanied by left rotation of the cervical spine, and elevation of the left shoulder, induces a scoliotic curve of the thoracic spine with a resultant preference to carry the weight of the body on the right foot. This in turn induces a downward shift of the left pelvis and a scoliotic curve of the lumbar spine (Kapandji, 2000), thus increasing the possibility of low back pain.

The left wrist and forearm muscles are used more than any other muscles for producing the notes and vibrato. Violinists with forward head posture and poor axial extension may have difficulty with prolonged bowing and with positioning the fingers of the left hand in the strings, due to excessive internal rotation of the left arm (Kapandji, 2000). Often the left wrist is flexed as the fingers curl to apply pressure to the strings. This is the classic position to induce carpal tunnel syndrome and may promote flexor carpi ulnaris tendonitis and ulnar nerve entrapment at the elbow and wrist (Chong *et al.*, 1989). Experienced violinists may display greater range of motion of their left hand when compared to the right, which most likely can be attributed to functional adaptation (Ackermann and Adams, 2003).

The right hand holds the bow, in which there is a sustained state of abduction and flexion of the right shoulder which can result in rotator cuff tendonitis if tension is not released (Chong *et al.*, 1989). Fjellman-Wiklund and Sundelin, (1998) found that the upper arm was elevated 30-90º during a fourth of a violinists working day, thus increasing the risk for injury.

Some large orchestral works lasting well over one hour require prolonged periods of tremolo, in which the neck, shoulder-girdle complex, and wrist flexors and extensors are held in a state of isometric contraction as the bow is moved up and down a few centimetres very rapidly. The quick back and forth movements of the wrist required for sustained tremolo can result in overuse injury of the extensor carpi radialis and flexor carpi ulnaris muscle-tendon units. Occasionally the ulnar nerve can be compressed in Guyon's canal. Passages requiring rapid changes over the four strings of the instrument may strain the rotator cuff, deltoid, and pectoralis muscles (Chong *et al.*, 1989). Ackermann and Adams (2003) mention abductor digiti minimus and dorsal interosseous muscle strains as additional injuries of the violin player.

2.2.4.2 The Viola and performance-related musculoskeletal disorders

While body positioning is similar to the violin, playing the viola requires wider-spaced fingerings, and the thicker strings used in a viola, necessitate increased pressure with the bow to make the required sound (Lamb-Cook and Lamb, 2001).

Disorders suffered by viola players have been found to be similar to violin players, due to their similar playing position (Chong et *al.*, 1989). However, if changing from a violin to a larger viola, shoulder abduction increases while playing, which can cause significantly higher intramuscular pressure of the supraspinatus muscle, and thus result in impaired circulation and chronic muscle damage (Jarvholm *et al.*, 1991 and Palmerud *et al.,* 2000).

2.2.4.3 The Cello and performance-related musculoskeletal disorders

The cello is played while seated, with the instrument steadied on the lower sides of the body between the knees of the player, and on the upper sides of the body against the musician’s upper chest. The neck of the cello is above the player's left shoulder, and the C-String tuning peg is just behind the left ear. The bow is drawn horizontally across the strings (Mattlin, 2007).

In the “neck” fingering position, the thumb rests on the back of the neck; in “thumb” position the thumb usually rests alongside the fingers on the string and the side of the thumb is used to play notes. The fingers are normally held curved with each knuckle bent, with the fingertips in contact with the string (Mattlin, 2007).

The bow is held with all five fingers of the right hand, the thumb opposite the fingers and closer to the cellist's body. All fingers are curved, including the thumb. The transmission of weight from the arm to the bow happens through the pronation of the forearm, which pushes the index finger, and to a lesser degree the middle finger onto the bow. The necessary counterforce is provided by the thumb. In a downbow, the bow is drawn across the strings by first using the upper arm, then the forearm, then the wrist (turning slightly inward), in contrast to an upbow where the forearm is used first, then the upper arm, then the wrist (pushing slightly upward). In order to perform string changes the whole arm is either lowered or lifted, with as little wrist movement as possible (Mattlin, 2007).

Turner-Stokes and Reid (1999) point out that the increased range of shoulder movement in the upper register of the cello may contribute to the greater prevalence of neck and shoulder symptoms among cellists. However, in an older study, Bejjani *et al.* (1984), found the highest prevalence rate (75%) of back disorders such as lower back pain or functional deformities amongst the cello players.

Chong *et al*. (1989) study found the following common diagnoses in cello players:

- Fibro-ligamentous neck pain
- Ulnar nerve entrapment on left
- Rotator cuff tendonitis on right
- Extensor carpi radialis tendonitis on right
- Flexor carpi ulnaris tendonitis on left
- Intrinsic muscle strain on left

2.2.4.4 The Double Bass and performance-related musculoskeletal disorders

Double bassists either stand or sit to play the instrument. Proponents of playing while sitting on a stool argue that it is easier to perform high-register passages, because they can steady the instrument between the knees. Fingering and bow hand positions are similar to that of the cello (Lamb-Cook and Lamb, 2001).

Performing on the double bass can be physically demanding because the strings are large and thick. The space between notes on the fingerboard is large due to the scale length and string spacing, so players have to shift positions frequently. For bassists with smaller hands, the large spaces between pitches may present a significant challenge (Lamb-Cook and Lamb, 2001).

The double bass's large size and relative fragility make it cumbersome to handle and transport. Most bassists use soft cases to carry the instrument by shoulder straps or slung handle. Players also may use a small cart or end-pin attached wheels to move the bass (Lamb-Cook and Lamb, 2001). In professional orchestras double basses are often left at rehearsal venues and moved from venue to venue by staff responsible for stage set-up (as is the case with most percussion instruments).

The disorders suffered by the double bass players were found to be very similar to cello players (Chong *et al.*, 1989). Bejjani *et al.* (1984), found the highest prevalence of upper extremity disorders in double bass players; this specific population also had a 62% and 24% prevalence rate of back and neck disorders respectively.

2.3 Risk Factors associated with Injury Development in the Professional Performing String Musician

According to Wu (2007) a number of risk factors have been associated with the development of PRMD's in professional orchestral musicians, of which the most statistically significant were gender (female), number of years playing experience, the type of instrument played, playing-related physical (long hours/over-practicing) and psychological stressors (self-pressure/academic), lack of preventive wellness behaviours (taking breaks), and previous trauma.

Zaza and Farewell (1997) found that the best predictors of playing-related health problems were warm-ups and break-taking, technically challenging pieces and preparing for performance. Manchester and Park's (1996) case-controlled study found that total hours of playing time per week and participation in Alexander-Feldenkrais lessons were both significant factors in increasing or decreasing the development of PRMD's, respectively.

Yeung *et al.*, (1999) found evidence that a change in symptoms was related to the intensity of practice. This was reinforced by the fact that a change in playing habits and rest helped to ease the respondent's discomfort.

A study by Newmark and Lederman (1987) surveyed amateur musicians who had significantly increased their playing time, which resulted in 72% of the musicians developing performance-related musculoskeletal disorders, most of which were diagnosed as overuse syndromes. Further identified risk factors include changes in playing posture, technique and body habitus, as well as the presence or development of joint laxity (Lederman and Calabrese, 1986). Fry (1987) additionally mentioned genetic vulnerability and intensity of practice.

2.3.1 Age

Warrington *et al*. (2002) found that non-specific pain was more common in the younger musicians with 49% of participants under the age of 25 suffering from non-specific pain, versus 2% of participants over the age of 40 years. Fry (1988) noted little change in the incidence or severity of pain above the age of 30. Similarly, Roset-Llobert *et al.* (2000) found most musicians who had musculoskeletal discomfort were between 10 and 20 years old.

Fishbein *et al.* (1988) found that medical problems (of which the majority were musculoskeletal complaints) peaked between the ages 35 and 45. Heming (2004) found similar results in which respondents aged between 36 and 40 reported the highest rate of musculoskeletal injury.

Heming (2004) suggested that due to a heightened family life for the majority of people at this age, warm-up and practice time would not be considered as necessary or easy to achieve as in previous years thus leading to increased stress on the muscles and joints. When rehearsal time was then heightened before a performance they would then rely on intense practice for a short while and familiarity with repertoire rather than regular practice; thus predisposing them to injury.

Warrington *et al.* (2002) reported that older musicians were more susceptible to degenerative conditions, in comparison to musculoskeletal strains. With the increase in arthritis in the aging population, an increase in pain from degenerative conditions is not surprising (Hoppmann and Ekman, 1999), hence a possible increase in reported pain in the ageing musician.

2.3.2 Age at which instrument is started and number of playing years

Heming (2004) showed that the basics of most instruments were taught before the age of skeletal maturity when there is incomplete fusion of the growth plates. These actions support Andrews' (1997) assertions that playing an instrument from a young age increases the risk of dysplasticity, deformity or malalignment in

later years because the bones of the wrist and hand do not completely ossify until around the age of 20. Also, young students have to support the weight of an adult-sized instrument as well as master fingering with small hands; resulting in increased muscle bulk at the expense of their bony attachments (Heming, 2004).

Bejjani *et al.* (1984) found that the onset of musculoskeletal symptoms was related to how long a musician had been playing, noting that the earlier a musician learnt to play the instrument, the later the symptoms appeared. This suggests that musculoskeletal changes, when they occur in musicians, may be adaptive and emphasizes the importance of training and level of experience. Yeung *et al*. (1999) found that younger musicians with less experience in playing were more likely to develop injury.

2.3.3 Gender

Studies by Abréu-Ramos and Micheo (2007), Kaneko *et al.* (2005), Dawson (2001), Yeung *et al.* (1999), Cayea and Manchester (1998), Zaza and Farewell (1997) Manchester and Flieder (1991), Middlestadt and Fishbein (1989), Lockwood (1988), Manchester (1988) and Fry (1986) all found women were more affected than men by PRMD's.

Possible reasons for the differences in gender have been attributed to hand size (Dawson, 2007), muscle strength (Burkholder and Brandfonbrener, 2004), an increased predisposition to joint laxity in females (Burkholder and Brandfonbrener, 2004) and higher levels of stress indicated by females (Zetterberg *et al.*, 1998).

Fry (1998), and Burkholder and Brandfonbrener (2004) also found that on average females practiced more than males, and practice time could be an influential factor in PRMD development. Hagberg *et al.,* (2005) found the relative risk (hazard ratio) was between 1.14 and 2.80 for women for different musculoskeletal disorders.

However, Roset-Llobert *et al*. (2000) questioned what level of influence gender had in promoting the development of PRMD's, as their study (n = 1639) found no relationship between gender and higher risk.

2.3.4 Smoking

Studies have indicated that there is a link between smoking and general injuries, as well as disorders of the neck, shoulders and back (Boshuizen et al., 1992; Leino-Arjas, 1998; Palmer et al., 2003). Additionally, Palmer et al. (2003) and Leino-Arjas (1998) found that smokers, as well as ex-smokers, report more pain and musculoskeletal symptoms than non-smokers.

2.3.5 Education

Dommerholt (2009) stated that when musicians are in training, teachers are not generally selected based on their awareness of risk education and injury prevention and there is little assurance that good teachers are aware of potential risk factors with regard to developing practice habits, general attitude to being a performer, repertoire, and teaching style. These findings support an earlier study in which it was found that injuries often develop when students switch teachers, and receive different instructions in technique and alter their repertoire (Dommerholt and Norris, 1997).

Barrowcliffe's (1999) questionnaire study revealed that university music teachers were not knowledgeable about focal dystonia, thoracic outlet syndrome or carpal tunnel syndrome; and moderately knowledgeable about tendonitis; but were knowledgeable about general playing related injury issues. Brandfonbrener (2006) also mentions that teachers, who have not experienced any playing-related injuries themselves, may not be empathic toward students who develop painful disorders (Brandfonbrener, 2006). Heming (2004) noted that posture was not considered as an important issue to address when it came to teaching.

A study of Symphony Orchestra Musicians in Brazil (Kaneko *et al.*, 2005), revealed that 53% of musicians had received some type of orientation regarding the potential for performance related injuries as a professional musician.

In South Africa, the level of education regarding PRMD's is yet to be determined on a formal basis. An informal interview was conducted by the researcher with the Durban Chamber Choir to partially determine the extent of such education in South Africa. Within the choir there were 14 professionally qualified musicians (8 Bachelor of Music, 5 Masters of Music, and 1 PhD). All had received their professional training at a South African tertiary institute (1970-1995), except the PhD candidate, whose qualification was obtained at an American university. Of interest, was that none of the South African qualified professionals had received any training or information on the potential for performance related injuries. However, the PhD candidate did receive such preventative training and information at the American institute.

To add to such informal research, the researcher contacted the various schools of music and music departments in South African tertiary institutes. Correspondence was via email in which the topic of the dissertation was explained. It was also requested that a brief description of any official preventative musculoskeletal programmes used by the departments in the training of undergraduate and postgraduate string students, as well as the amount of time spent instructing these programmes, be described to the researcher. Additionally, if any informal workshops/lectures were conducted, it was requested that they too be included in their response.

None of the departments, who responded, offered official programmes regarding PRMD's, they did however, mention that they recommend programmes and workshops to the students, but these are arranged and paid for privately by the students. They also commented that at each student's individual lesson, issues regarding PRMD's are addressed.

This sentiment concurs with that of Dr L.M. Jakobs who acknowledged that South African tertiary institutes provide little, if any, education in preventative techniques

during their training. Dr. Jakobs further stated that South African institutes “coach rather than teach” their students. Resulting in not paying enough attention being paid to technique adaptation due to injury, or poor technique, and this could potentially result in injury. Dr Jakobs concluded that “South African musicians struggle to compete on an international level, as they are not taught how to practise correctly; therefore they lack the ‘all-round’ skills acquired abroad”. Orchestral string musicians trained in South Africa could thus be at a greater risk for injury and PRMD development.

Some of the lecturers at South African tertiary institutes felt that it was the orchestras’ responsibility to ensure the health of their employees, by exposing the musicians to preventative techniques, and not the universities. They further suggested that changes to orchestral chairs and lighting be made, as a possible intervention which could be employed by the orchestras in preventing injury.

The results from Rardin (2007) indicated that injury prevention intervention in high school music students revealed a slightly decreased playing related pain level, slightly increased body awareness of tension, and more healthy attitudes towards playing with pain. This indicated that it is possible to affect change in these areas within an instrumental classroom setting. Although this study was used in a high school, similar interventions could be introduced at a university level.

Schäcke *et al.* (1986) emphasized the importance of proper musical education to ensure musicians gain appropriate motor skills. Fry (1987) also noted that during practise sessions of music students problems can be reported and easily corrected before they become disabling habits. Bejjani *et al*. (1984) further state that the better trained musicians use their muscles more efficiently and are less likely to produce problematic or excessive muscle contractions, and hence are less injury prone.

Barrowcliffe (1999) and Heming (2004) both concluded in their studies that music teachers must take an active role in preventing playing related injury in student musicians, through injury education and prevention strategies.

2.3.6 Specific education

According to Rosenthal (1987) the Alexander and Feldenkrais techniques emphasize the importance of correcting improper posture and the economy of muscle action in the upper extremity. These techniques are used to eliminate unnecessary and inefficient muscle contractions. According to Watson and Valentine (1987), the Alexander technique, as a system of kinaesthetic re-education, was widely used by musicians to enhance performance and prevent misuse and injury.

Khalsa *et al.* (2009) suggested that yoga and meditation techniques can reduce performance anxiety and mood disturbance in young professional musicians.

2.3.7 Body habitus when practicing

Chan *et al.* (2000) proposed ergonomics as another risk factor for PRMD's. This was based on surface electromyography used to record the fatigue level of the upper trapezius muscle of 14 orchestral musicians before and after a practice session and, the comparison of these results to a subjective rating scale. They found that 11 of the subjects reported a playing related musculoskeletal complaint. After a training session, there was a significant (p = 0:003) increase in perceived exertion using a visual analogue rating scale. However, there was no significant difference in the surface electromyography on the trapezius muscle before and after training, indicating ergonomic stress.

Heming (2004) suggested that in viewing ergonomic stress, playing posture should be evaluated. Additionally, concert halls and other playing venues should review their facilities with respect to chairs and stands provided for the musician, as these could have an effect on playing posture and stress perceived by the musician. Fry *et al.* (1989) noted that, as musicians play long movements or pieces, their posture gets progressively worse as the muscles fatigue.

2.3.8 Non-music related work

Non-music related upper extremity trauma is a common source of disability in musicians (Dawson, 1990, Blum and Ahlers, 1995). Dommerholt (2009) recommends that, in the taking of a musician's case history, information regarding possible other jobs or assignments, hobbies, and other physical activities should be ascertained as they may cause or contribute to the musician's injury. In the literature, relevant hobbies or activities mentioned include gardening, arts and crafts, and sporting activities (Dawson, 1995, Hopmann, 1998).

Fjellman-Wiklund (2003) also noted that in activities other than playing the instrument, the practice of proper warming up, taking regular pauses to recover and using good working techniques are also important to protect the musician from PRMD's.

2.3.9 Professional Health Care

Hoppmann and Patrone (1989) state that the health of professional athletes receives a great deal of attention from sports managers; however, managers within the fine arts have not shown the same degree of interest in the health of professional musicians.

Musicians' injuries are commonly related to practice, performances, and playing the instrument and these injuries may not always be detectable with a standard physical examination, which may subsequently lead to a dismissal of the pain complaint, or to an incorrect diagnosis (Winspur, 2003). Brandfonbrener (2006) adds that of all the performing artists, musicians have experienced the greatest difficulty in finding healthcare providers who understand the specific demands of playing musical instruments and the subtleties of their injuries.

Brandfonbrener (1998) stated that musicians as a group tend to consult more with alternative practitioners than with traditionally trained providers, often because of a lack of trust of the medical establishment. But, a German study

showed that as many as 68% of professional musicians treated by physicians did not follow their doctors' recommendations (Molsberger *et al*., 1989).

Abreu-Ramos and Micheo (2007) found that medical doctors and physiotherapists were consulted 42.6% of the time and chiropractors 39.3% of the time.

2.3.10 Stress

A study by Steptoe (1991) conclusively linked stress and illness. Psychological factors were found to influence the initiation of disease or affect the course, severity and prognosis of an illness, all of which have been long-established principles of psychosomatic medicine.

In viewing factors present in the lives of professional musicians, Sternbach (1993) found a "total stress quotient" well beyond what might be expected, thus contributing to a lifestyle of overwhelming stress unique to the music profession. Sternbach (1993) further quotes statistics attesting to the music profession being among the "top five life-threatening professions."

A Swedish study by Gabrielson (1992) compared symphony musicians with those in six other occupations. The results of the study showed that the symphony musicians and freight handlers had the highest blood pressure at work, further supporting evidence of negative occupational effects on health.

A study by Kivimaki and Jokinen (1994) compared musicians and other occupational groups. The results demonstrated that musicians not only reported the highest level of job satisfaction but also the highest levels of exhaustion, stomach aches, headaches and sleep disturbances. Anxiety and distress have also been attributed to a high degree of perfectionism of musicians, and the belief of the musicians that every live performance must be flawless and near recording quality (Stoeber and Eismann, 2007).

2.3.11 Warm-ups and Cooling Down

Markison (1994) warned against playing with cold hands, pointing out that cold hands indicated that circulation to the hands is not optimal, with Wristen (1998) mentioning that the chances of injury are lessened by adequately warming up muscle tissue.

In an examination of risk factors for injury, Zaza and Farewell (1997) found that a musical warm-up protected musicians from injury (p = 0.030). Yeung *et al.* (1999) compared musicians with PRMD's, to those without and found that 83.33% of participants who did warm-ups had a PRMD, whereas those who did not warm-up had an injury rate of 69.23%. This correlation was however not found to be significant in their study (p = 0.28). Yoshimura *et al*. (2008) however strongly correlated increased pain levels with warm-up routines.

Practicing a physical cool down after practice or rehearsal has been found as an uncommon practice, often as low as 20% in orchestral populations (Abréu-Ramos and Micheo, 2007). Zaza (1994) suggested that stretching after playing may be more appropriate than stretching beforehand. Ten years later, Heming (2004) proposed that stretching after playing and adopting a mirror image posture to force the body to re-centre as the basis for a warm-down after playing (Heming, 2004)

2.3.12 Carrying of the Instrument

Korovessis *et al*. (2005) noted that carrying a backpack, especially asymmetrically i.e. on one shoulder only, resulted in a shift of the upper trunk, shoulder and cervical lordosis, which seemed to increase back pain. Chansirinukor *et al*. (2001) recommend that a load carried by shoulder straps (backpack) should not exceed 15% of body weight, as any weight exceeding this amount would alter normal postural alignment. Both of these studies were conducted on high school students aged 12 – 18 years, thus the results may not apply to the mature instrumentalist; although the principles applied in the studies

with regards to carrying a load do apply to all age groups, and hence to the carrying of the instrument by the string musician.

Dawson (2005) however, concluded that playing musical instruments produced more and greater hand difficulties than holding, supporting, or transporting them.

2.4 Conclusion

South Africa presents itself as a unique orchestral environment for the professional string musician. There is however a paucity of information regarding the demographic and injury profile; and injury prevalence for professional orchestral string musicians in South Africa.

The literature has revealed what the common demographic and injury profiles are internationally, and this study will aim to compare the South African string musician to the available literature.

The methods and measurement tools used to obtain this data are explained in chapter three.

Chapter Three: Materials and Methods

This chapter outlines the research material and methods utilized in addressing the objectives outlined in Chapter One and the statistical analysis used to interpret the data.

3.1 Study design

The study was a quantitative, cross–sectional descriptive study based on a self administered questionnaire (Salant and Dillman, 1994). A questionnaire was the tool of choice, as it ensured that bias was kept to a minimum, and that there was less chance of misinterpretation of the results (Mouton, 1996). Additionally, survey research allows information to be collected from a large and dispersed group of people (Dyer, 1997).

Based on this study design, the research was approved by the Faculty of Health Sciences Research and Ethics Committee (FHSEC 057/09)(Appendix D5) indicating that the research protocol satisfied the ethical requirements set out by the Faculty of Health Sciences Research and Ethics Committee. Furthermore, this approval indicates that the research protocol is in line with the Declaration of Helsinki, 1975 (Johnson, 2005).

3.2 Study protocol and procedures

3.2.1 Advertising

No advertising was required, as the total sample was invited to participate.

3.2.2 Sampling method

The total sample was invited to participate by either personal invitation or email.

- The KwaZulu Natal and Cape Philharmonic Orchestras were visited and addressed by the researcher, after which the questionnaire was administered to the string players who agreed to participate in the study.

- The string players of the Johannesburg Philharmonic Orchestra were sent the questionnaire and Letter of Information and Consent in an electronic format via email.

3.2.3 Participant sampling

3.2.3.1. Population size

This research included all of the professional string musicians playing in a professional capacity within the three existing professional orchestras of South Africa, at the time of data collection:

Table 3.1: Total sample

Philharmonic Orchestra:	KwaZulu Natal	Cape	Johannesburg
First Violins	9	8	5
Second Violins	6	5	6
Violas	6	5	4
Cellos	7	4	5
Double Basses	4	3	2
Total Strings	32	25	22

The total sample population was n = 79

3.2.3.2 Allocation

Participants were not allocated to groups as this was a survey of an entire population group rather than a comparison between groups.

3.2.3.3 Method

All participants meeting the inclusion criteria were invited to participate; therefore, giving a possibility of total sample selection (Mouton, 1996). However, a process of self-selection based on the participants' willingness to complete the questionnaire was possible based on the participants' right to elect not to participate in the study.

3.2.3.4 Sample Characteristics

In order to participate in the research, the participants were required to meet the following inclusion criteria:

3.2.3.4.1 Inclusion criteria

a) Only string players (violins, violas, cellos, double bass), who were employed at the time of data collection, by one of the three professional orchestras in South Africa were considered for the study, as this was the population being investigated.

b) The participants had to be willing to take part in the study. The Letter of Information and Consent (Appendix D3 and D4) clarified that participation was voluntary, and that musicians were free to withdraw at any time during the study.

3.2.3.4.2 Questionnaires

There were no exclusion parameters for analysis placed on questionnaires not fully completed

3.2.4 Research procedure

Permission to conduct the study was obtained from the respective orchestral boards (Appendices A1, A2 and A3).

3.2.4.1 KwaZulu Natal and Cape Philharmonic Orchestras:

The researcher personally attended a rehearsal of the Cape and KwaZulu Natal Philharmonic Orchestras, at which all of the string players were expected to be in attendance. This was determined according to the programme and musical requirements of the score being played.

Orchestras typically have three breaks during a rehearsal, ranging from 15 minutes to one hour in length. The one hour break was used for the administration of the questionnaire.

At the beginning of the break, the researcher addressed the string players of the orchestra, explaining the research and its contents. After which the questionnaire (Appendix D2) along with a Letter of Information and Informed Consent (Appendix D3 and D4) were handed to the musicians. The musicians were then given approximately 15 minutes to complete the questionnaire.

Once completed, the musicians placed the completed questionnaire into a sealed box. It was requested that no names or identifying information be written on the questionnaire thus ensuring confidentiality. The questionnaires were kept by the researcher until all data had been collected. Only the researcher, supervisor and co-supervisor had access to the completed questionnaires.

3.2.4.2 Johannesburg Philharmonic Orchestra (JPO):

The JPO had a Christmas vacation over the November / December / January data collection period. Thus to obtain the necessary data and complete the study, the string players were emailed the questionnaires via the orchestral manager.

Once completed, it was requested that the questionnaires be emailed directly to the researcher (quinton.hohls@gmail.com) by the participant for printing and data capturing purposes. It was requested that the questionnaire be attached to the e-mail so that once the attachment had been printed out no identifying information was present on the documents, so ensuring confidentiality. Once the attachments were printed the e-mails were then deleted.

Additionally, once the completed questionnaires were printed out, they were combined randomly with the completed questionnaires from the other two orchestras increasing anonymity.

Once the questionnaires had been administered, and completed by the string players of all three orchestras, data capturing took place along with an analysis of the data.

All completed questionnaires will be kept in the Department of Chiropractic and Somatology for five years after which they will be shredded.

3.3 Research tool

3.3.1 Questionnaire Development

3.3.1.1 Questionnaire background

Zaza (1994) conducted a similar study on PRMD's utilising a questionnaire. The questionnaire had been approved by the Department of Health Studies, at the University of Waterloo, Canada, for a PhD study, thus validity of the questionnaire was accepted for the purposes of the current study. Dr. Zaza was contacted and permission was obtained (Appendix B1) to utilise and adapt her pre-validated questionnaire (Appendix B2) to a South African context.

Using the principles of Dyer (1997), the researcher prepared a pre-focus group questionnaire (Appendix B3) based on the questionnaire used by Zaza (1994).

3.3.1.2 Questionnaire contextualisation

The pre-focus group questionnaire was then validated by means of a focus group. Validity refers to establishing the accuracy and trustworthiness of an instrument, data and findings in research thereby ensuring that future research utilising that particular tool is accurate (Bernard, 2000).

Face validity, the simplest type of validity, is determined by agreement between researchers and those with a vested interest in the questionnaire, that 'on the face of it' the tool seems valid (Bernard, 2000). This was achieved by the use of a focus group.

The purpose of a focus group is to enable a group of individuals to discuss the questionnaire, stimulating their thinking and encouraging them to develop ideas about the topic supplied by the researcher, who takes on the role of moderator (Salant and Dillman, 1994). The members of the focus group critically assess the relevance of questions presented in the questionnaire and indicate whether these questions address the aims and objectives of the study (Mouton, 1996). In addition the focus group discussion allows for questions to be added to, deleted from or modified for clarity, thereby increasing the construct validity of the questionnaire (Mouton, 1996). The focus group is also able to contextualize the questionnaire (Salant and Dillman, 1994) in order to enhance its validity (Bernard, 2000).

According to Morgan (1998) a focus group should consist of between six to eight participants, selected on a basis of similarity to the participants that will ultimately complete the questionnaire. The members of this focus group were enlisted via word of mouth, based on their experience and expertise in the field of performing arts, music and health studies. Six respondents expressed interest in participating in the focus group.

The focus group in this study consisted of the researcher, the research supervisor, the co-supervisor (A homoeopath and qualified musician), a

chiropractic student (and a lay musician), a physiotherapist (and qualified musician), a music lecturer at the University of KwaZulu Natal (and performing cellist), and a recently qualified musician currently enrolled in the Faculty of Health Sciences, Durban University of Technology (Homoeopathy).

Before commencing with the focus group, each participant was required to read and sign a Letter of Information and Informed Consent (Appendix C1) and a Code of Conduct (Appendix C2). In the focus group, each member was given a copy of the pre-focus group questionnaire (Appendix B3). The participants were requested to comment on how the questionnaire could be modified for it to be used to assess PRMD's of professional orchestral string musicians.

The questions were discussed in numerical order in each respective section of the questionnaire. If any inconsistencies were found, queries were raised and changes proposed. The relevant question was discussed until an agreement was reached.

A video of the proceedings was made and is available as evidence of the individuals involved and the content of the discussion (Appendix C3). A summarised transcript of the proceedings is available (Appendix C4). The transcripts, documents and video of the proceedings that were made will be kept in a secure area in the Durban University of Technology, in department of Chiropractic and Somatology, and will be shredded or destroyed after five years to ensure confidentiality.

3.3.1.3 Focus group discussion

A number of changes to the questionnaire were suggested by the focus group. These included adding to or deleting from questions, or deleting questions entirely; correcting spelling and grammar, and changing the wording of the questions to make them less ambiguous.

It was recommended to change the entire lay-out of the questionnaire to allow for easier reading and maintain the participants' interest. The many lists of questions

were also recommended to be placed into a table format to allow for quicker and easier answering of the questions.

3.3.1.4 Content Validity

Content validity is an assessment of how well the instrument represents all the components of the variable to be measured. For evaluation of content validity the instrument is usually presented to a group of experts in the field, who then evaluate each item of the instrument to determine the overall suitability of the instrument for use (Brink, 2006). This was done by the focus group and the content of the questionnaire had also been validated by Zaza (1994) in the questionnaire construction.

Further content validity (in terms of research methodology and understanding) was achieved through the evaluation of the questionnaire by the Department of Chiropractic and Somatology Research committee, and Faculty of Health Sciences Research Ethics committee (Durban University of Technology) (Changes noted in Appendix D1).

3.3.1.5 Final Questionnaire

The final questionnaire (Appendix D2) and Letter of Information (Appendix D3 and Appendix D4) were distributed to the string players of the respective philharmonic orchestras.

Section A was concerned with the “Description of Self” in which current demographic, socio-economic and other personal data were obtained. These variables were used as a measurement of association in analysis.

Section B contained various questions regarding the musical background of the string musician.

Section C was concerned with the “Occupational Information” of the string player.

Section D was specifically concerned with the “Playing-Related Musculoskeletal Problems” of the string musicians.

3.3.2 Measurement frequency:

The questionnaire was administered only once per participant.

3.4 Statistical Analysis

The data was initially captured in Microsoft Excel and then analysed using SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA). A *p* value < 0.05 was considered to be statistically significant.

Cross tabulations with Pearson’s chi square tests were generated for ‘Current injury’ and the categorical variables relating to demographics, musical background, playing technique (PT), occupational and playing-related problems. Means of quantitative variables were compared between those with and without current injury using independent t-tests (Esterhuizen, 2010).

The prevalence of injuries was assessed as overall (career prevalence) and for the last 12 months - period prevalence. The prevalence of each site of injury was also reported. Characteristics of the injuries, such as severity, diagnosis, treatment and effects were descriptively analysed and reported in terms of percentages and bar charts.

The demographics of the injured musicians were described overall. This included site of injury, as well as by type of instrument. The risk factors for injury were assessed by comparing those who have had career injuries with those that have never been injured in their career in terms of a variety of risk factors such as: demographics, type of instrument, playing technique and occupational information. These comparisons were analysed using Pearson’s chi square tests in the case of categorical risk factors and t-tests for quantitative risk factors. A *p* value < 0.05 was considered statistically significant (Esterhuizen, 2009).

3.5 Conclusion

Through the validation of the questionnaire and its distribution to the specific sample who agreed to participate in the study, the aims and objectives of the study were addressed.

The results of the study, statistical analysis and critical evaluation of the results are to be presented in the following chapter.

Chapter Four: Results and Discussion

4.1 Introduction

This chapter presents the results obtained from the statistical analysis of the data, and contains a discussion of these results. The discussion will be done either after a section of data or immediately after the presentation of a set of results.

4.2 Key for symbols utilised in this chapter

n	=	sample size
SD	=	Standard deviation
Mean	=	the average of 'n' numbers, computed by adding the sum function of the numbers and dividing them by the sum function of n
OR	=	Odds ratio
CI	=	Confidence interval

4.3 Data

4.3.1 Primary Data

The primary data was collected by means of a self-administered, quantitative questionnaire designed specifically for this study (Appendix D2).

4.3.2 Secondary Data

This included all information sourced in the development of the questionnaire and write up of the dissertation. Journal articles, published dissertations, internet websites, books and government publications were evaluated and included in this study and referenced accordingly. The secondary data will be compared to the outcome of the results of this study during the discussion.

4.4 Response Rate

The sample consisted of the entire population of professional orchestral string musicians in the three professional orchestras of South Africa (n = 79), namely the Johannesburg Philharmonic Orchestra (JPO), Cape Town Philharmonic Orchestra (CPO) and KwaZulu Natal Philharmonic Orchestra (KZNPO). A combined total of 27 participant questionnaires met the inclusion criteria as described in the methodology and were used for statistical analysis, making the response rate 34%.

All of the 27 questionnaires were returned from the CPO and KZNPO where the researcher had personally visited the individual orchestras to distribute the questionnaire. There were no responses from the JPO string players who had been contacted repeatedly via email through the orchestral manager and the researcher. Lapane *et al*. (2007) noted the value of multiple mailings in achieving a better response rate; however, in this study it yielded none.

Heming (2004) found that there was a higher percentage of questionnaires returned by post compared to those distributed during rehearsals. Suggestions for this were that musicians were unable to spend the time during a busy rehearsal to fill in a questionnaire; or that the musicians did not want to admit to having problems, or risk the possibility of colleagues finding out ‘‘weaknesses’’ they may have had if the questionnaire was filled in whilst other orchestral members were present. Yeung *et al.* (1999) gives a similar explanation for her low response rate.

In this study a higher response was obtained by handing out the questionnaire to the musicians, which is in contrast to that of Heming (2004). Lapane *et al*. (2007) similarly reported more responses when distributing surveys at an employee’s workplace in comparison to mailing the survey. The low response rate to e-mails for this study may be attributed to the timing of the research as the researcher was unable to meet with the JPO, leaving e-mail contact as the only option to invite them to participate. The low response could have been due to the

orchestra breaking for Christmas holidays and the members not checking their emails.

When comparing the response rate to studies done on a similar population it was found that the response rate in this study was higher than that achieved by Yeung *et al.* (1999) at 23%, and a 16.73% by Roset-Llobert *et al.* (2000). Gasenzer and Parncutt's study (2006) had a total of 27 professional musicians willing to participate in the study, the results of which were presented at the ninth International Conference on Music Perception and Cognition. This indicates that small samples and response rates are reported internationally, and are not unique to the South African environment.

However, Zaza (1998) mentions that a critically evaluated study, with a response rate of below 60% would have methodological weakness, and be ineligible for use in a future review studies. The results of this study will therefore give information on the South African string players; however, the response rate may affect the statistical comparison of variables in terms of significance.

4.5 Results

4.5.1 Objective One

To determine the demographic profile of string players in South African Philharmonic orchestras.

Results were obtained primarily from Section A (Description of Self), Section B (Musical Background) and Section C (Occupational Information) in the study questionnaire.

4.5.1.1 Section A: Description of Self

4.5.1.1.1 Gender

Figure 4.1 shows gender distribution with a frequency of 8 male and 17 female string players. Two respondents did not indicate their gender, and were not included in the calculation of percentage.

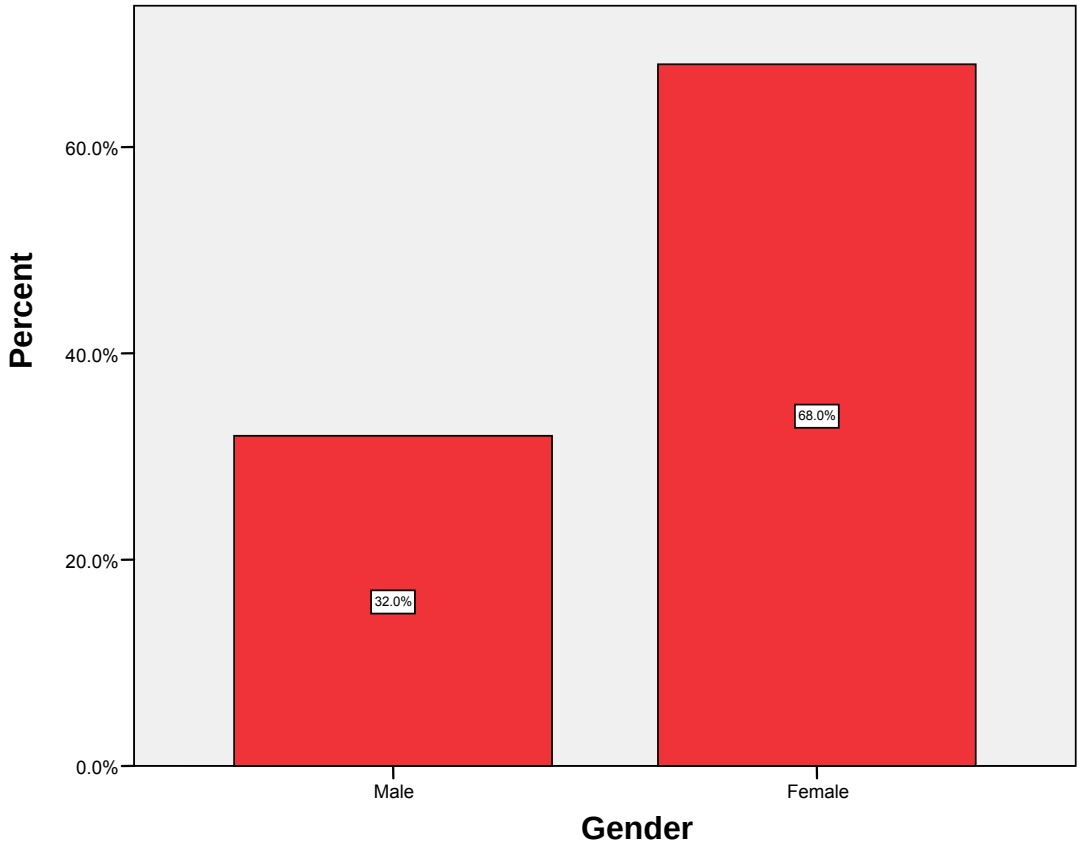


Figure 4.1: Gender distribution of respondents

4.5.1.1.2 Age, weight and height distribution

Table 4.1 represents maximum and minimum values for age, weight and height distribution. The mean age of the participants was 37.11 (SD = 11.768), with a mean height of 1.563m (SD = 0.463) and a mean weight of 62.96kg (SD = 22.293)

Table 4.1: Age, weight and height minimum and maximum values for the respondents

	Minimum	Maximum
Age	23	61
Height (m)	1.5	1.9
Weight (kg)	48	96

4.5.1.1.2.1 Body Mass Index

The mean Body Mass Index (BMI) for the string players was placed at 25.768 kg/m^2. This would place the average string player just inside the overweight category (Vizniak, 2007). This would place them at an increased risk of developing health problems, although individuals may have a very muscular body build without a high body fat level which would thus have less associated health risks.

4.5.1.1.3 Ethnicity of Respondents

Table 4.2 shows that Caucasians (88.9%; n = 24) made up the majority of respondents.

Table 4.2: Ethnicity of respondents

		Frequency	Percent
Valid	Caucasian	24	88.9
	Black	1	3.7
	Coloured	1	3.7
	Other	1	3.7
	Total	27	100

4.5.1.1.4 Country of Origin

Table 4.3 shows that 48.1% (n = 13) of respondents were from The Republic of South Africa (RSA).

Table 4.3: Country of origin

		Frequency	Percent
Valid	Austria	1	3.7
	Belgium	1	3.7
	Bulgaria	2	7.4
	Germany	2	7.4
	Namibia	1	3.7
	Netherlands	2	7.4
	Poland	2	7.4
	Romania	1	3.7
	RSA	13	48.1
	U.K.	1	3.7
	USA	1	3.7
	Total	27	100.0

4.5.1.1.5 Qualification obtained at a South African Institute

Table 4.4 shows that just over half of the respondents (51.85%, n = 14) obtained their qualification from an educational institute outside of South Africa.

Table 4.4: Percentage of Respondants who qualified at a South African Institute

	Frequency	Percent
Yes	13	48.15%
No	14	51.85%

4.5.1.1.6 Institution within South Africa from which a musical qualification was obtained

Figure 4.2 shows that the University of Cape Town (UCT), incorporating the South African College of Music (SACM) was the most popular university of study (22.2%, n = 6). One respondent, who obtained their qualification in South Africa, did not specify from which institution they had obtained their qualification.

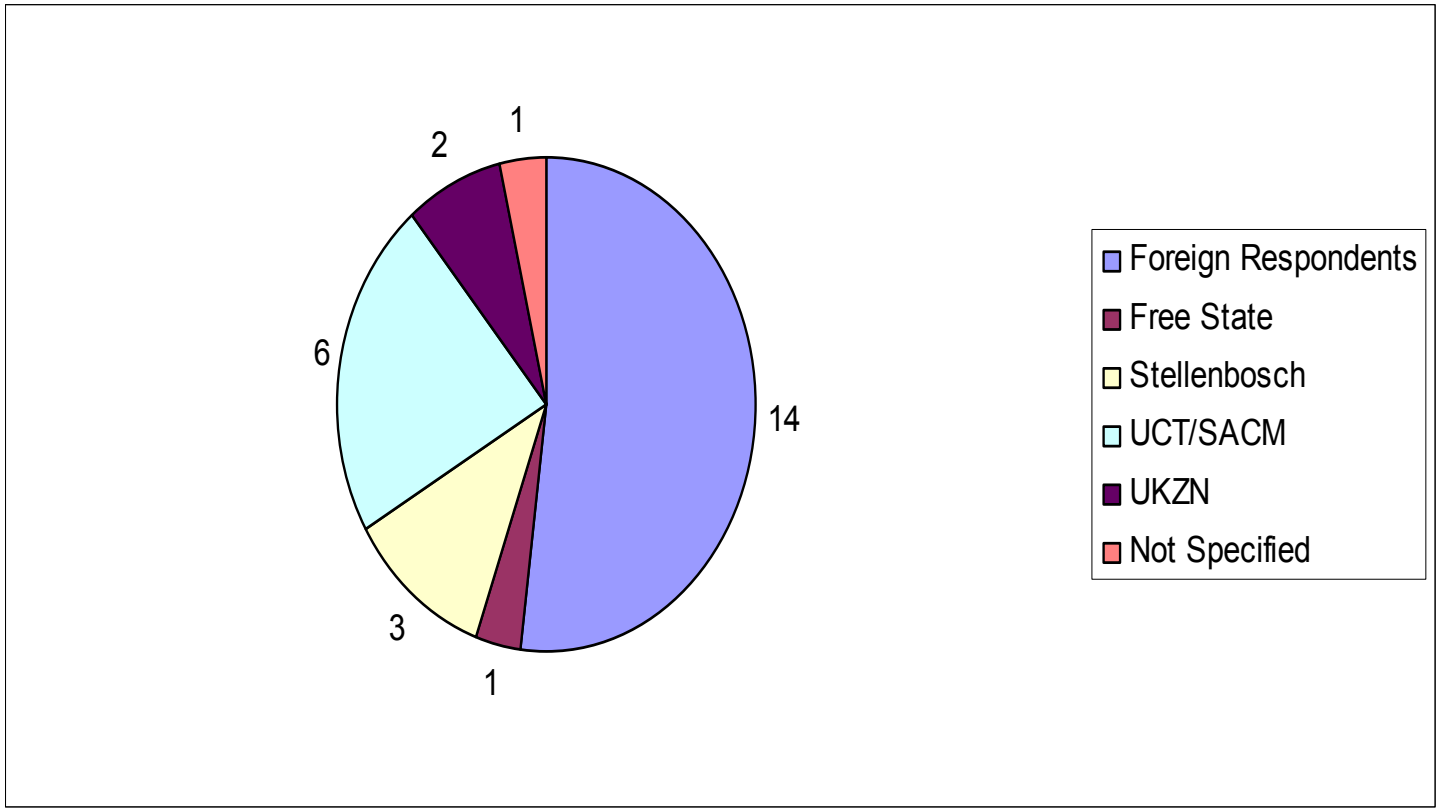


Figure 4.2: Institution in South Africa from which qualifications were obtained

4.5.1.1.7 Countries in which Foreign Qualifications were obtained

Table 4.5 shows that continental Europe (37%, n = 10) was the most popular region from which an international qualification was obtained.

Table 4.5: Countries in which Foreign Qualifications were obtained

		Frequency	Percent
Valid	Belgium	1	3.7
	Bulgaria	1	3.7
	Germany	2	7.4
	Netherlands	2	7.4
	Poland	2	7.4
	Romania	1	3.7
	RSA	13	48.1
	Switzerland	1	3.7
	U.K.	1	3.7
	USA	3	11.1
	Total	27	100

4.5.1.1.8 Foreign Institution from which qualification was obtained

The foreign respondents attended a variety of institutions, from universities to conservatories as represented in Table 4.6.

Table 4.6: Foreign Institution from which qualification was obtained

		Frequency	Percent
Valid	South African Respondents	13	48.1
	Academy of Arts - Akademija Umeinosti	1	3.7
	Boston University - College of Fine Arts	1	3.7
	Conservatoire of Brussels	1	3.7
	DePaul University School of Music, Chicago	1	3.7
	Erschede Conservatorium	1	3.7
	Musikhochschule Luebeck	1	3.7
	Roosevelt University Musical College	1	3.7
	Royal College of Music, London, U.K	1	3.7
	Royal Conservatory The Hague	1	3.7
	Wroclaw	1	3.7
	Zurich Conservatoire, RAM	1	3.7
	Not Specified	3	11.1
	Total	27	100

4.5.1.1.9 Highest Musical Qualification obtained

Figure 4.3 shows that the vast majority of string players had a Bachelor degree in music (55.6%, n = 15) as their highest qualification. There are no PhD in music graduates playing in South African professional orchestras

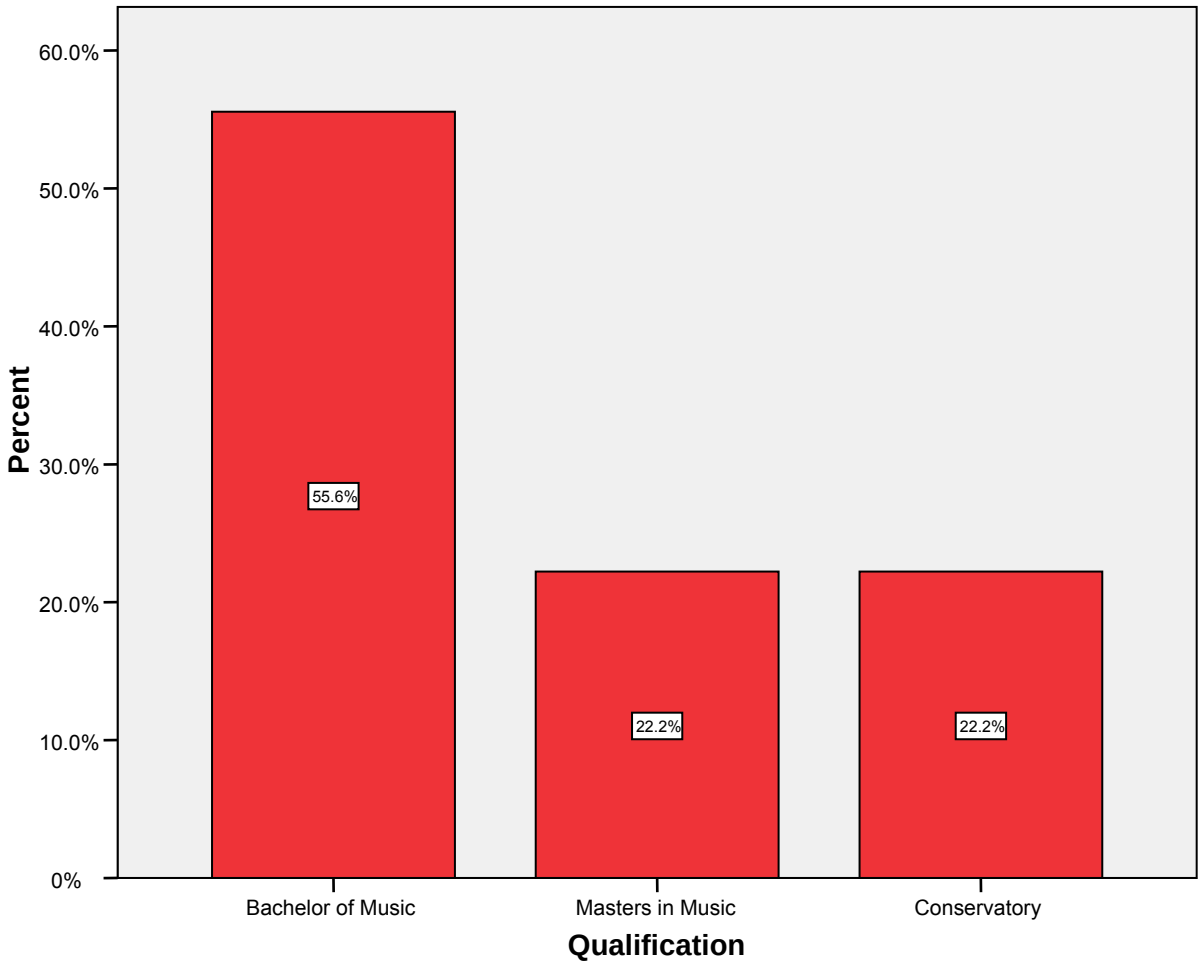


Figure 4.3: Highest Musical Qualification obtained

4.5.1.1.10 Category of Institution from which the highest musical qualification was obtained

Table 4.7 shows that majority of respondents (66.7%, n = 18) obtained their qualification from a University

Table 4.7: Category of Institution

		Frequency	Percent
Valid	University	18	66.7
	Conservatory	7	25.9
	College of Music	2	7.4
	Total	27	100

4.5.1.1.11 Year in which the highest musical Qualification was awarded

Figure 4.4 shows that most of the respondents (44%, n = 12) obtained their qualification between 2000 and 2009. The earliest qualification was achieved in 1971, with the most recent being in 2009. Four respondants did not indicate in which year they had obtained their highest musical qualification.

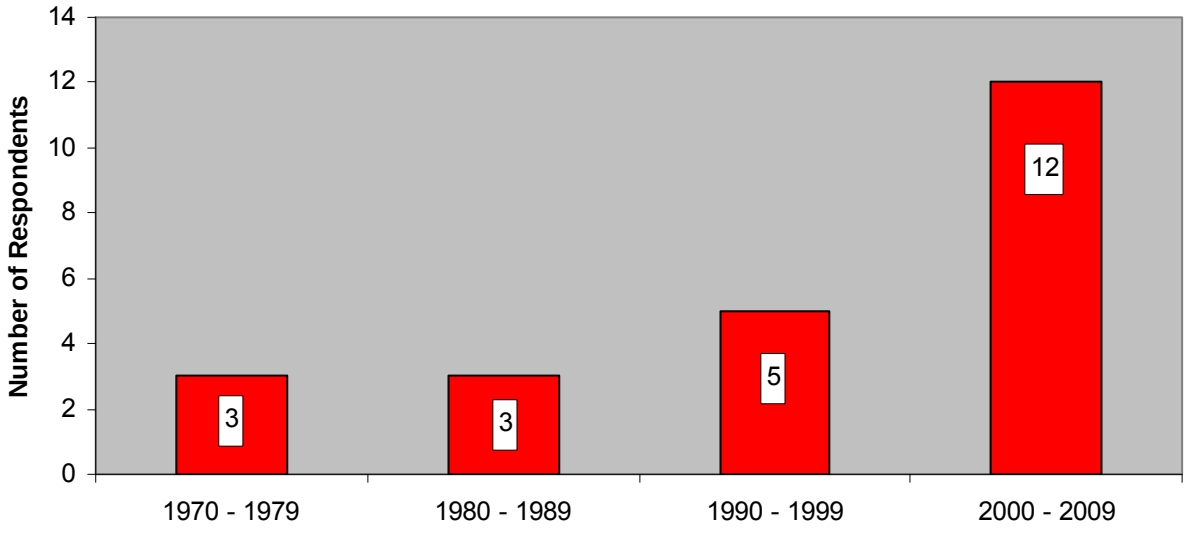


Figure 4.4: Year of Qualification

4.5.1.1.12 Handedness of Respondents

Figure 4.5 shows that right handedness had the highest frequency (88.9%, n = 24), followed by left handedness (7.4%, n = 2) and one ambidextrous (3.7%, n = 1) respondent.

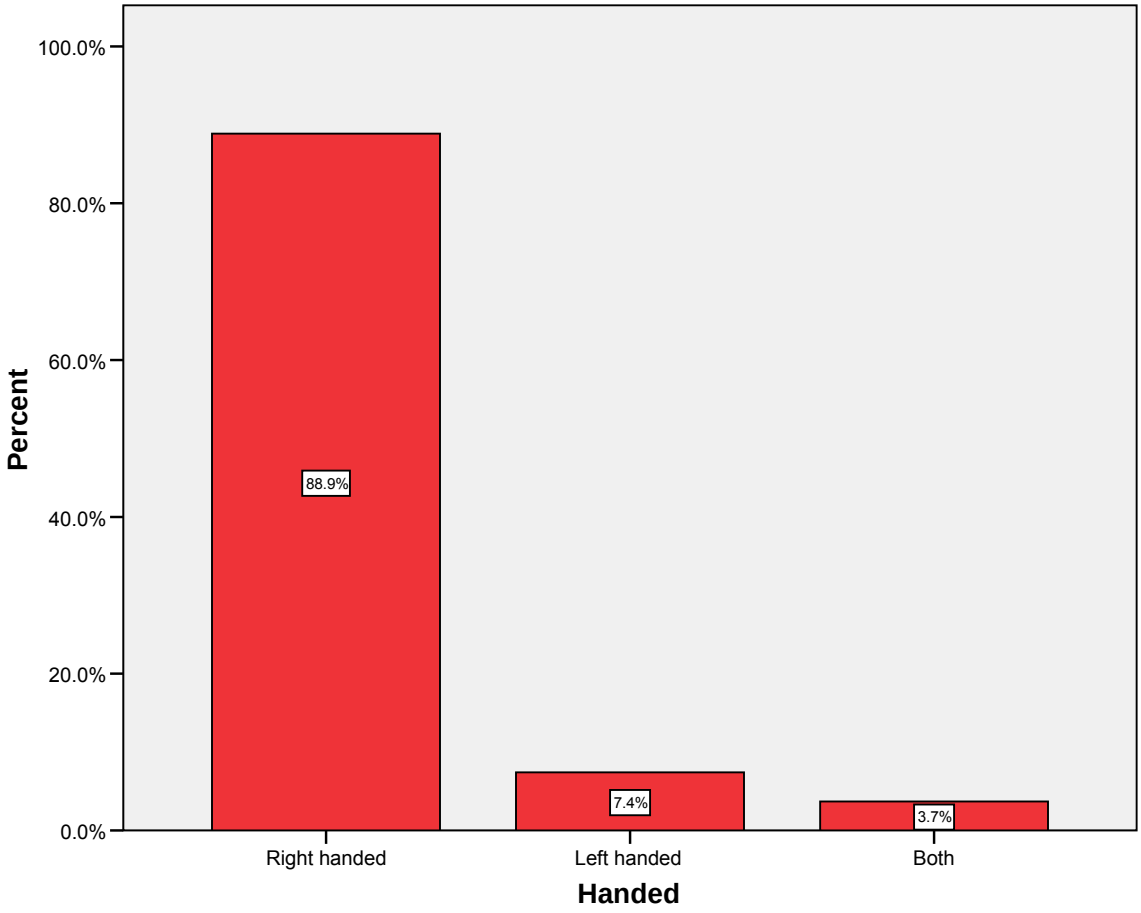


Figure 4.5: Handedness of Respondents

4.5.1.1.13 Smoking status of respondents

Tables 4.8 and 4.9 show that the majority of respondents did not smoke (n = 20). Of those that smoked, the majority (n = 4) smoked 10 – 15 cigarettes per day.

Table 4.8: Smoking status of respondents

		Frequency	Percent
Valid	Yes	7	25.9
	No	20	74.1
	Total	27	100

Table 4.9: Number of cigarettes smoked per day

		Frequency	Valid Percent
Valid	5-10	1	14.3
	10-15	4	57.1
	>20	2	28.6
	Total	7	100

4.5.1.1.14 Respondants engaged in Regular Physical Activity

Table 4.10 shows that 81.5% (n = 22) of respondents engaged in regular physical activity, with Figure 4.6 indicating gym work as their main form of exercise (62.96%, n = 17). The respondents had the opportunity to indicate if they were taking part in more than one type of physical activity.

Table 4.10: Respondents engaged in Regular Physical Activity

		Frequency	Percent
Valid	Yes	22	81.5
	No	5	18.5
	Total	27	100

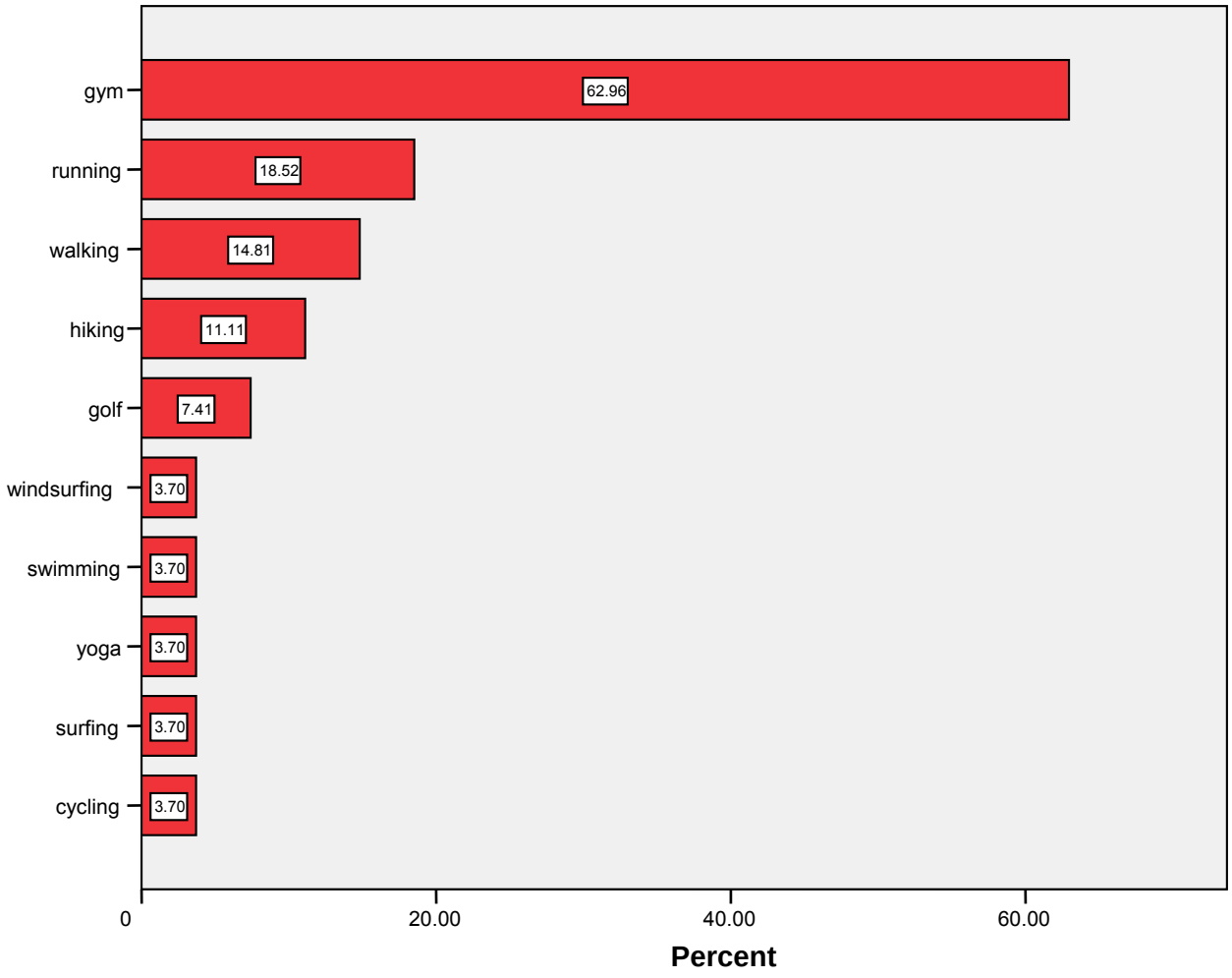


Figure 4.6: Exercise types performed by respondents

4.5.1.1.15 Demographic average

The demographic average for the string musician in South African Philharmonic orchestras was a Caucasian, right handed, non-smoking female, approximately 37.11 years of age (SD = 11.768), 1.5631 meters tall, with a weight of 62.96 kilograms (BMI = 25.768) who exercised regularly (primarily in the gym). A bachelors degree in Music was the most commonly awarded qualification, obtained between the years 2000 – 2009, from a foreign university, outside of the Republic of South Africa.

4.5.1.1.16 Discussion

Črnivec (2004) found that in the Slovene Philharmonic Orchestra, the average age of musicians was 46 years (SD = 9.4). The Kaneko *et al.* (2005) sample found an age range between 18 and 73 years of age (mean = 32.4, SD = 10.6); and the results from Heming's (2004) study showed an age range of 16 to 72 years (mean age = 40). In this study the age range was 23 to 61 years (mean 37.1; SD = 11.768).

The South African sample included only professionally qualified and performing musicians, thus the starting age of the youngest musician at 23 years can be explained by the four year degree required to achieve a bachelors degree in music. Other studies included music students and amateurs without a completed tertiary level education hence a younger starting age in these studies.

This study also found that the oldest musician was 61 years of age, seemingly 'younger' than oldest musician in other international orchestras. The CPO has a mandatory retirement age of 65 years (Christian, 2010). However, KZNPO was not permitted to divulge company policy (Peterson, 2010). It is therefore assumed that string players in South Africa enter mandatory retirement at an earlier age when compared to international orchestras.

Studies by Kaneko *et al*. (2005), Hagberg *et al*. (2005), Heming (2004), Roset-Llobert *et al*. (2000) and Fishbein *et al*. (1988) found that the general orchestral populations were majority males (ranging from 51% to 69.7%). In this study, female musicians were found to be in the majority at 68%. Studies by Abréu-Ramos and Micheo (2007), Kaneko *et al.* (2005), Dawson (2001), Yeung *et al.* (1999), Cayea and Manchester (1998), Zaza and Farewell (1997) Manchester and Flieder (1991), Middlestadt and Fishbein (1989), Lockwood (1988), Manchester (1988) and Fry (1986) have indicated that females are more at risk for developing PRMD's. Therefore total injury rates found in this study could potentially be elevated with the dominance of female string players.

Right handedness amongst musicians appears to be a common finding (Roset-Llobert *et al*., 2000; Abréu-Ramos and Micheo, 2007) as confirmed by this study in which 88.9% of musicians were right handed.

Zaza and Farewell (1997) found BMI amongst musicians at 24.6 kg/m^2, and this study found 25.7 kg/m^2. A higher BMI in South African string players is unaccounted for despite the high level of exercise (81.5%) amongst the musicians. According to Vizniak (2007) it is better to be slightly overweight and healthy through exercise, than it is to be an ideal weight and sedentary, as was found in this study in which the majority if respondents engaged in regular physical activity (81.5%, n = 22).

Črnivec (2004) noted that most of the members of the professional orchestras investigated had a university level qualification. This was similar to this study where 100% of respondents had university degrees. According to Ms A. Van der Linde, a university level education is not a requirement to enter a South African professional orchestra, thus the high level of education of the string players could offer some degree of protection against PRMD development, if attention was given to this facet of education.

Although the number of smokers in the investigated population was relatively low (25.9%), smoking has been identified as a risk factor for musculoskeletal disorders (Palmer *et al*., 2003). Despite this, according to the researcher, the

literature on professional musicians and the level of smoking amongst this population is under researched and possibly under recognised as a causative factor in PRMD development.

4.5.1.2 Section B: Musical Background

4.5.1.2.1 Question 1: Age at which the string musicians began to play any instrument

The results indicated that the average age of starting to play any musical instrument was 6.59 years of age (SD = 2.291). One participant indicated they started to play an instrument at the age of three (violin and recorder). In comparison, another participant indicated they only started to play an instrument (violin) at the age of 12.

4.5.1.2.2 Question 2: First instrument played by the string musicians

Table 4.11 shows that the first instrument learnt by 17 of the respondents was a string instrument.

Table 4.11: First Instrument played

	n
Glockenspiel	1
Piano	4
Piano/Guitar	1
Piano/Violin	2
Recorder	4
Recorder/Cello	1
Violin	14
Total	27

4.5.1.2.3 Question 3: String Instrument currently played in the professional orchestra

Figure 4.7 shows that the majority of respondants (51.85%, n = 14) were violin players.

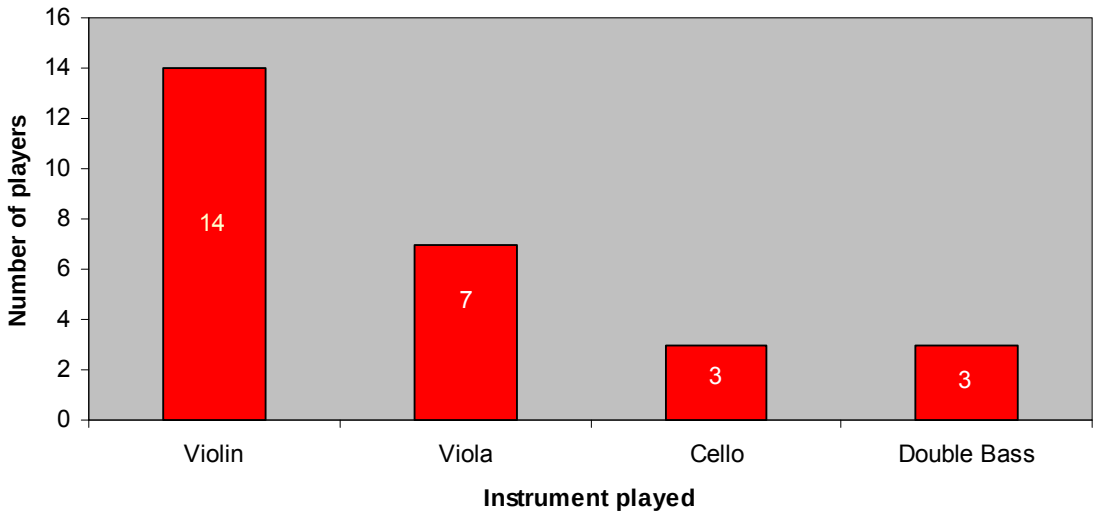


Figure 4.7: Instrument currently played in the orchestra by frequency

4.5.1.2.4 Question 4: Starting age of current string instrument

The average starting age for the current string instrument played in the orchestra was 10.11 years of age (SD = 6.110 years). The youngest starting age of the instrument currently played was 5 years of age (violin), with oldest being 28 years of age (viola).

4.5.1.2.5 Question 5: Other instruments played professionally

Only two respondents played other instruments professionally; these included the bass guitar (played 3 hours per week), and the viola (2 hours per week).

4.5.1.2.6 Question 6: Specific instruction on preventing physical injury related to playing a String Instrument

Figure 4.8 illustrates that 59% (n = 16) of respondents were not educated on preventing physical injury related to playing their instrument. Figure 4.9 illustrates that more South African trained musicians (22%, n = 6) had received instruction on injury prevention

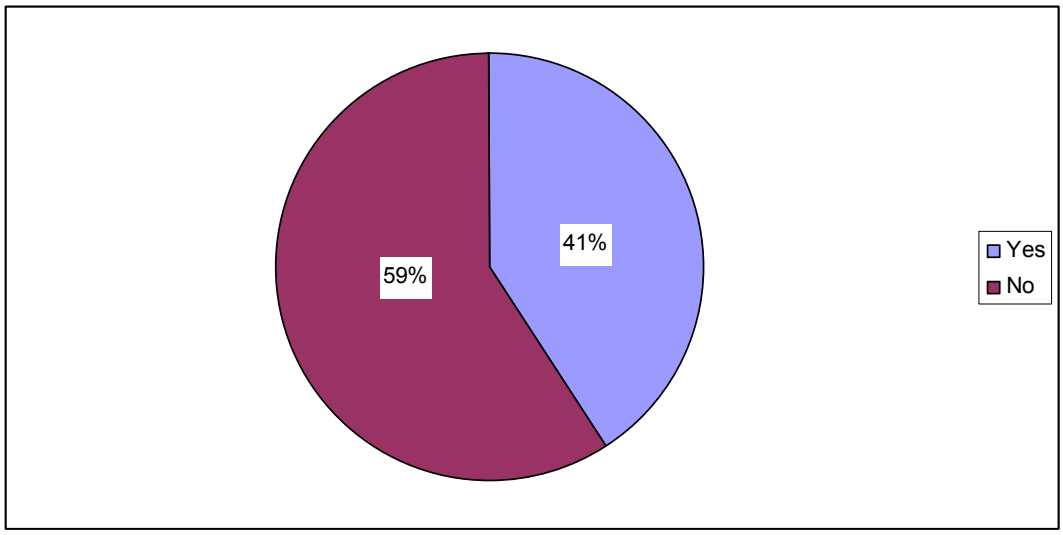


Figure 4.8: Instruction on preventing physical injury related to playing a String Instrument

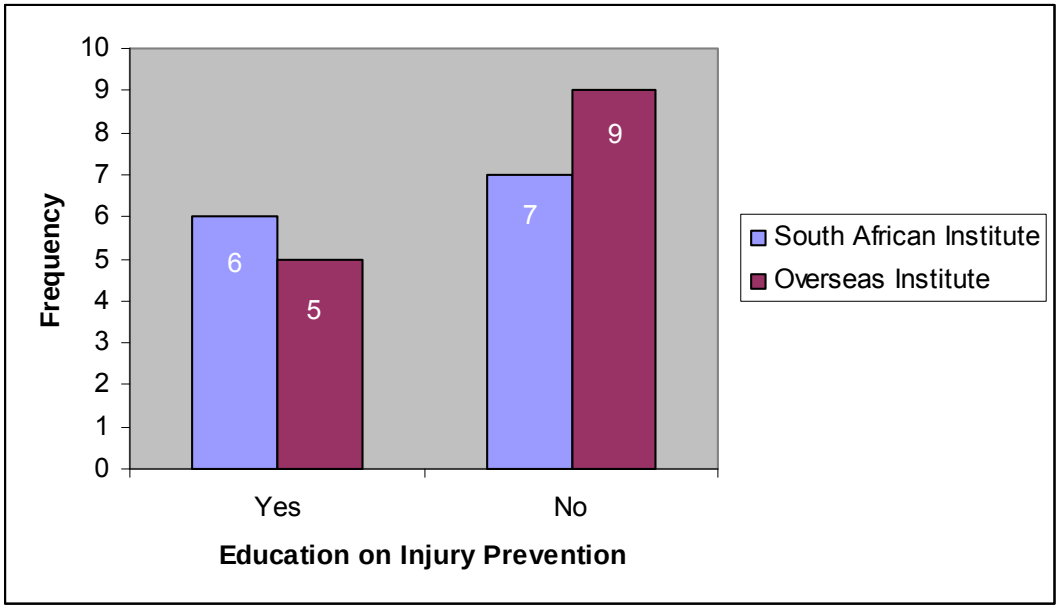


Figure 4.9: Comparison of locally trained musicians and musicians trained at overseas institutes with regard to education on injury prevention

4.5.1.2.6.1 Professional from whom instruction was received:

Figure 4.10 shows that 10 of the string players received instruction regarding injury prevention from a musical educator (music teacher/lecturer at university). If respondents had received instruction from more than one professional, they were asked to note this on the questionnaire. Additionally, if they had received instruction from a professional not mentioned, they were asked to list them under the "other" space provided in the questionnaire.

The one respondent, who noted "other" as a form of instruction, had received information on injury prevention through the practice of Yoga.

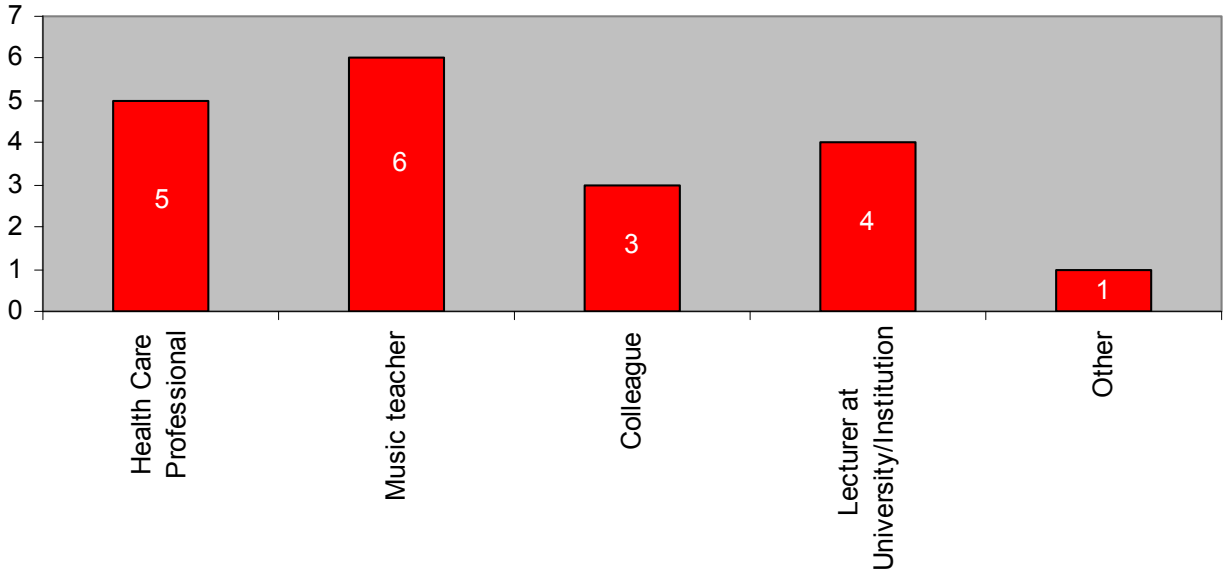


Figure 4.10: Professional (in frequency) from whom instruction was received

4.5.1.2.6.2 Type of instruction received (including duration):

Figure 4.11 shows the type of instruction received (in frequency), with one respondent noting that private lessons were received as a form of instruction.

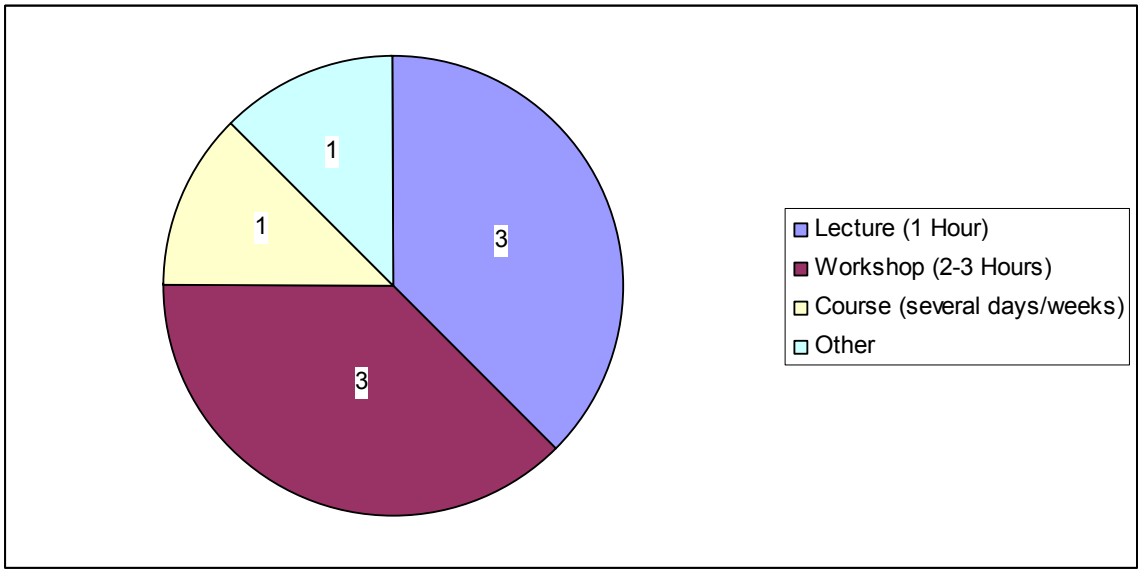


Figure 4.11: Type of Instruction received (including duration)

4.5.1.2.6.3 Specific Technique Name

The Alexander Technique was described as the specific instruction by four respondents. Five respondants noted that the technique taught to them was not given a specific name.

4.5.1.2.6.4 Technique change due to Specific Instruction

Of the 11 respondents who had received instruction on physical injury prevention related to playing their instrument, eight described positive changes to their playing technique following the instruction.

The changes made to the musicians playing technique were noted as:

- “Better posture behind instrument”
- “More relaxed arms and shoulders. Engaging stomach more”
- “Position of neck, relaxation of shoulders and arms, sitting position”

- “Posture and Technique”
- “Posture, usage of only necessary muscles, preferred use of back muscles”
- “Technique applied to playing in a master class”
- “Tension release, sitting position, shoulder/chin rest adjusting”
- “Using larger muscle groups, strengthening, warming up joints”

4.5.1.2.7 Question 7: Carrying of the Instrument

Two respondents (7.4%) (Double bassists) did not carry their instrument, as illustrated in Figure 4.12, as it was transported by the orchestra to the required venues for rehearsal or performance. The majority of respondents (66.7%, n = 18) carried their instrument by shoulder straps, mostly on the left shoulder (51.9%, n = 14). The respondents whose instrument cases had wheels attached for transport, all mentioned that the case was pulled (vs. pushing) using the right arm.

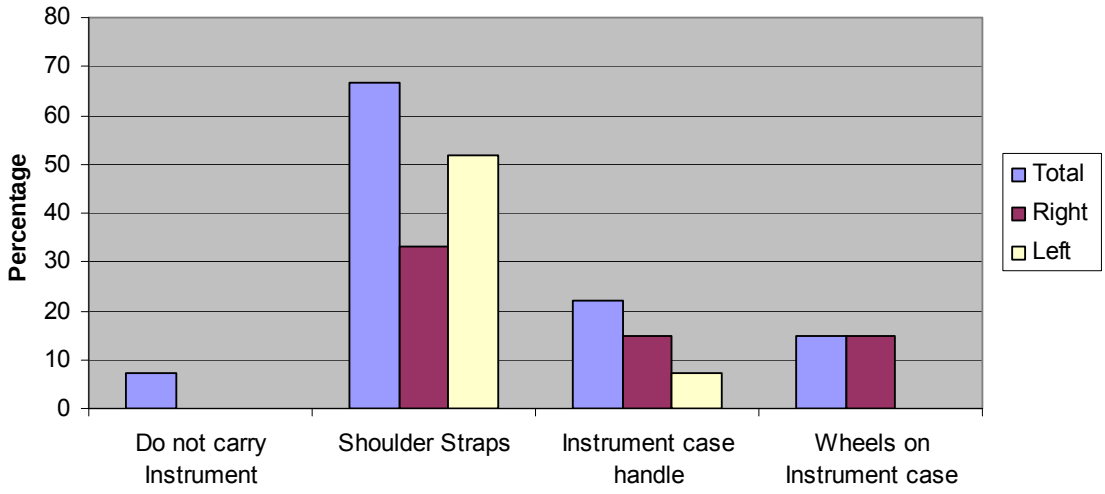


Figure 4.12 Carrying of the Instrument

4.5.1.2.8 Summary of Musical Background (Section B)

The average string player in a South African orchestra began playing a string instrument at the age of 6.59 years, after which the violin was started at the average age of 10.11 years. The musician carried their instrument by shoulder strap on their left shoulder. Mostly, the string musicians, received no instruction on preventing injury related to playing a string instrument.

4.5.1.2.9 Discussion

Kaneko *et al*. (2005) noted that individuals within the São Paulo symphonic orchestral population were introduced to their instruments from the ages of two to 25 years (mean = 10.6, SD = 4.2). Similar results were gained by Abréu-Ramos and Micheo (2007) (mean = 11.0, SD = 3.2) and Roset-Llobert *et al*. (2000) (12.74 years, SD = 11.12). Crnivec (2004) found that in comparison to other instrumental groups, string players were on average younger when they began to play their instrument (mean = 10 years of age, SD = 3.3, $p < 0.001$).

The results of this study indicated that the starting age of playing a string instrument was (mean = 10.11, SD = 6.110 years), with a range of five to 28 years of age being very similar to aforementioned studies.

The majority of respondents in this study were violin players. This is in line with the population of the string players in orchestras, in which the majority are violin players (Lamb-Cook and Lamb, 2001). Heming (2004), in contrast to Črnivec (2004), found that the upper strings (violin and viola players) were more commonly affected by PRMD's than the lower strings. Therefore with the majority of respondents being violin players, the injury rate could be slightly elevated.

The education of professional musicians performing in South African orchestras, with regard to injury prevention, at 41%, is slightly lower than that of Kaneko *et al*. (2005) at 53%. Just over half (51.85%, n = 14) of participants in this study were trained at overseas institutes, and it was expected that the level of education regarding injury prevention would have been at a higher level.

It was, however, found that only five of the 14 overseas trained musicians had received such instruction; with six of the 13 string players trained in South Africa having received instruction on injury prevention. Proportionally, it was therefore found that the South African string players had received a greater degree of instruction at 46% in comparison to the 36% of overseas trained musicians. This was an unexpected result when considering the initial informal interviews conducted by the researcher with regards to injury prevention in South African institutes.

A survey of conservatoire students regarding awareness and incidence of physical and mental health problems resulting from performing music; found that students revealed a significant inclination to go to their instrumental teacher first about health and psychological problems, before appropriate medical practitioners (Williamon and Thompson, 2006). In this study, it was similarly found that the musical educator (lecturer or teacher) was the primary source of information (n = 10) regarding injuries and their prevention when playing their instrument. This demonstrates that musicians have an affinity to consult with a musical expert for advice before a medical expert.

Khalsa *et al.* (2009) suggested that yoga and meditation techniques can reduce performance anxiety and mood disturbance in young professional musicians. One respondent in this study mentioned yoga as the primary source of information regarding injury prevention.

Those individuals who changed their technique due to education, listed principles similar to that of the Alexander technique (Rosenthal, 1987; Watson and Valentine; 1987), through which they learnt of body awareness and how it assists in injury prevention. Fjellman-Wiklund *et al*. (2003) monitored muscle activity in musicians who had undergone body awareness technique (BAT) training and compared this to a control group. The study found no differences in muscle activity between a group of violinists practicing a body awareness technique and the control group. However, the BAT-trained group perceived positive changes in

breathing, muscular tension, postural control and concentration mainly during practice sessions.

It is of interest that those who carried their instrument with shoulder straps (66.7%, n = 18), carried their instrument mostly on the left shoulder (51.9%, n = 14). The majority of the string players were right handed (88.9%, n = 24), and were using their non-dominant shoulder to carry the instrument, possibly to free their dominant arm for other use. The carrying of extra weight on the possibly weaker non-dominant shoulder could have put them at risk for injury development.

4.5.1.3 Playing Technique (Subsection of Section B)

4.5.1.3.1 Question 1: Technique change in the last 6 months

Table 4.12 shows that the majority of respondents (88.9%, n = 24) did not make significant changes to their technique in the last six months.

Table 4.12: Significant change of technique in the last 6 months

		Frequency	Percent
Valid	Yes	1	3.7
	No	24	88.9
	No Response	2	7.4
	Total	27	100

4.5.1.3.2 Question 2: Finger Isolation exercises

Figure 4.13 illustrates that 44% (n = 12) of participants utilised finger isolation exercises. Four participants did not respond to the question.

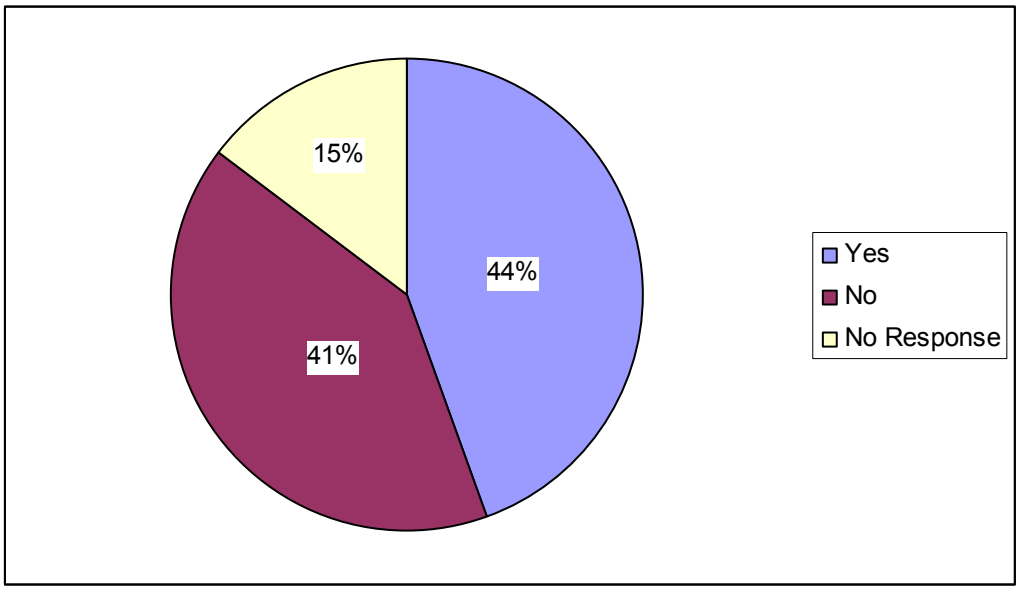


Figure 4.13: Practice of technical exercises specifically for Finger Isolation

4.5.1.3.3 Question 3: Body habitus when practicing

Nine respondents (33.3%) reported that they sat when practicing, with an equal number standing to practice. Seven respondents (28%) noted that they sit and/or stand during a practice session.

When sitting to practice, the string players sat equally (50%) 'high' or 'low' in their practice chairs. This refers to how 'up-right' the players sit, and is thus an indicator of posture during practice sessions.

4.5.1.3.4 Question 4: Warm-up without instrument before a practice session

Figure 4.14 shows that 66% (n = 18) of respondents did not warm-up without their instrument (e.g. stretching, yoga, meditation**)**. Three participants (12%) did not respond to the question.

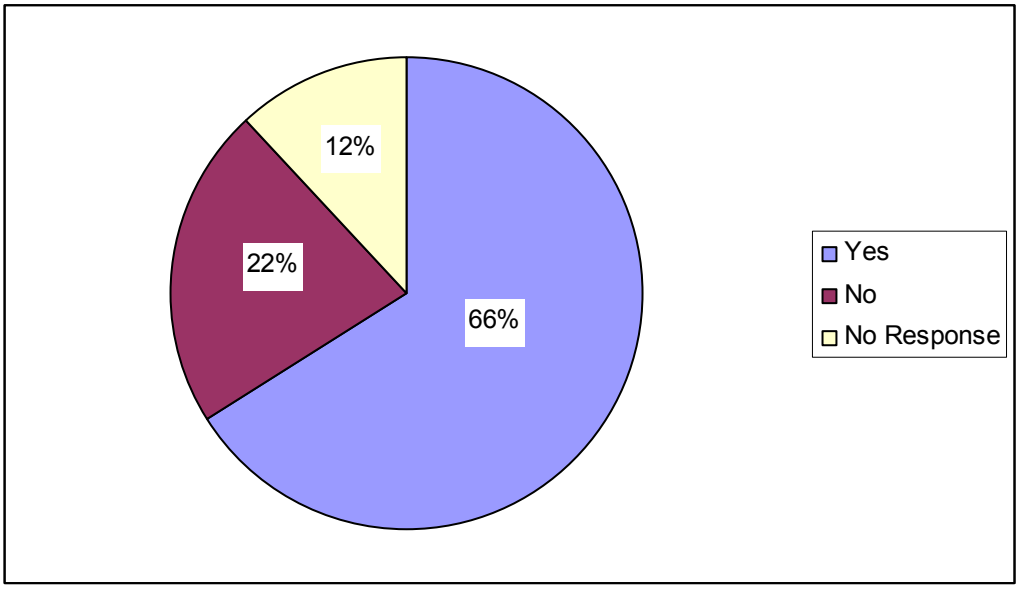


Figure 4.14: Warm-up without instrument before a practice session

4.5.1.3.5 Question 5: Warm-up exercises with the instrument before a practice session

Figure 4.15 shows that the most commonly performed warm-up exercises were Scales and Arpeggios (66.67%, n = 18), with most participants doing these exercises for more than five minutes. Three participants did no warm-up with their instrument.

Other exercises performed as a warm-up (not listed on the questionnaire) before a practice session (all of which were performed for more than 5 minutes) included:

- Finger Stretching
- Jack de Wet Exercises
- Left Hand Exercises
- Bowing Exercises
- Double Stops

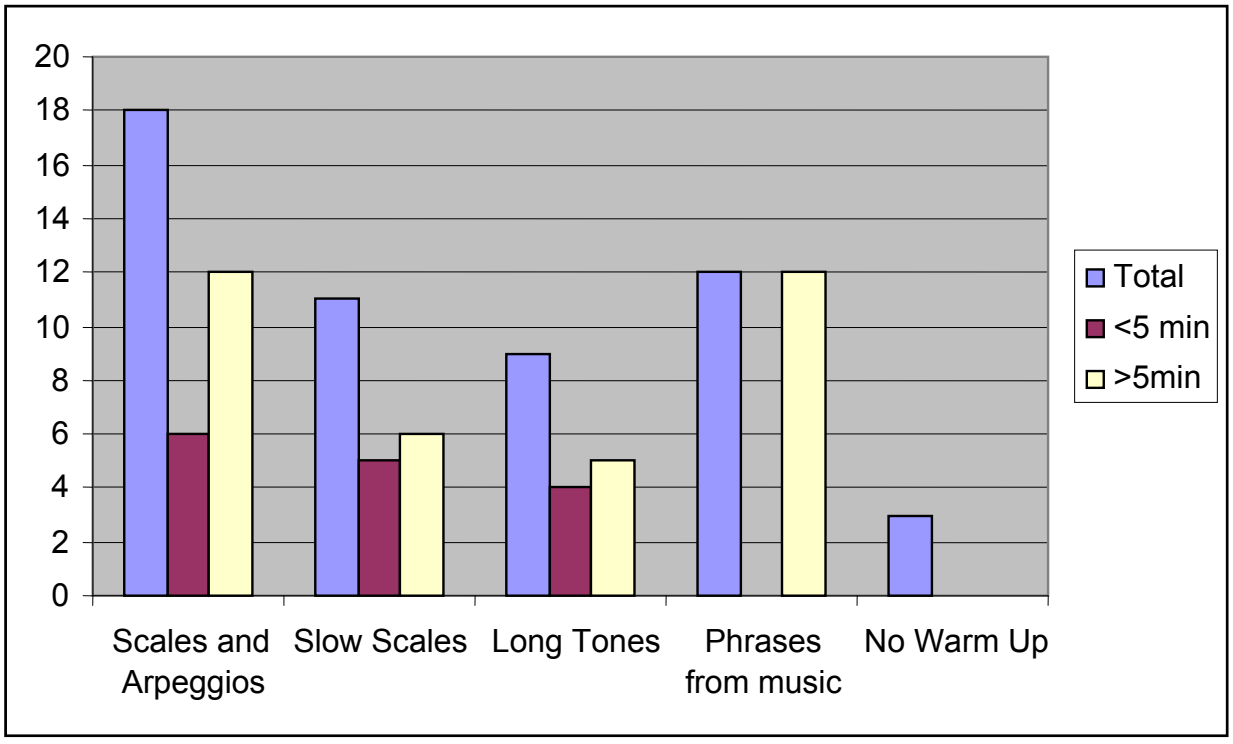


Figure 4.15: Warm-up exercises performed on instrument before practice (by number of musicians)

4.5.1.3.6 Question 6: Physical cool down after practice

Figure 4.16 shows that only 15% (n = 4) of respondents cooled down after a practice session.

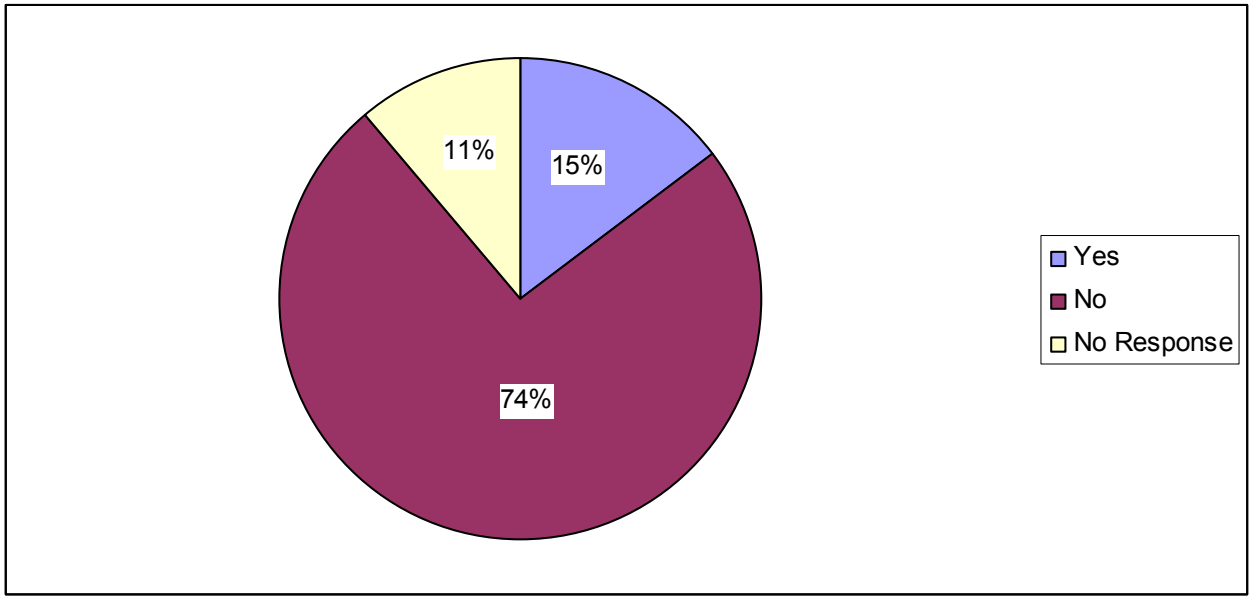


Figure 4.16: Physical cool down after practice

4.5.1.3.7 Question 7: Most common activity during rehearsal breaks

Figure 4.17 shows that 70.4% of the participants ate or drank during the rehearsal breaks. The total percentage is greater than 100% as musicians were asked to note up to three activities they do during rehearsal breaks.

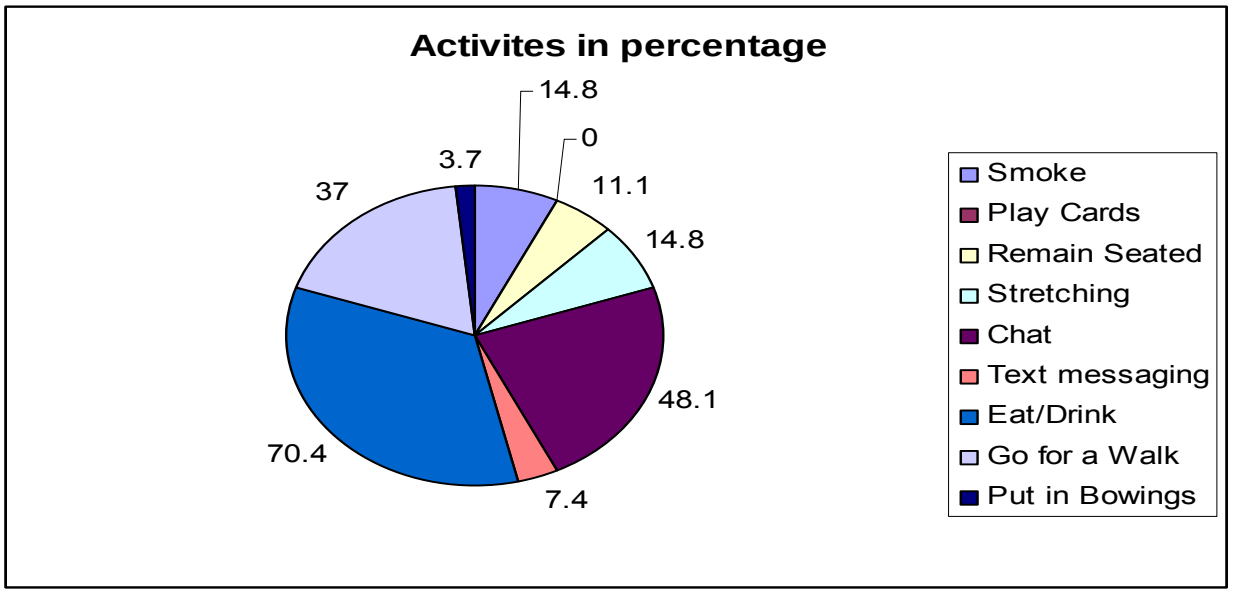


Figure 4.17: Most common activity during rehearsal breaks

4.5.1.3.8 Summary of Playing Technique

The average string player in a South African orchestra either sits or stands to practice, and if sitting, they sit high or low. Scales and arpeggios are warm-up exercises with the instrument before a practice session. No warm up exercises were performed without the instrument; no cool down exercises were performed after the rehearsal session either. Finger isolation exercises were performed regularly. Additionally, there was no change in playing technique in the last six months.

4.5.1.3.9 Discussion

Kaneko *et al*. (2005) found that 43% of the musicians had changed their musical technique at some time during their professional career. Zaza and Farewell (1997) found that 29.5% of musicians had made some type of change to their technique or playing habits, which resulted in a higher risk for injury development ($p < 0.001$). This study only assessed change in the last six months, in which 88.9% had made no change to their technique. Thus, no real comparison could be made to other studies in this regard.

Only three musicians (11%) admitted to not warming up with their instrument. Finger isolation exercises (a basic warm up technique, done repetitively in all finger frames and positions (Kennedy and Bourne, 1996), were performed by 44% of respondents. Warm-up's using the instrument is common amongst musicians (Zaza, 1992), with Abréu-Ramos and Micheo (2007) indicating that 90.7% of musicians perform a warm-up routine. In this study in 66.67% of respondents noted practicing scales and arpeggios as a common warm-up technique with the instrument.

The repetitive actions required to complete warm-up exercises could result in the development of an overuse syndrome as defined by Bejjani *et al*. (1996), with Yoshimura *et al*. (2008) having strongly correlated pain with warm-up routines. In contrast, Wristen (1998) mentioned that chances of injury are lessened by adequately warming up muscle tissue. Warm-up exercises, however, have been

noted as protective for PRMD's by Markison (1994), Zaza and Farewell (1997) and Yeung *et al*. (1999). According to the researcher, no studies specifically looked at the type of warm-up exercises performed and its association to injury.

Zaza (1994) found that a general body warm-up to prepare for music playing was less common practice, which again was similar in this study, in which 75% of participants admitted to no general body warm-up. A general body warm-up before instrumental warm-up would allow for further muscle stretching thus possibly further protecting against injury, and should be encouraged amongst the South African orchestras.

Practicing a physical cool down after a rehearsal session has been found as an uncommon practice, often as low as 20% in orchestral populations (Abréu-Ramos and Micheo, 2007). In this study, a cool down, of any type, was practiced by only four respondents (14.8%). Zaza (1994) and Heming (2004) both advocate a physical cool down after playing as a protective mechanism against injury. The low frequency of such practice in South Africa may predispose to further injury, and should be addressed and its use advocated to string players in the orchestras.

With regards to body position when practicing or playing, this study found no common position amongst the string players. There is a paucity in the literature examining the body position of the string players, whether seated or standing, during practice sessions. Musicians will remain in these positions for the duration of the rehearsal, with their posture worsening throughout the duration of the rehearsal, as noted by Fry (1986). Chan *et al.* (2000) and Heming (2004) both agree that orchestral seating arrangements, chairs and music stands should be ergonomically assessed as a risk for injury.

When the researcher informally interviewed a cello lecturer at a South African University, the lecturer alluded to the fact that orchestral management in South Africa should take greater care and responsibility when arranging orchestral seating, as they noticed through their professional career how the chairs that were used affected the musicians posture and resulted in back pain.

Therefore, in terms of body habitus when practicing, the results of this study have only a minimal amount of literature against which to be compared. However, it does appear to be a topic which generates a substantial amount of discussion, and should be addressed by the players and orchestral management to improve the playing environment.

Zaza (1994) mentions that in preventing injury, regular breaks should be taken during practice sessions, the content of the break was noted to be equally important as the frequency of breaks. The suggestion is that musicians should avoid activities which require repetitive motions similar to those used in playing their instrument. In this study only one participant noted that they put in extra bowings during breaks, the remainder however were involved in passive activities in which little repetitive action is required, besides the constant flexion of the elbow when lifting food and drinks to their mouths.

Although the physical activity during rehearsal breaks by the South African string players is limited, it could act as a protective mechanism against injury, and should be encouraged.

4.5.1.4 Section C: Occupational information

4.5.1.4.1 Question 1: Main profession as considered by the string musicians

The vast majority of the respondents (92.59%, n = 25) considered their main occupation to be a performing string musician, with 7.41% (n = 2) respondents considering their main profession to be a performing string musician and as well as music teacher.

4.5.1.4.2 Question 2: Number of years working as a professional musician

The average number of years working as a professional musician was 13.67 years. The least amount of time working as a professional was six months, with the most number of years being 40.

4.5.1.4.3 Question 3: Music teaching by the musicians

Most of the respondants (70.37%, n = 19) were currently teaching the instrument they were playing in the orchestra with 11.11% (n = 3) of respondents not involved in musical education at any level. One respondent (3.7%) was teaching the instrument played as well as the theoretical component of music education.

One respondent (3.7%) did not teach the instrument played in the orchestra, but was involved in Youth Orchestra Education (conductor). Two orchestral viola players taught the viola, as well as the violin, on a part time basis. One Violin player taught the violin as well as the piano. Four participants (14.81%) did not respond to the question.

4.5.1.4.4 Question 4: Practical teaching

Figure 4.18 shows that the respondents who were involved in practical teaching, taught mostly for 1 – 5 hours per week (71.4%, n = 15).

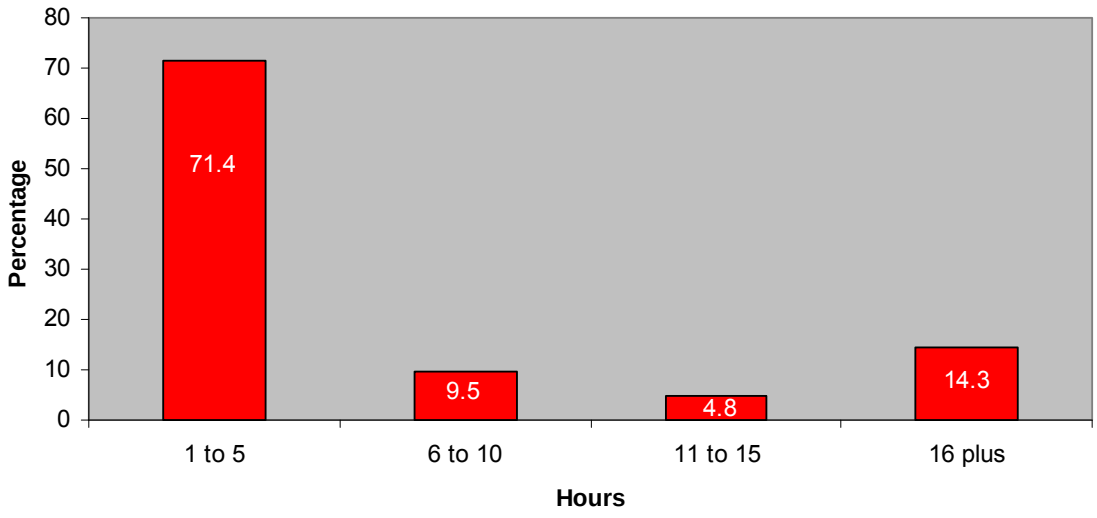


Figure 4.18: Number of hours per week engaged in Practical teaching

4.5.1.4.5 Question 5: Performance in other Musical Contexts

Performance in other musical contexts such as freelance, ensembles or bands, was found at 77.78% (n = 21) amongst the respondents, with 18.52% (n = 5) not involved in any other type of musical performance. One participant (3.7%) did not respond to the question.

4.5.1.4.5.1 Hours of Performance in other Musical Contexts

Figure 4.19 shows that the majority of musicians who performed in additional musical contexts, did so for mostly 1 to 5 hours per week.

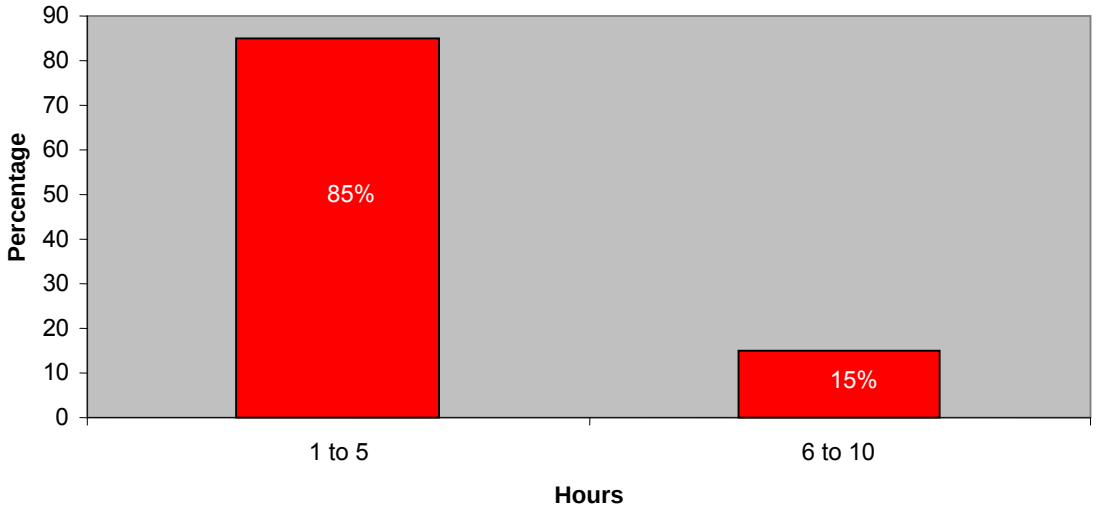


Figure 4.19: Number of hours per week performed in other musical contexts

4.5.1.4.6 Question 6: Non-music related work

Only 7.4% (n = 2) of respondents were involved in non-music related work. One of the respondents indicated that they were involved in gardening as non-music related work, although the number of hours per week involved in this activity was not indicated. This musician also indicated that she was currently suffering with PRMD's.

4.5.1.4.7 Financial situations of string players

4.5.1.4.7.1 Question 7: Orchestral salary sufficient to cover monthly expenses

Figure 4.20 shows that for the majority of respondents (70.37%, n = 19), their orchestral salary alone was not sufficient to cover their monthly expenses.

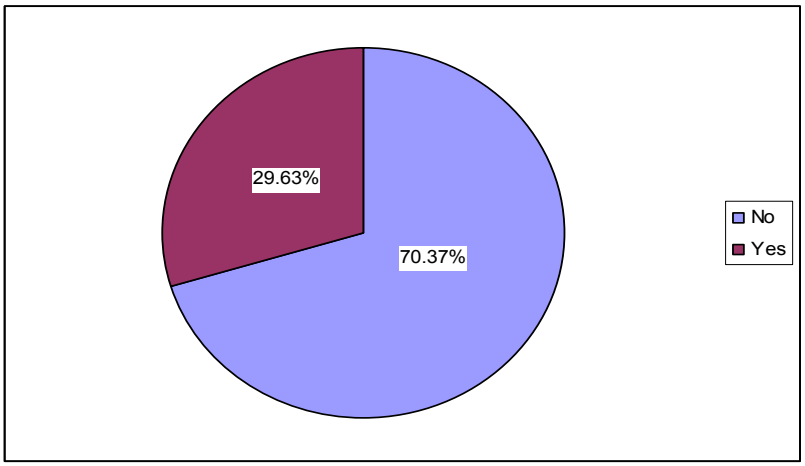


Figure 4.20: Orchestral salary sufficient to cover monthly expenses

4.5.1.4.7.2 Question 8: Orchestral salary in addition to other income as sufficient

Figure 4.21 shows that 48.15% (n = 13) of respondents were able to cover their monthly expenses if their orchestral salary was supplemented.

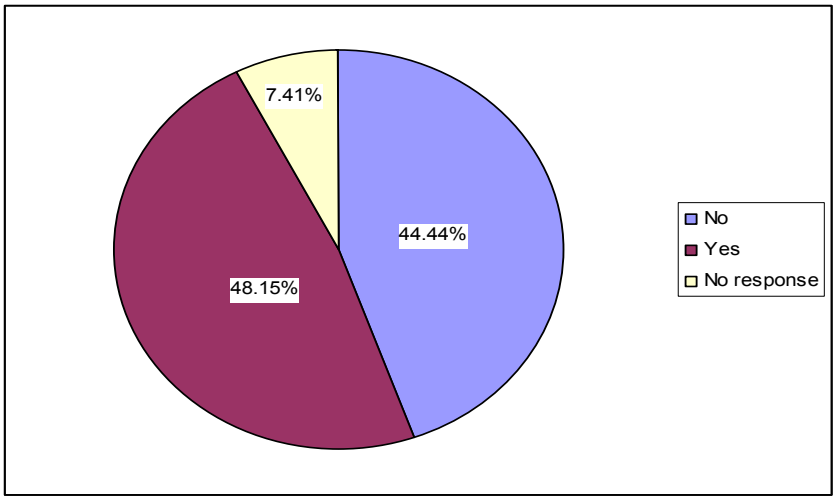


Figure 4.21: Orchestral salary in addition to other income as sufficient

4.5.1.4.7.3 Question 9: Financial stress

Respondents were asked to rate their financial stress on a Licket scale, with 1 = no stress and 5 = severe stress. Figure 4.22 shows that 33.3% of the string population experienced a high level of stress with regards to their finances.

This specific question appeared to strike a proverbial “chord” amongst musicians, with many writing additional remarks alongside the simple ‘yes/no’ question. One respondent stated “despite working the same hours as my husband, in a similarly demanding job, his salary is four times that of mine”. Another participant added a similarly relevant comment of “currently under severe financial strain”.

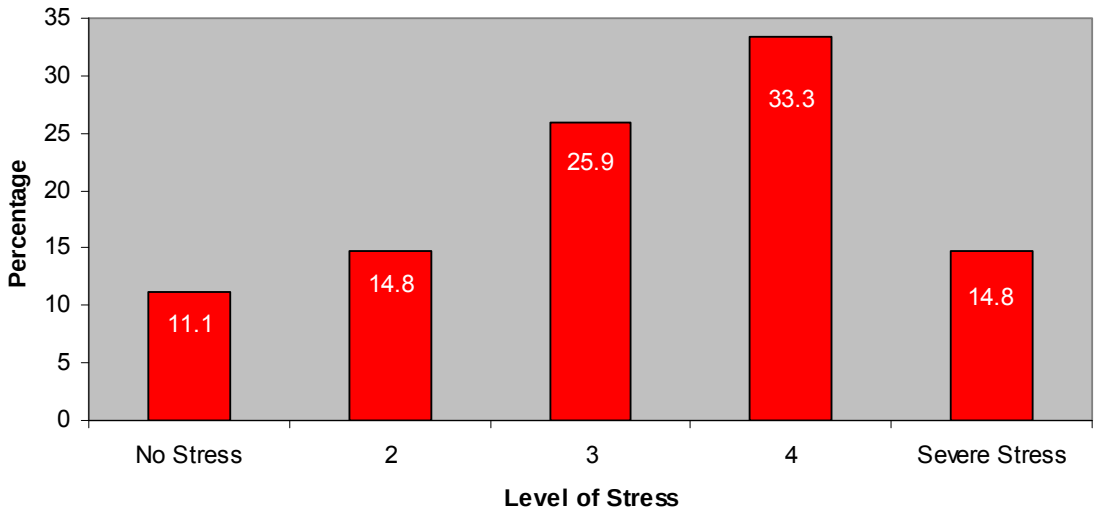


Figure 4.22: Level of financial stress experienced by the musicians

4.5.1.4.8 Summary of Occupational average

The average string player in a South African orchestra considered their main profession to be a performing musician, having worked 13.67 years as a professional performer. They mostly taught the instrument, with which they performed, for an average of 1 to 5 hours per week. Additionally, they performed in other musical contexts (apart from philharmonic) for 1 to 5 hours per week. Financially they were not able to cover monthly expenses with their orchestral salary alone. However, with other sources of income they were able to cover necessary expenses. Financially a stress rating of 4 out of 5 (where 5 was severe stress) was identified.

4.5.1.4.9 Discussion

Kaneko *et al.* (2005) found the length of professional careers ranged from three months to 56 years (mean = 12.5, SD = 9.9). Črnivec (2004) found that the average total length of service was at 23 years (SD 9.6). Zaza and Farewell (1997) found the number of years playing an instrument professionally at 17.6 years. This study at 13.67 years is thus in a similar range to that of other studies. The lower value in comparison to Zaza and Farewell (1997) and Črnivec (2004) could be because many (44%, n = 12) of the string players investigated in the study, obtained their qualifications between 2000 and 2009, indicating that almost half of the respondents had been playing professionally for a relatively short period (between 0.5 and 9 years).

Heming (2004) found that 63% of professionals taught the instrument they played. Similarly, Abréu-Ramos and Micheo (2007) found that 73.3% of the professionals in their study taught the instrument they played. Kaneko *et al*. (2005) found that on average each musician held two music related jobs.

Although 92.59%, of the musicians in this study considered their main profession to be a performing musician, 70.37% of the population additionally taught the instrument they played. Although this is similar to other studies, the high figure is still important when one considers time spent playing in a professional orchestra,

which is a full time occupation, coupled with teaching in the hours when not rehearsing with the orchestra. Roset-Llobert et al. (2000) and Fjellman-Wiklund and Sundelin (1998) both noted how music teachers suffer more with injury. Hence the combination of performance and musical teaching could place a high number of South African professional string players at greater risk for injury development.

Ms A. Van der Linde mentioned the shortage of professional string musicians in South Africa, which has subsequently resulted in more total playing hours per week. This comment was therefore confirmed by this study in which 77.78% (n = 21) of string players additionally performed in other musical contexts. This added time spent playing the instrument could thus effectively place the musicians at greater risk for injury.

There is a paucity of literature about the financial stress experienced by professional orchestral musicians, with Kaneko *et al.* (2005), remarking fleetingly about finances and job dissatisfaction amongst musicians.

This study revealed that a vast majority of musicians in South Africa are under severe financial strain, thus necessitating a second job to supplement their income. This high level of stress amongst respondents could lead to the exacerbation of illness and musculoskeletal pain as noted by Steptoe (1991).

4.5.1.5 Objective One: Conclusion

To determine the demographic profile of string players in South African Philharmonic orchestras.

On average, the demographic profile of the South African professional orchestral string musician is very similar to international studies. The most relevant difference could be the gender distribution in South African orchestras, in which the majority were female (62.96%, n = 17).

4.5.2 Objective Two

To determine the prevalence of musculoskeletal injuries amongst the string players in South African Philharmonic orchestras.

The point prevalence in the sample was 63% (n = 17). The 95% confidence intervals of this estimate were 42.4% to 80.6%.

4.5.2.1 Discussion

A similar prevalence of 66% was found by Middlestadt and Fishbein (1989), on a separate analysis of string players in their study on the International Conference of Symphony and Opera Musicians (ICOSM). However, Roset-Llobert *et al.* (2000) found that 85.1% of bowed string musicians (including professional and student musicians) suffered from a musculoskeletal disorder.

When compared to general musician populations, the prevalence found in this study was similar to Yeung *et al.* (1999) at 64%, and within the 39% to 87% range proposed by Zaza's (1998) systemic review of the literature.

Thus, despite the unique environment encountered in South Africa, the prevalence of musculoskeletal disorders amongst professional orchestral string musicians is similar to that of international studies of the same nature.

4.5.3 Objective Three

To determine the profile of musculoskeletal injuries amongst the string players in South African Philharmonic orchestras.

Results were obtained from Section D (Playing related musculoskeletal problems) in the study questionnaire. The results of each section are discussed below each area of injury.

4.5.3.1 Question 1: Part of the body in which a playing related musculoskeletal disorder was experienced during the preceding 12 month period (December 2008 – December 2009) period.

Figure 4.23 shows that the majority (48.64%; n = 54) of the injuries occurred around the spinal column (neck, upper back and lower back), followed by the upper extremity (shoulder and upper arm, elbow and forearm, wrist, hand and fingers) (40.54%; n = 45).

Many of the respondents mentioned that they had pain in an area, but did not mention if the pain was unilateral or bilateral.

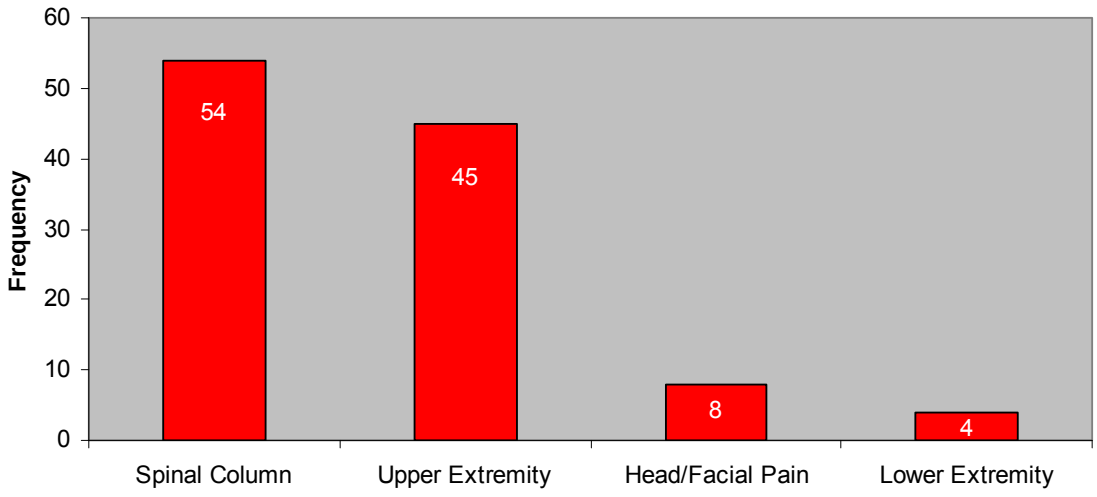


Figure 4.23: Area of PRMD's in the body

Table 4.13 shows that the upper back (defined as the area between the shoulder blades) was the most commonly injured area of the body (77.8%, n = 21). There were no reports of ankle or knee pain.

Table 4.13: Areas of the body injured in the last 12 months

	Count	Row N %
Upper back	21	77.8%
Shoulder	19	70.4%
Neck	18	66.7%
Lower back	15	55.6%
Elbow	7	25.9%
Hand	7	25.9%
Fingers	7	25.9%
Jaw	6	22.2%
Wrist	5	18.5%
Hips	4	14.8%
Face	2	7.4%
Knees	0	0%
Ankles	0	0%
Total	111	411.1%

Discussion:

In this study there was a high rate of injury (6.53 PRMD's per player over a 12 month period). This equates to 111 reported injuries in a population of 27 string players. Črnivec (2004) similarly found an average of five health problems in each musician. Rush (2003) mentions that due to the repetitive movements and unnatural positions required for playing the instruments, a high injury rate is expected.

Aside from the awkward position required for playing a string instrument, South African string players could be presenting with a high rate of injury due to the high level of stress encountered in the sample (sections 4.5.1.4.7.3 (financial stress) and 4.5.3.11 (stress level before injury). Stress, as noted by Steptoe (1991), is conclusively linked to illness, and could thus have contributed to this high injury rate.

In the following subsections, the rates of injury will be discussed in relation to the total population, as well as percentages given according to the instrumental group populations (Violin, n = 14; Viola, n = 7; Cello, n = 3, Double Bass, n = 3).

4.5.3.1.1 The Upper Back (area between the shoulder blades)

The upper back was injured in 77.8% (n = 21) of string players. Figure 4.24 shows that 71% (n = 10) of the violin players, 71% of the viola players (n = 5), and 100% (n = 3) of the cello and double bass players had an injury of the upper back.

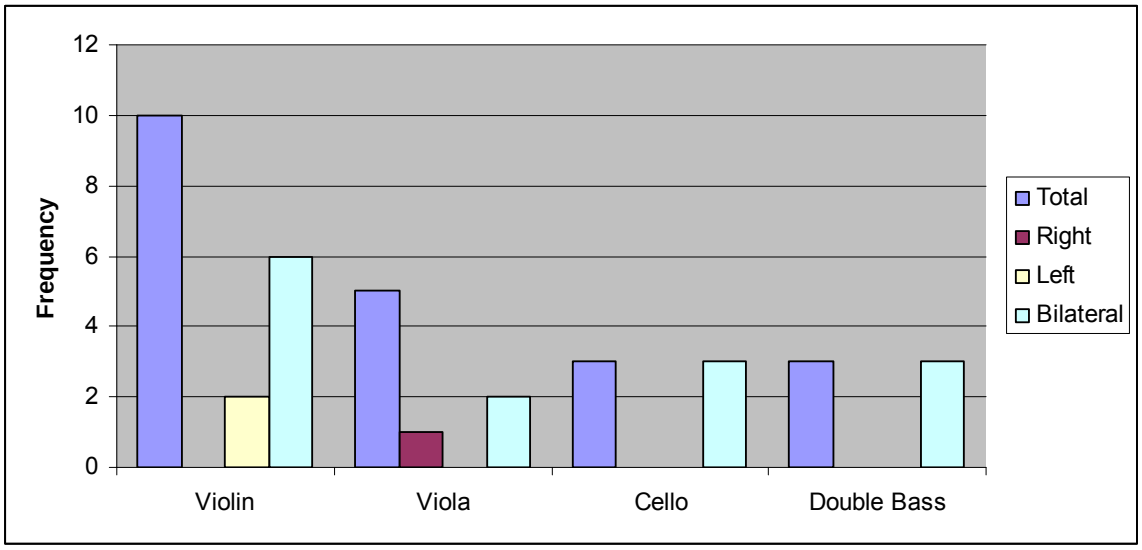


Figure 4.24: Upper Back Injury by Instrument and Side

Discussion:

This study had a higher upper back injury rate when compared to other studies, in which rates varied between 7.2% (Kaneko *et al.*, 2005) and 34% (Roset – Llobert *et al.*, 2000) for upper back pain. Possible reasons for this could be the stress experienced by the respondents, the manner in which the instruments are carried, and the predominance of violin and viola players in the sample.

Travell, Simons and Simons (1999) note that the upper trapezius muscle, with symptomatic (active) myofascial trigger points, can refer pain to the area between

the shoulder blades. They attribute this to chronic injury due to overload or microtrauma, as would be the case in string musicians who hold certain postures for prolonged periods whilst playing (see section 2.2.4) or due to “sustained load in habitual elevation of the shoulders as an expression of anxiety or emotional distress”, such as in an individual who is experiencing elevated stress levels.

As stated by Sternbach (1993), high stress is common among musicians; and this was found in the South African sample, with 48.1% of the South African respondents indicating moderate to severe financial stress (see section 4.5.1.4.7.3), and furthermore, 47.4% of the string players were moderately stressed before an injury occurred (see section 4.5.3.11). Therefore, as a result of high stress levels, there could be a high rate of pain in this area.

Backpacks using shoulder straps are also mentioned, by Travell, Simons and Simons (1999), as a cause of trapezius injury. With 66.7% (n = 18) of respondents mentioning the use of shoulder straps to transport their instruments (see section 4.5.1.2.7), this factor may have contributed to upper back pain.

The majority of respondents in this study were violin and viola players (77.78%, n = 21). Violin and viola players keep their left shoulders and neck in a state of static contraction to play their instruments (see section 2.2.4.1), which predisposes them to developing myofascial trigger points, especially of the trapezius (Travell, Simons and Simons, 1999). Other muscles implicated with the development of myofascial trigger points and referred pain to this region, include the scalenii, levator scapulae, supraspinatus, multifidi, triceps and biceps brachii, and rhomboids. These muscles are all used in the positioning and playing of the violin and viola, and could therefore, if strained, worsen the pain felt in the upper back region.

4.5.3.1.2 The Shoulder or Upper Arm

The shoulder or upper arm was injured in 70.4% (n = 19) of respondents. Figure 4.25 shows that 71% (n = 10) of the violin players, 71% (n = 5) of the viola players and 67% (n = 2) of the cello and double bass players reported injury of this area.

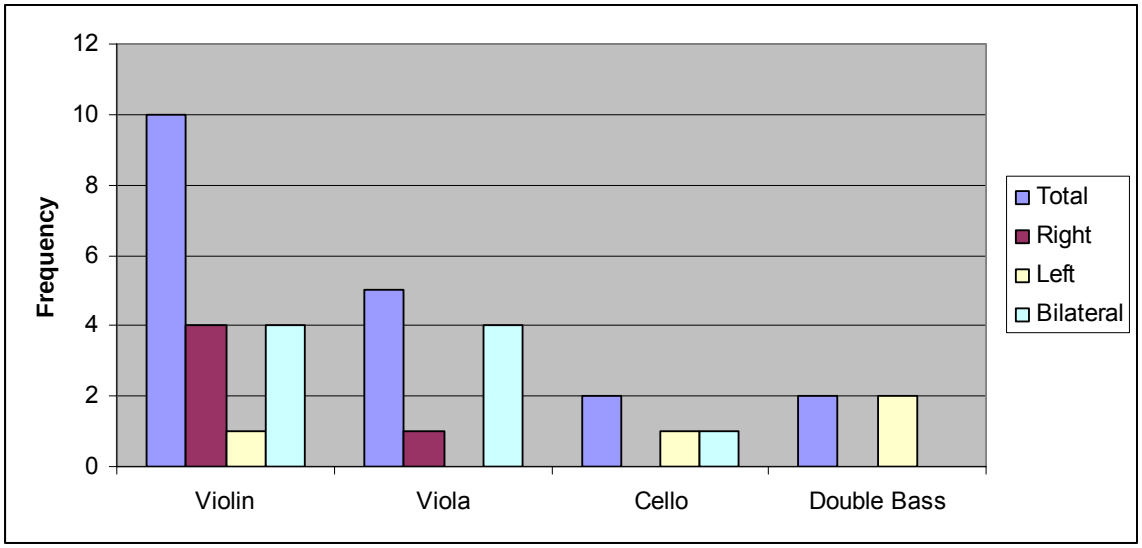


Figure 4.25: Shoulder or Upper Arm Injury by Instrument and Side

Discussion:

The results of this study are supported by Hagberg *et al.* (2005) who found that string musicians had a high incidence of pain in the right shoulder (4.6 disorders per 1000 years of instrumental practice). Fishbein and Middlestadt (1988) found that the right shoulder was often injured due to the bowing activities shared by these instruments.

The violin and viola players were especially affected in the shoulder, with 71% of both populations suffering from shoulder pain. In both instrument groups there is a sustained state of abduction and flexion of the right shoulder when playing, and this may result in rotator cuff tendonitis if the tension is not released (Chong *et al.*, 1989). This further explains the high rate of injury in this group.

The rates of shoulder injury found in this study (70.4%; n = 19) were higher when compared to other studies. The highest international rate was found by Abreu-Ramos and Micheo (2007) at 52% amongst violinists and violists. This higher injury rate in South Africa may have been due to the increased playing time experienced by local musicians as mentioned by Van der Linde (2009).

4.5.3.1.3 The Neck

Injury of the neck was reported in 66.7% (n = 18) of respondents. Figure 4.26 shows 64% (n = 9) of violin players, 71% (n = 5) of viola players, and 67% (n = 2) of cello and double bass players reported neck injury.

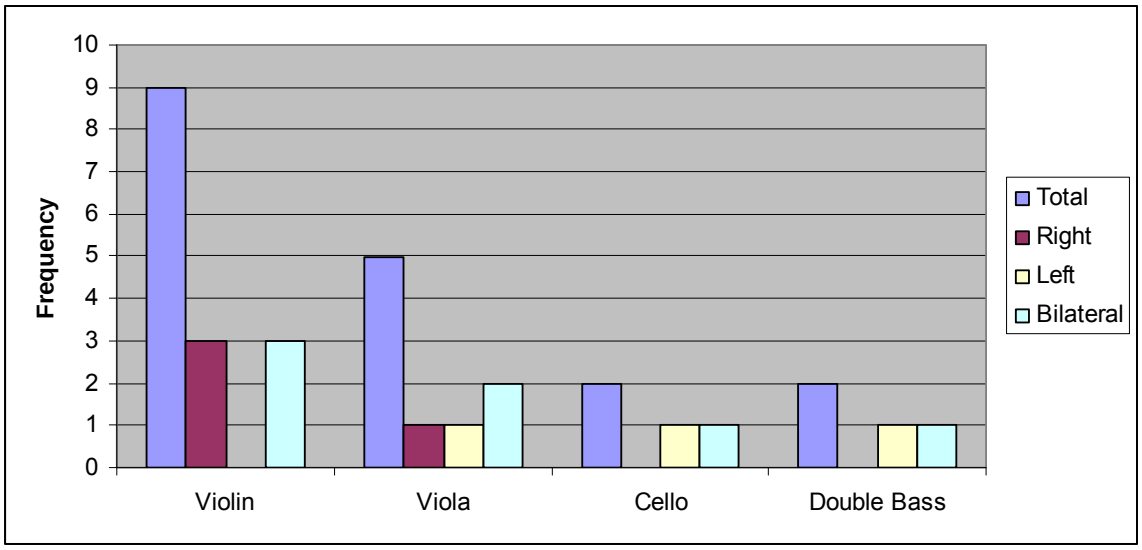


Figure 4.26: Neck Injury by Instrument and Side

Discussion:

The rate of neck injury in this study was similar to Roset – Llobert *et al.* (2000) who found a neck injury rate of 70.5% (n = 1639) amongst a general musician population. The injury rate was however, higher than that found by Fishbein and Middlestadt (1988), who found a 28% prevalence of neck injury amongst a professional string population (n = 1378). Possible reasons for this could be high stress levels experienced by the musicians in this study, both in financial terms and from increased playing time. In addition, there were more females in this

study than in other studies; and female participants have been found to be more prone to injury (Abréu-Ramos and Micheo, 2007).

Violin and viola players were significantly affected in the neck region. The neck position to play their instruments requires constant and static left rotation and lateral-flexion of the neck (Berque and Gray, 2002) (section 2.2.4.1 and 2.2.4.2). Muscles required to maintain this position of the neck are the levator scapulae, sternocleidomastoid, trapezius, posterior cervical muscles (Moore and Dalley, 1999). If these muscles are kept in a constant state of contraction, they may develop active or latent myofascial trigger points (Travell, Simons and Simons, 1999), which all could radiate pain to the neck region, resulting in increased pain levels in the neck.

Articular dysfunction of the joints of the neck can be a source of referred pain in this region (Travell, Simons and Simons, 1999). With the constant strain put onto the joints during playing the instruments, the articular joint dysfunction of the neck would contribute to pain experienced by the players.

4.5.3.1.4 The Lower Back (small of back)

Lower back injury was reported by 55.6% (n = 15) of respondents. Figure 4.27 shows 57% (n = 8) of violin players, 71% (n = 5) of viola players, and 33% (n = 1) of cello and double bass players reported lower back injury.

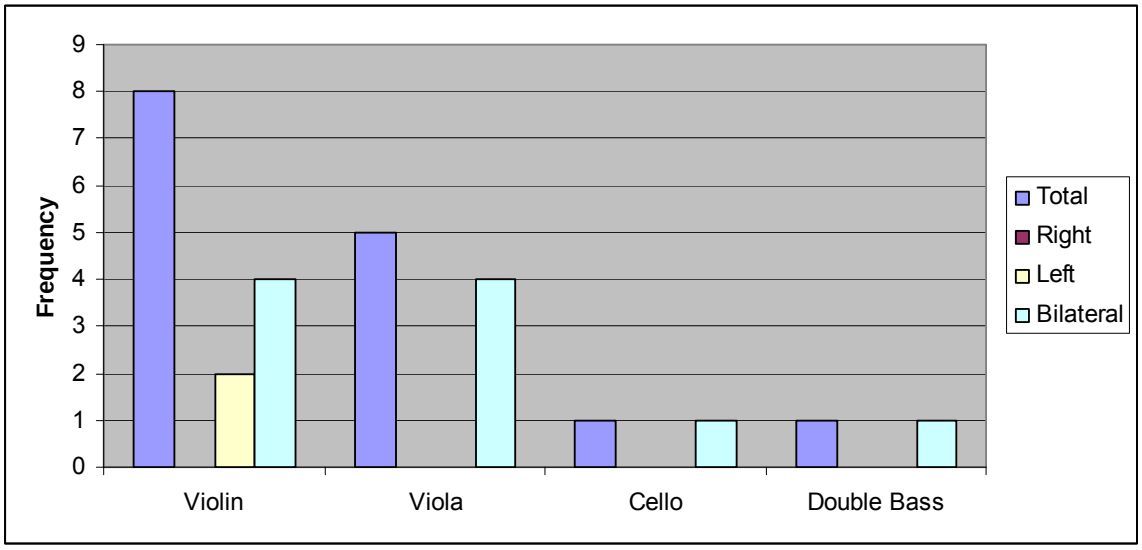


Figure 4.27: Lower Back Injury by Instrument and Side

Discussion:

Over half of the injured respondents in this study complained of low back pain which is in contrast to Fishbein and Middlestadt (1988) who found that only 26% of the string players were injured in this area. Cellists and double bassists had the least low back pain at 33%. This is an unexpected result as Abreu-Ramos and Micheo (2007) found that double bassists and cellists commonly suffer with back problems with Mattlin (2007) attributing this to their playing positions.

The low back has been linked with emotional distress (Kirkaldy-Willis and Burton, 1999) through muscle contraction and posterior facet joint strain. Emotions such as tension, stress and anxiety have been mentioned as the most common emotional disturbances contributing to low back pain. The musicians in the study were found to be stressed both financially and just prior to injury. The high rate of low back pain could thus have been caused by the level of stress experienced by these musicians.

4.5.3.1.5 The Elbows or Forearms

Elbow injury was reported by 25.9% (n = 7) of respondents. Figure 4.28 shows 14% (n = 2) of violin players, 43% (n = 3) of the viola players and 67% of the double bass players (n = 2) reported elbow or forearm injury. The cello players reported no elbow or forearm injury.

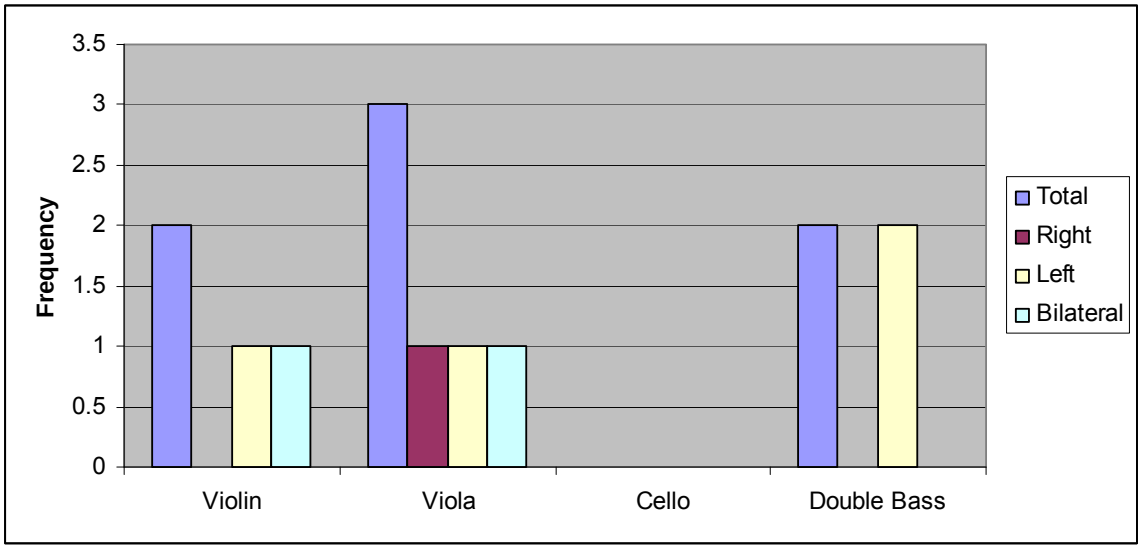


Figure 4.28: Elbow or Forearm Injury by Instrument and Side

Discussion:

Hagberg *et al*. (2005) found that musicians with a string instrument as their main instrument had four times the incidence of right elbow/ forearm disorders and twice the incidence left elbow/forearm disorders compared to musicians who had piano as the main instrument.

Similarly, Fishbein and Middlestadt (1989) found the elbow to be affected in 23% of the string population. However, they found all string components to be relatively equally affected, whereas in this study, the viola and double bass players were more affected, with no cello players being affected. This is an unaccounted for anomaly.

The elbow is commonly an area of referred pain, especially from neck and shoulder muscles (Travell, Simons and Simons, 1999). With a high rate of injury found in these areas in this study, the high rate of elbow pain may be explained purely through referred phenomena.

The carrying angle of the elbow is greater in females than in males (Moore and Dalley, 1999). The increased carrying angle amongst the greater female population in this study, may have contributed to a higher level of elbow disorders in this study. This hypothesis of an occupational disadvantage in female string players requires further investigation.

4.5.3.1.6 The Hand

Hand injury was reported by 25.9% (n = 7) of respondents. Figure 4.29 shows 29% (n = 4) of violin players, 29% (n = 2) of viola players and 33% of double bass players (n = 1). No cello players reported hand injury.

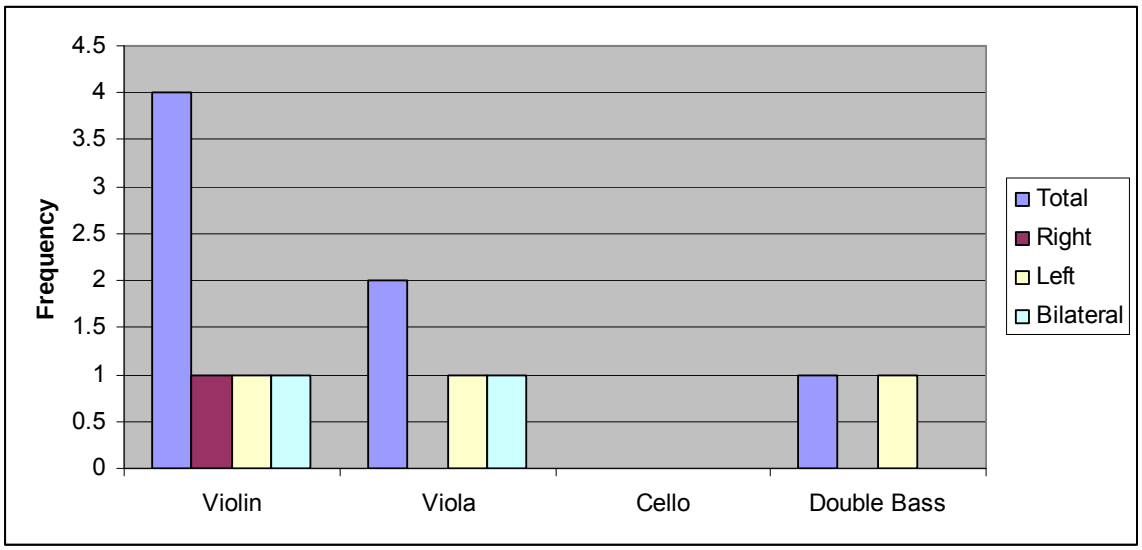


Figure 4.29: Hand Injury by Instrument and Side

Discussion:

Fishbein and Middlestadt (1989) showed an overall hand injury rate of 18% for string musicians. Fishbein and Middlestadt (1989) also found that as the size of the string instrument increased from violin to viola to cello, so did the risk for severe musculoskeletal problems at the hand and wrist. In contrast, the results of this study showed that players of the larger instruments had fewer hand injuries, when compared to the upper string (violin and viola), as only one double bass player and no cello players complained of injury. The small response rates (comprising of only three cello and three double bass players) for these groups could have influenced the results.

The rate of 25.9% found in this study is lower than that found by Fry (1986), but higher than that found by Fishbein and Middlestadt (1989). Fry (1986) examined the general orchestral population which may have elevated the results. Abreu-

Ramos and Micheo (2007) found that 29% of cellists and double bassists had some type of hand injury, with 24% of violinists and violists being affected. They however examined lifetime prevalence in comparison to the point prevalence of this study which could have increased their injury rates.

4.5.3.1.7 The Fingers

Finger injury was reported by 25.9% (n = 7) of respondents. Figure 4.30 shows 29% (n = 4) of violin players, 29% (n = 2) of viola players and 33% (n = 1) of double bass players reported finger injury. No cello players reported finger injury.

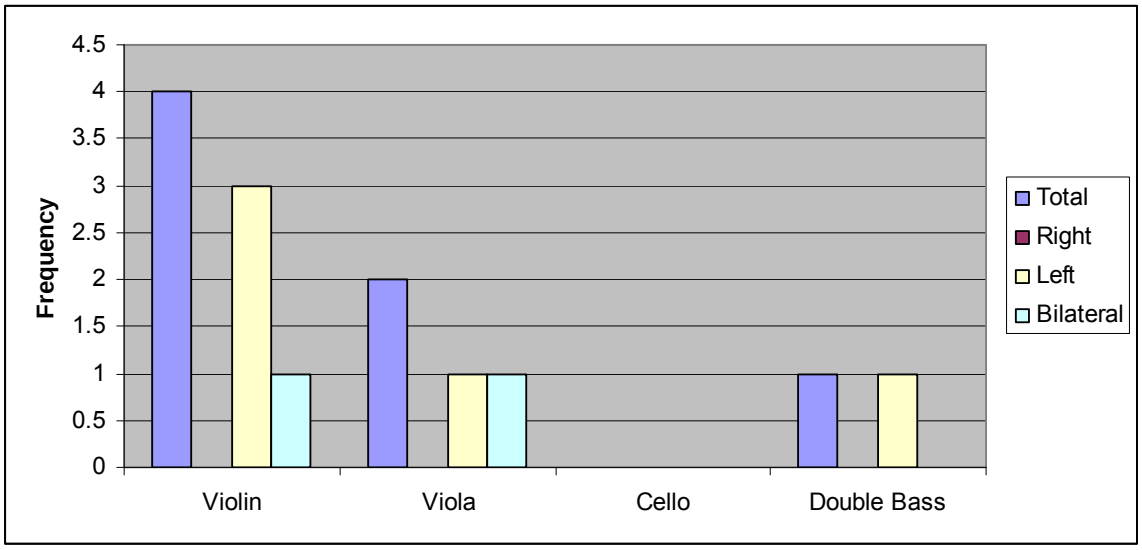


Figure 4.30: Finger Injury by Instrument and Side

Discussion:

Fishbein and Middlestadt (1988), Fry (1988) and Manchester (1988) found the left fingers to be more affected than the right due to the playing technique required to play a string instrument. Similar results were found in the current study.

Most studies encountered in the literature combined the fingers with the hand; or with the hand and wrist as regions of study. In the current study the fingers were isolated as an area of investigation. Only two other studies isolated the fingers as

areas of study; Fishbein and Middlestadt (1988) found that 16% of the string players reported injury of the fingers; and Abreu-Ramos and Micheo (2007) found that 15% of cellists and double bassists and 28% of violinists and violists had some type of hand injury. The results of this study show similar rates amongst the violin and viola players. However, in comparison, no cello players were affected, with only one double bass player being affected. This again, is an unaccounted for anomaly.

4.5.3.1.8 The Jaw

Jaw pain and injury was reported in 22.2% (n = 6) of respondents. Figure 4.31 shows 14% (n = 2) of violin players, 43% (n = 3) of viola players and 33% (n = 1) of the double bass players reported jaw injury and pain. No cello players reported injury in this area.

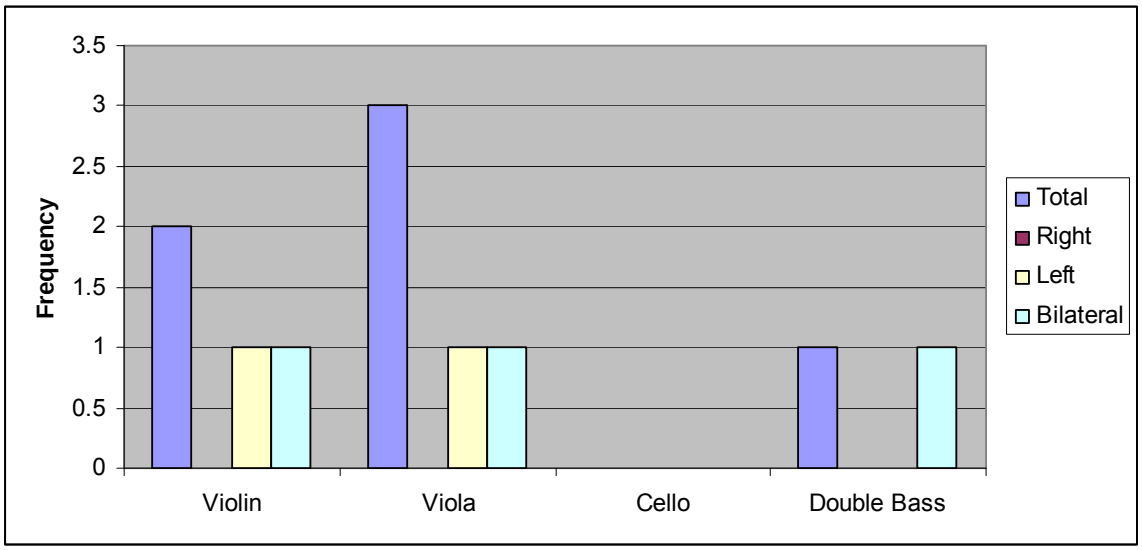


Figure 4.31: Jaw Injury and Pain by Instrument and Side

Discussion:

The jaw can be injured due to the effects of pressure on the mandible, clenching of the muscles of mastication, and transmitted vibrations from the instrument through the shoulder rest and chin pad of the violin and viola (Taddey, 1992). Myofascial trigger points of the muscles of mastication can all refer pain into the

temporomandibular joint presenting as jaw pain (Travell, Simons and Simons, 1999).

The jaw, as an area of injury, was only assessed by Yeung *et al*. (1999) where two respondents reported some type of disorder over a one year period; compared to six respondents reporting jaw injury in this study. This is a high rate of injury which is unaccounted for and possibly contributing to significant morbidity for the affected musicians.

The South African string players were suffering from high levels of stress, and one of the common manifestations of stress is bruxism and clenching of the jaw (Travell, Simons and Simons, 1999). These manifestations of stress would lead to development of myofascial trigger points of the muscles of mastication, which could then present as jaw pain (Travell, Simons and Simons, 1999). This would also explain the development of jaw pain in the double bass player, who does not use a chin rest, but still presented with jaw pain.

4.5.3.1.9 The Wrist

Wrist injury was reported by 18.5% (n = 5) of respondents. Figure 4.32 shows 21% (n = 3) of violin players, 14% (n = 1) of viola players and 33% (n = 1) of double bass players reported wrist injury. No cello players reported injury of this area.

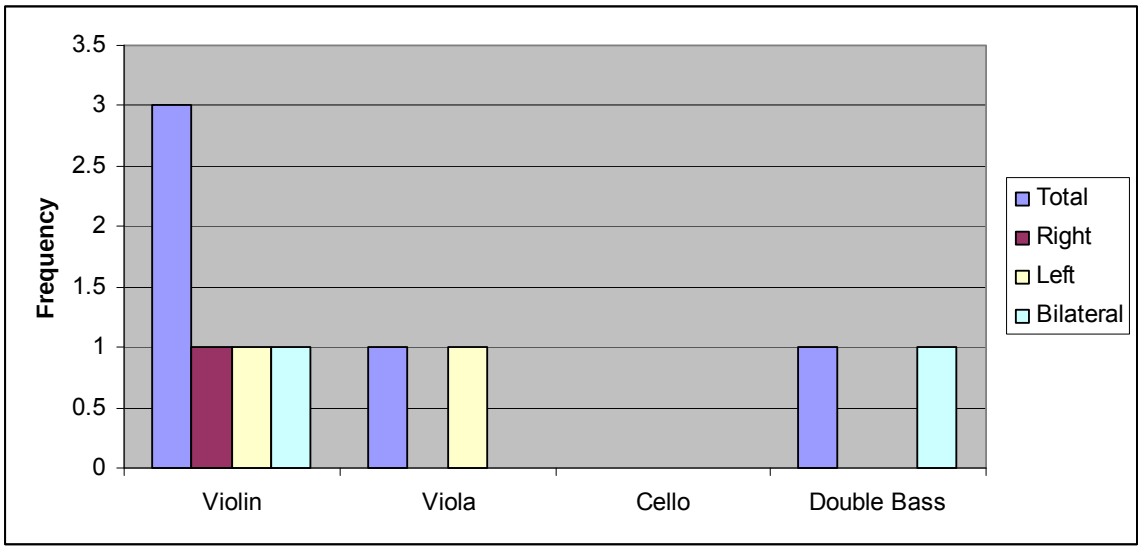


Figure 4.32: Wrist Injury by Instrument and Side

Discussion:

Fishbein and Middlestadt (1988) found that 14% of the string players were injured in this area. Manchester and Flieder (1991) found injury rates of 44.4% (cello and double bass) and 40.9% (violin and viola); and Abreu-Ramos and Micheo (2007) found that 28% of violinists and violists reported wrist injury.

The rates of wrist injury in this study are therefore relatively lower when compared to the above mentioned studies, this despite a larger, more at risk female population. This low rate of wrist injury cannot be accounted for in this study.

4.5.3.1.10 The Hips, thighs and buttocks

Hip, thigh or buttock injury was reported by 14.8% (n = 4) of respondents. Figure 4.33 shows 21% (n = 3) of violin players and 14% (n = 1) of viola players reported injury of this area. No cello or double bass players reported injury.

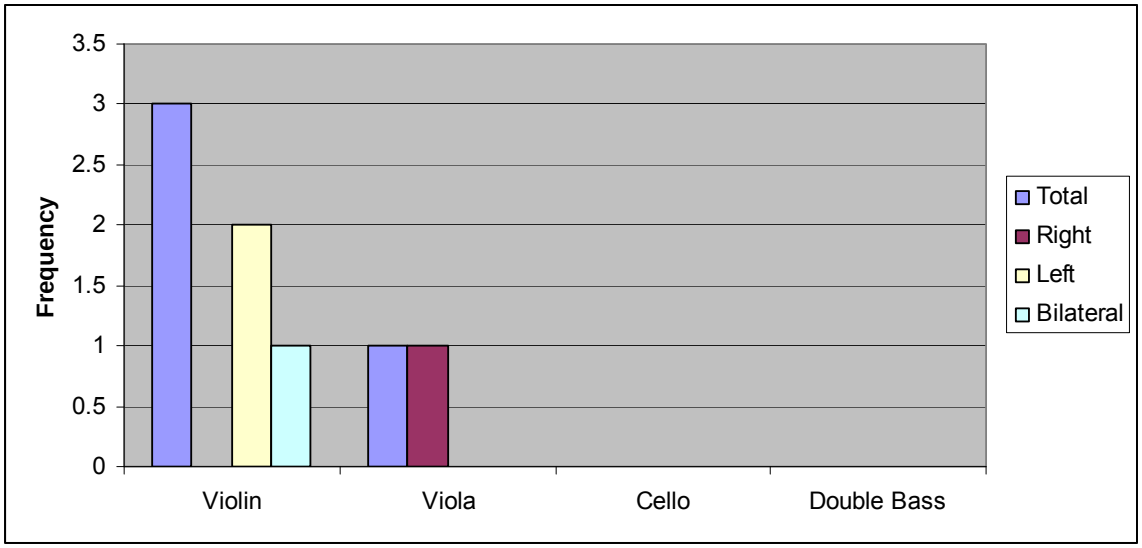


Figure 4.33: Hip, Thigh or Buttock Injury by Instrument and Side

Discussion:

Of the literature reviewed by the researcher, only one study investigated lower extremity injury amongst string players. Fishbein and Middlestadt (1988) found

only 3% (n = 41) of string players had injury in the lower extremity. During an informal interview with lecturers at South African universities with music programmes, the chairs the players use for performance and rehearsals were mentioned as possible contributing factors to lower extremity injury, and further analysis of this ergonomic factor should be undertaken.

4.5.3.1.11 The Face

Facial injury or pain was reported by 7.4% (n = 2) of respondents. Figure 4.34 shows one violin and one viola player reported facial pain, both occurring on the left side of the face (chin rest side). No cello or double bass players reported facial pain.

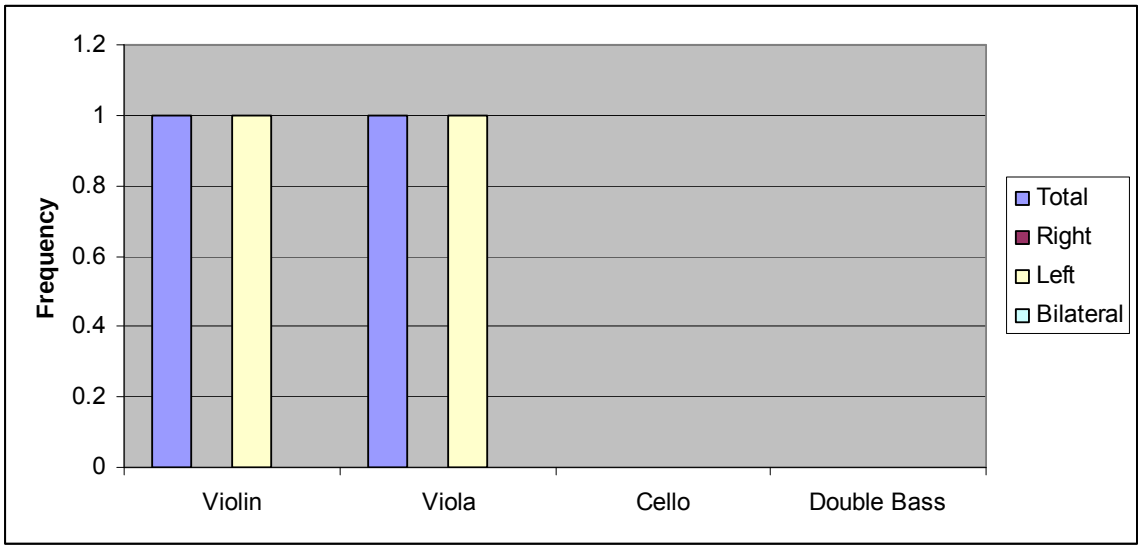


Figure 4.34: Facial Injury or Pain by Instrument and Side

Discussion:

In the literature reviewed by researcher, facial pain was not assessed as a singular site of injury by any other studies of string players; and despite its low prevalence in this study, facial pain requires further investigation.

4.5.3.2 Question 2: Current injury

Table 4.14 shows that 63% (n = 17) of the string musicians were currently injured. This included the preceding three month period.

Table 4.14: Current Injury (including the last 3 months)

		Frequency	Percent
Valid	Yes	17	63
	No	10	37
	Total	27	100

4.5.3.2.1 Worry of getting an Injury

Table 4.15 shows that 33.3% of respondents, without current injury, “never worry” about getting an injury, while 44.4% “seldom worry”. One respondent without an injury did not complete this question.

Table 4.15: Frequency of thought about developing an injury, if there is currently none

		Frequency	Valid Percent
Valid	Never	3	33.3
	Seldom	4	44.4
	Often	1	11.1
	Very often	1	11.1
	Total	9	100

4.5.3.3 Question 3: Playing related injury in the past of their professional career

Table 4.16 shows that 70.8% of respondents reported that in their past professional career they had suffered from an injury. Three participants did not respond to the question.

Table 4.16: Playing related injury in the past

		Frequency	Valid Percent
Valid	Yes	17	70.8
	No	7	29.2
	Total	24	100

4.5.3.3.1 Diagnoses given of injuries in the past (including duration of the problem, and how recently it occurred).

Table 4.17 shows there was a variety of PRMD's given as diagnoses to the musicians by medical professionals in the past. The diagnoses given to musicians are similar to those discussed in the literature review of the current study.

Table 4.17: Past Injuries

Problem Diagnosis	**Duration of the Problem**	**How Recent the problem was**
Carpal Tunnel Syndrome	6 Months	Not given
Left Arm Pain and Weakness	1-3 months	3 months ago
Pinched Nerve	1-2 weeks	2-3 years ago
Rotator Cuff Impingement	1.5 years	
Severe Muscular Pain and Stiffness		5 years ago and 1 year ago
Shoulder Pain	9 months	2 years ago
Sore Shoulder Muscles	weeks	long ago
Tendonitis	4 weeks	3 times
	6 months	
	3 months	
Thoracic Outlet Syndrome	Whole Life	6 years ago
Torn Ligament	3 months	once
Upper Back Pain	2 weeks	1 year ago

4.5.3.4 Question 4: Severity of current (worst) playing related problem

Table 4.18 shows that 31.6% of respondents displayed mild negative symptoms while 26.3% had severe symptoms with regards to their current injury. Rating was done using a 1 to 5 scale, where 1 = no negative symptoms, and 5 = unbearable symptoms.

Table 4.18: Severity rating of current (worst) playing related problem

Valid	Frequency	Valid Percent
1 - No negative symptoms	3	15.8
2 - Mild	6	31.6
3 - Moderate	4	21.1
4 - Severe	5	26.3
5 - Unbearable symptoms	1	5.3
Total	19	100

4.5.3.5 Question 5: Frequency of playing related problem affecting daily living and playing

Table 4.19 shows that the injuries reported by string players, affected 47.4% of them to a mildly moderate extent in the activities of daily living and playing.

Table 4.19: Frequency rating of playing related problems affecting daily living and playing

Valid	Frequency	Valid Percent
1 – No problem ever	4	21.1
2	5	26.3
3	9	47.4
4	1	5.3
5 – problem affects all activities of daily living and I cannot play because of the problem	0	0
Total	19	100

4.5.3.6 Question 6: Consultation with a Health Care Professional

Table 4.20 shows that 84.2% of the string players had consulted a Health Care Professional regarding their injury.

Table 4.20: Consultation with a Health Care professional regarding injury

		Frequency	Valid Percent
Valid	Yes	12	70.6
	No	2	11.8
	No response	3	17.6
	Total	17	100

4.5.3.6.1 Health Care Professional consulted

Figure 4.35 shows that 40.7% (n = 11) of string musicians consulted with a physiotherapist to treat their injuries, this was followed by chiropractors at 25.9% (n = 7), and medical doctors at 18.5% (n = 5). Respondents were able to note consultation with more than one health care professional if they had done so.

Other health care professionals mentioned for consultation regarding injury were:

- Biokineticists
- Massage/Sports Massage Therapists
- Personal Trainers

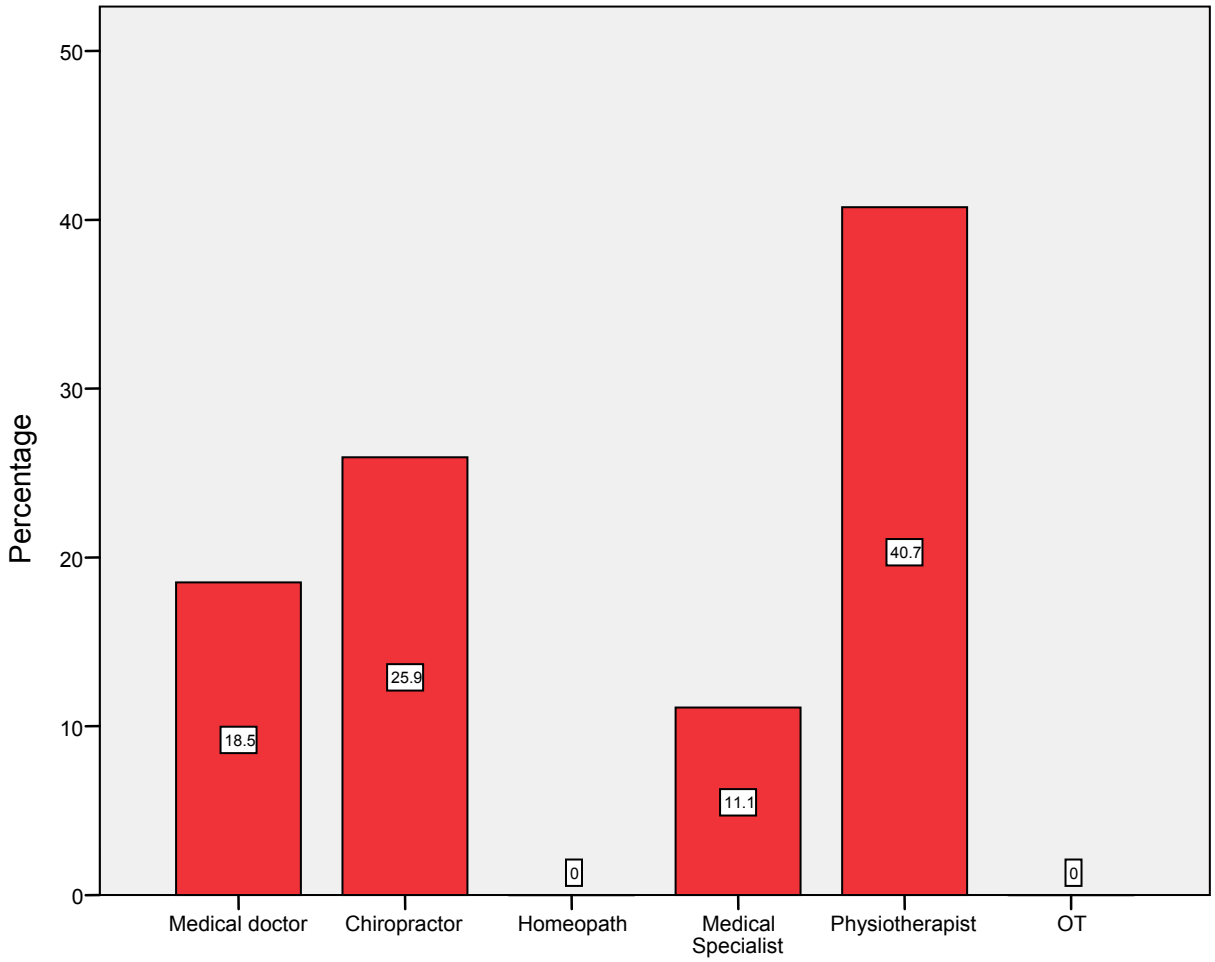


Figure 4.35: Health Care Professionals consulted by the injured string player

4.5.3.7 Question 7: Diagnoses given by the Health Care Professional

Table 4.21 indicates the diagnoses given to the string players by health care professionals. The diagnoses given to the musicians are similar to those discussed in the literature review of the current study. One respondent indicated that playing the instrument exacerbated an injury from a previous motor vehicle accident. This injury would thus not be considered as a PRMD according to its definition.

Table 4.21: Diagnoses given by Health Care Professionals

		Frequency	Percent
	Back, neck, shoulder pain	1	3.7
	Carpal Tunnel Syndrome	1	3.7
	Degeneration of Disc Spaces	1	3.7
	Disc Slip	1	3.7
	Lower back pain	1	3.7
	Muscular Tension	1	3.7
	Neck injury from car accident compounding problem - incorrect curvature	1	3.7
	Overuse injury	1	3.7
	Pain numbness and severe weakness of left arm	1	3.7
	Pulled Muscle	1	3.7
	Rotator Cuff Impingement/tendonitis left shoulder	1	3.7
	Rotator Cuff Syndrome	1	3.7
	Shoulder muscle spasm on left hand side	1	3.7
	Tendonitis	2	7.4
	Tension in Trapezius and Rhomboid muscles	1	3.7
	Torn Ligament	1	3.7

4.5.3.8 Question 8: Treatment given for the most severe current problem

Table 4.22 shows that the most commonly received treatment was massage (37%), with only 22.2% (n = 6) of the injured musicians being recommended to rest.

Tables 4.22, 4.23 and 4.24 all represent Question 8 of Section D in which more than one answer could be given by the respondents. Medications/remedies and 'other' treatments were written down by the respondents in the space provided in the questionnaire.

Table 4.22: Treatment received for the most severe current problem

	Count	%
Massage	10	37.0%
Stretches	7	25.9%
Manipulation	5	18.5%
Dry needling	8	29.6%
Electrotherapy	2	7.4%
Rest	6	22.2%
Splinting	0	0%
Strapping	2	7.4%
Ice	6	22.2%
Heat	6	22.2%
Medication/Remedy	6	22.2%
Other Treatments	4	14.8%

4.5.3.8.1 Medication/Remedies prescribed for use in injury as an adjunct for treatment of the most severe current problem

Table 4.23 shows medication or remedies given to the musicians by their consulting health care professional to assist in the treatment of their current injury.

Table 4.23: Medication/Remedy

		Frequency	Percent
Valid	Medication type not mentioned	1	3.7
	Chinese remedy	1	3.7
	Cortisone Injections, Anti-inflammatories, Pain Killers	1	3.7
	Diclofenac, Cortisone injection	1	3.7
	Transact patches	1	3.7
	Voltaren, Arnica, Comfrey and Traumeel	1	3.7

4.5.3.8.2 Other Treatments received in treating the most severe current problem

Table 4.24 indicates the specific treatments received by individual respondents for their current injury, aside from those listed in the questionnaire and medications as noted in Table 4.23.

Table 4.24: Other Treatments

		Frequency	Percent
Valid	Exercises	1	3.7
	Surgery - Rib Resection	1	3.7
	Operation on both shoulders (stopped playing 4-6 months after)	1	3.7
	Strengthen Stabilizers (shoulder and Back) through a rehabilitative programme with a personal trainer – "worked when I did the exercises religiously"	1	3.7

4.5.3.9 Questions regarding treatment

Table 4.25 represents the questions asked regarding the treatment the musicians had received for their current injury (i.e. including problems experienced and treated in the last 3 months).

Table 4.25: Questions regarding treatment received

	Yes		No	
	Count	Row N %	Count	Row N %
Q.9 Did the treatment correct the problem	10	62.5%	6	37.5%
Q10 Have you decreased your playing time because of the problem	5	33.3%	10	66.7%
Q.11Have you stopped playing for a time because of the problem	6	40%	9	60%
Q.12 Does the problem prevent you from playing as much as you would like	8	50.0%	8	50.0%
Q.13 Have you changed your playing technique because of the problem	6	31.6%	13	68.4%

4.5.3.9.1 Question 11: Duration of playing time stopped due to injury

Time intervals were not given as distinct options to the musicians, thus a variety of time intervals were given by the string players:

- 2 weeks (neck pain), 1 week (arm pain)
- 6 months
- 3 – 4 weeks
- 7 – 10 days
- 1 week
- 2 days

The average time in which musicians stopped playing was 35.8 days (per calendar year) for the worst current injury. This average may have been distorted due to one player taking 6 months off from playing.

4.5.3.9.2 Question 13: Aspect of playing technique changed due to current injury

Figure 4.36 shows the aspects of playing technique which were changed due to the effect of the current injury experienced by the musician. If the musician changed an aspect of their playing technique which was not listed as an option in the question, they were asked to note this change in the 'other' space available in the questionnaire. These changes were noted as:

- 'Arm/Shoulder position'
- 'Relaxing intentionally'

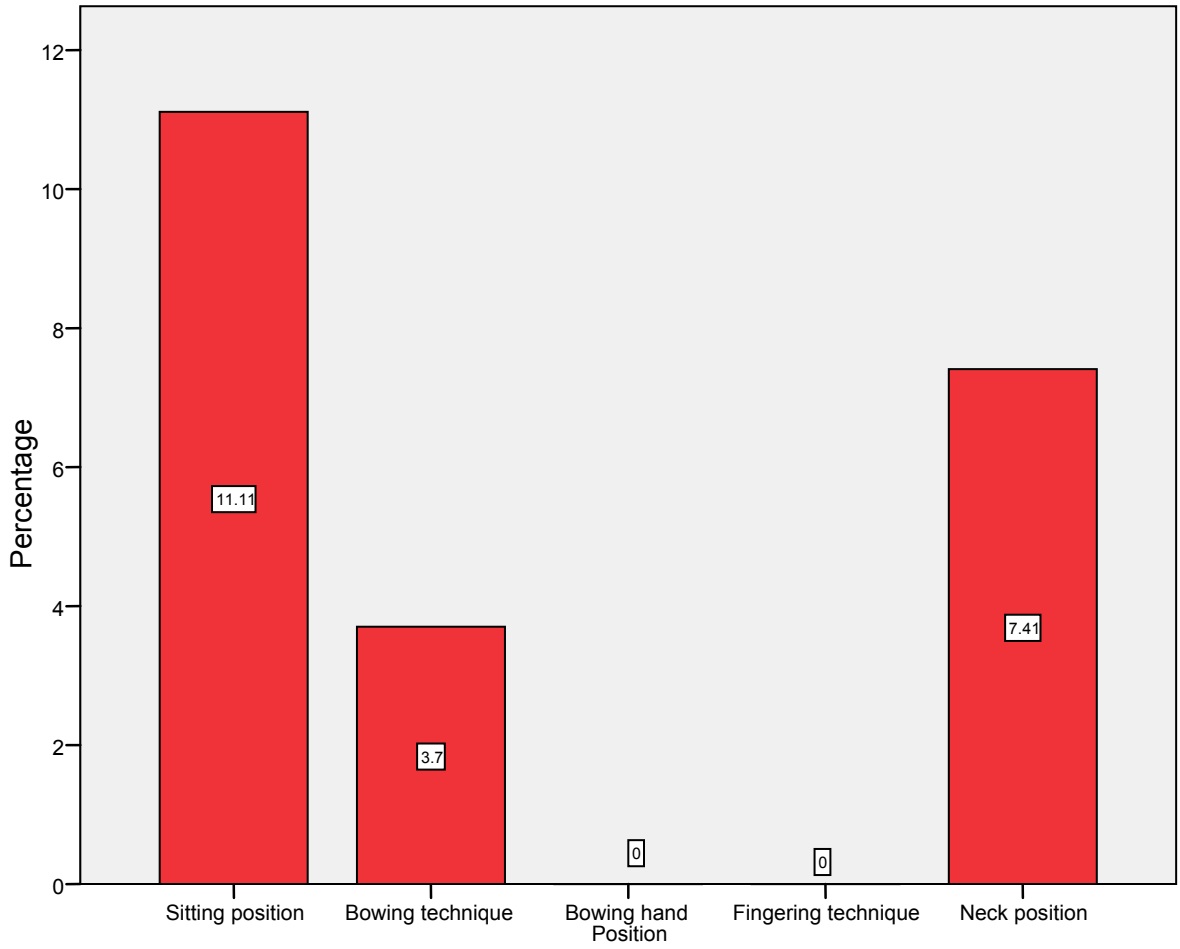


Figure 4.36: Change in Technique due to current injury

Discussion:

Participants were asked to grade their pain, in terms of it affecting daily living and playing (section 4.5.3.5), with the results showing that 47.7% (n = 9) of the respondents reported a mildly moderate effect of the pain (3 on a Licket Scale, where 1 was “no problem ever”, and 5 was “problem affects all activities of daily living”), only one respondent indicated a level 4 on the Licket scale rating. This is a similar, although slightly lower level of pain affecting daily living, when compared to the Kaneko *et al*. (2005) study which found most respondents (50%) reporting a moderate to severe effect of the pain on their daily living and playing.

Fry (1986) found that 42% of symphony orchestra musicians reported pain as mild pain (grade 2), with the majority of pain experienced by musicians reported

as ‘few negative symptoms’ (grade1) or ‘mild pain’ (grade 2). Most musicians reported that the pain they experienced was normal for a musician (Fry, 1986). The majority of participants in the current study reported the pain that they were currently suffering from, to be mild (grade 2) (31.6%) or severe (grade 4) (26.3%).

The results of this study indicate that although the South African string players reported suffering from pain of a relatively high level, respondents felt that it did not affect their lives as greatly in comparison to the pain experienced by musicians in the aforementioned international studies. This may indicate that despite a high level of injury, South African musicians have a high pain tolerance.

When non-injured respondents were asked if they had concerns about getting an injury (section 4.5.3.2.1), 78% answered that they “never” or “seldom worried” about sustaining an injury. This result was unexpected as one would have expected a professional musician to have concerns of becoming injured, as it has such an impact on their ability to perform and sustain an income (Brandfonbrener, 1991).

When the respondents were questioned regarding performance-related injury sustained in the past, 70.8% (n = 17) of respondents reported having suffered with a previous injury. Zaza (1998) found that the prevalence of PRMD’s in adult classical musicians ranged from 39% to 87%, between 1980 and 1996, thus making the results of this study inline with the previous literature.

The most common diagnosis reported by injured respondents in the past and present was a tendonitis (sections 4.5.3.3.1 and 4.5.3.7). According to Bejjani *et al.* (1996) the overuse syndrome is the most prevalent medical problem amongst musicians. On the other hand, Fry (1986) noted that the overuse syndrome is often misdiagnosed as a tendonitis or tenosynovitis. Similarly, respondents in this study are in line with trends in the literature.

The majority of respondents sought medical advice from a musculoskeletal practitioners (physiotherapists and chiropractors) (66.6%, n = 18) and general

medical practitioners (18.5%, n = 5). Similar findings were found by Abreu-Ramos and Micheo (2007) where conventional medical (any type), physiotherapy (both 42.6%), and chiropractic (39.3%) were the main practitioners consulted. Roset-Llobert *et al*. (2000) suggested that musical artists have a predisposition to look for solutions in alternative medicine and techniques, and that this may delay the resolution of their problem. Both Ramos and Micheo (2007) and Roset-Llobert *et al*. (2000) further mention that musicians look for alternatives precisely because conventional medicine has not provided a useful response to their problems. However, in this study, chiropractors (as CAM practitioners) were consulted less than conventional medical practitioners.

When assessing recommended treatments for current injury the results were similar to other studies (Fry (1986), Chong *et al*. (1989), and Norris (1993)). Rest, however, was only recommended in 22.2% of cases in the current study. Rest is the best solution to overuse injuries (Fry, 1986), however, this is not always feasible, as to rest means to not play, and to not play, means to not get paid. This would then impact on the financial standing of the musician. Bejjani (1993) has indicated this as a possible reason for the delay in seeking medical treatment by musicians.

Other treatments given to South African string players were massage (37%, n = 10) and dry needling (29.5%, n = 8), and both of these are common treatment modalities used in treating musculoskeletal disorders (Liggins, 2006). When the respondents were asked about the treatment they received, the majority of them were satisfied that the treatment corrected their problem (62.5%, n = 10).

Six of the respondents with an injury (40%) reported taking time off from playing, with the duration of playing time stopped, lasting from 3 days to 6 months. When treating repetitive performance related injuries, the literature shows that rest from aggravating activities is the best form of treatment (Bejjani *et al.,* 1996 and Roset-Llobert *et al.,* 2000). The duration of rest is not prescribed in the literature, and would therefore be case dependant.

Half of the respondents with injury (50%, n = 8) reported that they were prevented from playing as much as they liked due to their injury. This could have impacted negatively on their psychological well-being and contribute further to their stress levels, and thus possibly worsen the perceived severity of their musculoskeletal injury (Steptoe, 1991).

A third of the respondents with injury reported a change to their playing technique due to the injury. The most commonly reported changes to their playing technique included changing their sitting position (11.11%) and their neck position (7.41%). The most common reported areas of injury were the neck and upper back (section 4.5.3.1), both of which would have benefited from changes made to their playing technique, as mentioned by the respondents.

4.5.3.10 Questions 14 and 15: Factors believed to contribute to injury development.

Question 14 of the questionnaire attempted to determine what factors the respondents felt contributed to injury development, and table 4.26 shows that most of the musicians (85.7%, n = 12) felt they were playing more than usual before developing and injury.

Question 15 of the questionnaire attempted to determine what habits were being practiced by the musicians just before injury development. Table 4.26 shows that before developing an injury, the musicians did not warm up without their instrument, nor did they cool down after a practice session.

The total number of respondents in this question was less than the 17 currently injured musicians. This could possibly have occurred as some injured respondents did not look on the back-page of the questionnaire to answer these questions.

Table 4.26: Factors contributing to injury development

	Yes		No	
	Count	Row N %	Count	Row N %
14.1 I was playing more than usual	12	85.7%	2	14.3%
14.2 I was playing less than usual	0	0%	5	100%
14.3 I had returned from a break	0	0%	5	100%
15.1 Take breaks during practice sessions	7	53.8%	6	46.2%
15.2 Physically warm up without instrument	3	23.1%	10	76.9%
15.3 Physically warm up with instrument	8	61.5%	5	38.5%
15.4 Physically cool down	2	15.4%	11	84.6%

4.5.3.11 Stress level before injury development

Figure 4.36 shows that 47.4% (n = 9) of the string players were moderately stressed (grade 4) before an injury occurred. (Rated on a Licket scale, where 1 = not at all stressful, and 5 = Very stressful).

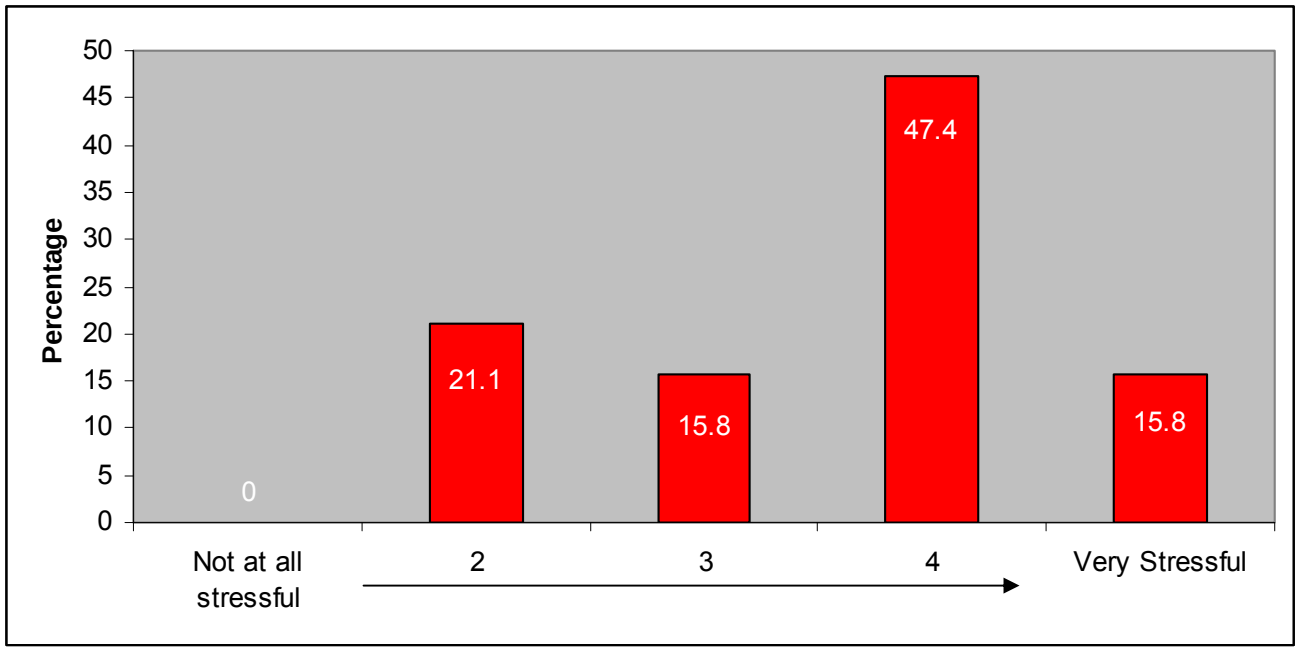


Figure 4.37: Level of stress before injury development

Discussion:

It was found that the majority of respondents (84.2%, n = 16) had increased their playing time prior to being injured. Yeung *et al*. (1999) reported that a change in symptoms was related to the intensity of practice, suggesting an exposure–response relationship. Yeung *et al*. (1999) felt that this relationship was reinforced by the fact that a change in playing habits and rest helped to ease the respondent's discomfort. Similarly, Fry (1986) found that a sudden increase in practice time to prepare for an audition, recital or concert, was correlated to the onset of pain and dysfunction.

Performing a physical warm up without the instrument and a cool down after playing the instrument have been shown to prevent injury (Markison (1994), Zaza and Farewell (1997), Yeung *et al.* (1999), Heming (2004), and Abréu-Ramos and Micheo, (2007)).The poor practice of these techniques, as mentioned by the musicians in table 4.26 just prior to injury development, may explain the high rate of injuries experienced by the respondents. Taking breaks during practice sessions has shown to be protective against injury development (Wu, 2007). Just under half of the respondents noted that they were not taking breaks prior to injury development, thus possibly contributing to the development of injury in the musicians.

In terms of stress, the majority of respondents with injury (47.4%) reported a grade 4 stress level just prior to developing an injury (rated on a Licket scale, where 1 = not at all stressful, and 5 = Very stressful). Stress has been shown to be a risk factor in injury development (Steptoe, 1991). This may have therefore been a contributing factor to the high injury rate seen in this study. Fishbein and Middlestadt (1988) note that the assessment of stress among symphony orchestra musicians has been largely neglected. This lack of investigation into stress is thought to have occurred as Fishbein and Middlestadt (1988) further note, that it is generally believed that musicians do not suffer emotional stress, since they do what they like to do, and it gives them pleasure.

4.5.4 Objective Four

To determine the association of occupational history, risk factors and prevalence of injury amongst the string players in South African Philharmonic orchestras.

4.5.4.1 The average demographic profile of an injured professional string player in South African orchestras

4.5.4.1.1 Means of age, weight and height of respondents with current injuries

Table 4.27 shows that the mean age of a musician with an injury in this study was 35.5 years (SD = 12.3), with a BMI of 28.8 indicating that they were pre-obese (Vizniak, 2007). Injured musicians were therefore shorter and heavier, with the non-injured musicians being taller and thinner.

Table 4.27: Means of quantitative demographic variables in participants with current injuries

	N	Mean	Std. Deviation
Age	17	35.5	12.3
Height (m)	17	1.5	0.6
Weight (kg)	17	64.8	22.0

Discussion:

In comparison to those players without injury, the injured player was slightly younger (difference of 1.61 years), slightly shorter (difference of 0.063m) and slightly heavier (difference of 1.84kg). This indicates a higher BMI in the injured (28.8) player in comparison to the uninjured player (25.768).

Zaza and Farewell (1997) found that a higher BMI was associated with an increased risk for PRMD development. The only other study to have measured BMI (Roach *et al.*, 1994) did not find any association between BMI and PRMD

risk. In this study no association was found between height and weight and the development of a PRMD (Appendix E, Table 4.30).

4.5.4.1.2 Categorical demographic characteristics of respondents with Current injury

Table 4.28 shows the demographic characteristics of participants with current injury.

Table 4.28: Categorical demographic characteristics with Current injury

		Count	Percent
Gender	Not noted	1	3.7
	Male	3	11.1
	Female	13	48.1
Race	Caucasian	16	59.3
	Black	0	0.0
	Indian	0	0.0
	Coloured	1	3.7
	Asian	0	0.0
	Other	0	0.0
Hand dominance	Right handed	15	55.6
	Left handed	1	3.7
	Both	1	3.7
Smoking	Yes	6	22.2
	No	11	40.7
Qualification	Bachelor of Music	10	37.0
	Masters in Music	3	11.1
	Doctorate in Music	0	0.0
	Conservatory	4	14.8
Exercise	Yes	14	51.9
	No	3	11.1

Discussion

- **Gender**

Studies by Abréu-Ramos and Micheo (2007), Kaneko *et al.* (2005), Dawson (2001), Yeung *et al.* (1999), Cayea and Manchester (1998), Zaza and Farewell (1997) Manchester and Flieder (1991), Middlestadt and Fishbein (1989), Lockwood (1988), Manchester (1988) and Fry (1986) found women were more affected than men by PRMD's. In this study, of the 17 participants who admitted

to an injury, 37.5% of the male string population (n = 3), and 76.47% of the female string population (n = 13) were currently affected by PRMD's.

Gender was however not found to be statistically significant in terms of current injury (p = 0.157), although the female participants were affected more than their male counterparts.

- **Ethnicity**

The majority of respondents to the questionnaire were Caucasian 88.89 % (n = 24), thus most injuries were found in this ethnic group. The Black and 'Other' respondents did not have any current injury, although each category only had one respondent, therefore no conclusions could be drawn from this data.

Ethnicity was not found to be statistically significant factor in the development of current injury (p = 0.248).

- **Hand Dominance**

This study found that most of the participants were right handed 88.9% (n = 24) which was similar to that found by Abréu-Ramos and Micheo (2007) in which 90.7% of participants were right handed. However, no statistically significant relationship was found between handedness and the development of current injury (p = 0.693). Similar findings were also found by Abréu-Ramos and Micheo (2007)

- **Smoking**

No statistically significant relationship was found between smoking and current injury in this study (p = 0.148). Results showed that non-smokers, who were in the majority, had more injuries than the smokers.

- **Level of Qualification**

There was no statistically significant relationship found between the level of the qualification obtained and the risk for developing current injury (p = 0.757).

- **Exercise**

According to Yeung *et al*. (1999) regular physical exercises has been reported to reduce the risk of work-related musculoskeletal disorders. There was no statistically significant result in this study to indicate that regular physical exercise was protective against injury (p = 0.879).

Dommerholt (2009), unsubstantiated, claims that musicians do not necessarily make regular exercise part of their daily routine, which increases their risk of injury. In this study it was found that the vast majority of respondants did exercise regularly, although this did not protect them from PRMD's.

- **Sports played by those with Current injury**

Table 4.29 shows that the most common exercise performed by the 17 string musicians with an injury was gym training (70.6%, n = 12). No statistically significant relationship was found between the type of exercise performed and current injury (Table 4.33, Appendix E). Musicians were able to mention more than one exercise type performed, hence a total greater than 100%.

Table 4.29: Sports played by those with Current injury

	Count	Percent
gym	12	70.6%
running	4	23.5%
surfing	0	0%
walking	2	11.8%
yoga	0	0%
golf	1	5.9%
hiking	3	17.6%
windsurfing	0	0%
swimming	0	0%
cycling	0	0%
Total	22	129.4%

4.5.4.1.3 Summary of Average demographic profile of a string player with injury

Tables 4.27, 4.28 and 4.29 show that the average demographic variable of a string player with current injury was a 35.5 year old, right handed, Caucasian, non-smoking female with a Bachelor of Music qualification; 1.5 meters tall with a weight of 64.8 kilograms (BMI = 28.8 [thus considered to be pre-obese] Vizniak, 2007), who exercised regularly at the gym.

4.5.4.2 Comparison of variables and current injury

Any trends found in comparing variables and current injuries are discussed below. No statistically significant relationships or trends were seen between the following variables and current injury (See Appendix E for Tables E1 to E11).

- Demographic characteristics
- Regular activity performed
- Instrument played in the orchestra and site of injury
- Musical Background and current injury
- Aspects of playing that were changed after instruction
- Playing technique
- Warm-up exercises performed before a practice session
- Performing a physical cool down after practice
- Most common activity during rehearsal breaks
- Occupational information
- Means between those with current injury and those without

4.5.4.2.1 Demographic means between those with current injury and those without.

Table 4.30 shows that those string players who had current injury, had started playing their current instrument at a younger age (8.6 years, SD = 4.8), in comparison to those with no injury, who started playing at an older age (12.7 years, SD = 7.4).

Table 4.30: Comparison of means between those with current injury and those without

	D2	N	Mean	Std. Deviation	p value
Age	Yes	17	35.5	12.3	
	No	10	39.8	10.9	0.373
	Total	27	37.11	11.768	
Height	Yes	17	1.5	0.6	
	No	10	1.7	0.1	0.084
	Total	27	1.5631	.46317	
Weight	Yes	17	64.8	22.0	
	No	10	59.9	23.7	0.697
	Total	27	62.96	22.293	
Starting age playing any instrument	Yes	17	6.2	1.8	
	No	10	7.3	2.9	0.290
	Total	27	6.59	2.291	
Starting age playing current string instrument	Yes	17	8.6	4.8	
	No	10	12.7	7.4	
	Total	27	10.11	6.110	0.092

Discussion:

Bejjani *et al.*, (1984) found that professional musicians generally start playing an instrument at an early age and as a result may become anatomically shaped according to their instrument, thus placing them at risk for injury. This trend was seen in this study, although there was no statistical correlation.

4.5.4.2.2 Comparison of locally trained musicians to musicians trained at a foreign institute, and current injury.

Table 4.31 shows that there was no association between whether the qualification was local or overseas in comparison to current injury (p = 0.516). Of those who qualified locally, 69% were injured, while of those who qualified internationally, 57% were injured. Thus there was a slight trend indicating that the risk for injury was higher in locally trained players but this could not be confirmed statistically.

Table 4.31: Comparison of locally trained musicians to musicians trained at a foreign institute, and current injury

			Current injury		Total
			yes	no	
S.A Institution	yes	Count	9	4	13
		% within S.A Institution?	69.2%	30.8%	100%
	no	Count	8	6	14
		% within S.A Institution?	57.1%	42.9%	100%
Total		Count	17	10	27
		% within S.A Institution?	63%	37%	100%

Chi square 0.422, p = 0.516

Discussion:

This was an interesting result as South African trained musicians, in proportion, had received more training regarding PRMD's, and it was expected that they would present with fewer injuries, yet the opposite was seen in this comparison. This could possibly be because, of the South African players (n = 13), 84.6% (n = 11) were female. As discussed previously, females are more prone to PRMD development, and this could have therefore increased the injury rate amongst South African trained musicians.

4.5.4.2.3 Comparison of instrument played in the orchestra and current injury

Table 4.32 shows that the risk for injury in this study was lowest in viola players (43%) and highest in cello players (100%) who were all female musicians. This risk factor however, could not be confirmed statistically, and this result may have been due to the small sample size.

Table 4.32: Instrument played and current injury

			Current injury		Total
			yes	no	
What instrument are you playing in this orchestra?	Violin	Count	9	5	14
		% within What instrument are you playing in this orchestra?	64.3%	35.7%	100%
	Viola	Count	3	4	7
		% within What instrument are you playing in this orchestra?	42.9%	57.1%	100%
	Cello	Count	3	0	3
		% within What instrument are you playing in this orchestra?	100%	0%	100%
	Double bass	Count	2	1	3
		% within What instrument are you playing in this orchestra?	66.7%	33.3%	100%
Total		Count	17	10	27
		% within What instrument are you playing in this orchestra?	63%	37%	100%

Chi square 3.006, p=0.391

Discussion:

Burkholder and Brandfonbrener (2004) mentioned that the instrument played is an important co-factor in playing- related injury development. Playing a string instrument places a musician at a greater risk for developing a PRMD (Caldron *et al*. (1986), Lockwood (1988), Manchester (1988), Fishbein *et al.* (1989) and Manchester and Flieder (1991)). As an example, Črnivec (2004) found that cello, double bass and harp players had a higher level of musculoskeletal problems than violin and viola players did.

4.5.4.2.4 Comparison of how instrument is carried and current injury

Figure 4.12 (section 4.5.1.2.7) showed that 66.7% (n = 18) of the strings population carried their instrument using shoulder straps. The data in Table 4.33 shows that 40.7% (n = 11) of respondents who used a shoulder strap, had a current injury. It was also found 18.5% of the musicians who carried their instrument by the handle of the instrument case, were injured.

Table 4.33: Comparison of how instrument is carried and current injury

		D2 (Current Injury)					
		Yes		No		Total	
		n	%	n	%		
I don't carry an instrument	Yes	1	3.7	1	3.7	2.0	7.4
I use a shoulder strap	Yes	11	40.7	7	25.9	18.0	66.7
I use a shoulder strap on Right shoulder	Yes	6	22.2	3	11.1	9.0	33.3
I use a shoulder strap on Left shoulder	Yes	9	33.3	5	18.5	14.0	51.9
I carry it by handle	Yes	5	18.5	1	3.7	6.0	22.2
I carry it by handle on Right shoulder	Yes	4	14.8	0	0.0	4.0	14.8
I carry it by handle on Left shoulder	Yes	2	7.4	0	0.0	2.0	7.4
Have wheels attached to my case	Yes	3	11.1	1	3.7	4.0	14.8
Push my bag	Yes	0	0.0	0	0.0	0.0	0.0
Push my bag with Right arm	Yes	0	0.0	0	0.0	0.0	0.0
Push my bag with Left arm	Yes	0	0.0	0	0.0	0.0	0.0
Pull my bag	Yes	3	11.1	1	3.7	4.0	14.8
Pull my bag with Right arm	Yes	3	11.1	1	3.7	4.0	14.8
Pull my bag with Left arm	Yes	0	0.0	0	0.0	0.0	0.0

Discussion:

The association seen between shoulder straps and injury (Korovessis *et al*. (2005)) may have occurred in this study due to the small sample size. The majority of respondents were violin and viola string players whose instruments weigh relatively little in comparison to body weight. In contrast to the cello and double bass which are relatively bulky instruments and weigh significantly more, but are carried less by shoulder straps.

4.5.4.2.5 Musical teaching in comparison to current injury

The results in Table 4.34 show that 40.7% of respondents who teach with the instrument they play in the orchestra, have a current injury.

Table 4.34: Musical teaching in comparison to current injury

Music taught		D2					
		Yes		No		Total	
		n	%	n	%	n	%
Instrument played in the orchestra	Yes	11	40.7	8	29.6	19.0	70.4
Theory	Yes	0	0.0	1	3.7	1.0	3.7
I don't teach	Yes	3	11.1	0	0.0	3.0	11.1
Piano	Yes	1	3.7	0	0.0	1.0	3.7
Violin	Yes	1	3.7	2	3.7	3.0	7.4
Youth orchestra teaching	Yes	0	0.0	1	3.7	1.0	3.7

Discussion:

Roset-Llobert *et al*. (2000) and Fjellman-Wiklund and Sundelin (1998) both noted how music teachers suffer more with injury; and this trend was confirmed by this study.

4.6 Conclusion

This study has shown similar results when compared to previous investigations, showing that classical music performance places a mental and physical stress on musicians, and is a health threatening activity The results may however be skewed due to the small sample size, thus accounting for no statistically significant relationships or association being identified.

Chapter 5 will make final conclusions about the study and recommendations shall be proposed for future studies.

Chapter Five: Conclusions and Recommendations

5.1 Introduction

PRMD's are a serious occupational problem, and are considered as personal, chronic and disabling health problems that affect the whole person, physically, emotionally, occupationally, and socially (Zaza *et al.*, 1998). This chapter incorporates a summary of the results of the study; recommendations are provided for futures studies based on the results, and limitations of the study are discussed.

5.2 Conclusions

The aim of objective one was to determine the demographic profile of string players in South African Philharmonic orchestras. The South African sample was very similar in its demographic profile when compared to international studies.

Notable differences included the female dominance in gender distribution, a slightly higher Body Mass Index, with the oldest members of the orchestra being younger than the oldest participants in international studies reviewed in this study.

Furthermore, the assumption of a poor level of education regarding PRMD's from South African Universities was refuted with the finding that only five of the 14 overseas trained musicians had received such instruction; with six of the 13 string players trained in South Africa having received instruction on injury prevention. Proportionally, it was therefore found that the South African string players had received a greater degree of instruction at 46% in comparison to the 36% of overseas trained musicians.

Additionally, it is of interest that those who carried their instrument with shoulder straps (66.7%, n = 18), carried their instrument mostly on the left shoulder (51.9%, n = 14). The majority of the string players were right handed (88.9%, n = 24), and were using their non-dominant shoulder to carry the instrument, possibly to free their dominant arm for other use. The carrying of extra weight on the

possibly weaker non-dominant shoulder could have put them at risk for injury development.

The low frequency of practice of a physical cool down after a performance or rehearsal in South Africa was also found, and this may predispose the musicians to further injury, and should be addressed and its use advocated to string players in South African orchestras.

This study additionally revealed that musicians in South Africa are under severe financial strain, thus necessitating a second job to supplement their income. This high level of stress amongst respondents could lead to the exacerbation of illness and musculoskeletal pain as noted by Steptoe (1991), and requires attention from orchestral management.

A similar injury prevalence was found amongst the string players in South African Philharmonic orchestras when compared to international studies. The injury rate was high, with 6.53 PRMD's reported per player over a 12 month period. This equated to 111 reported injuries in a population of 27 string players. This study additionally found a very high rate of upper back injury when. The health professionals consulted and the diagnoses given to the musicians, were similar to that of international orchestral groups. However, the treatment prescribed by the health professionals was not in line with that of the available literature (with rest as the best option), and requires attention.

When assessing the association of occupational history, risk factors and prevalence of injury amongst the string players in South African Philharmonic orchestras, no statistically significant factors were identified. Trends did however, indicate that the risk for injury in this study was lowest in viola players (43%) and highest in cello players (100%); that 40.7% of respondents who taught the instrument they played in the orchestra were suffering from an injury and that 40.7% (n = 11) of respondents who used a shoulder strap, had a current injury.

5.3 Recommendations

- A larger sample population is required in future studies in order to accurately assess the risk factors for injury and to make generalisations. The professional orchestral population in South Africa is small, thus future studies could incorporate string musicians who have graduated from tertiary institutes, but are not playing in an orchestral capacity, such as in the Hagberg *et al*. (2005) study.

- Practice time of each musician should be included in future studies as this is seen as a risk factor, but was not fully investigated in this study.

- A larger, more representative study with regard to ethnicity is needed in order to verify association between ethnicity and PRMD's, as this study only had three respondents who were not Caucasian.

- All other instruments played by the orchestral string musician should be assessed, even if not played in a professional capacity, as this could possibly contribute to injury development.

- South African tertiary institutes, involved in the education of string players, require a formal assessment regarding the extent of formalised education on preventing PRMD's.

- The best treatment for PRMD's, as prescribed by Bejjani *et al.* (1996) is rest from any physical activity. This was however only advocated by health professionals, to 22.2% of the currently injured string musicians in South Africa, thus possibly indicating a lack of knowledge regarding specific injury incurred by musicians. Therefore, a study investigating health care professionals' knowledge on injury to musicians may be necessary

- Studies on the aetiology, prevalence and risk factors for neck, upper and low back pain in professional orchestral string musicians need to be conducted both locally and internationally, as there appears to be a paucity in the literature in this area.

- This study did not fully assess how many hours per week the musicians were playing their instruments. This particular variable is assessed in many international studies, and its inclusion in the study would have increased the depth of the study.

- Specific studies on chair and standing positions during rehearsals and performance need to be assessed from an ergonomic perspective as a potential risk factor for PRMD development. Various studies and musicians themselves all allude to this fact, but there is no conclusive data in this regard.

- The financial position of musicians is a topic which is also briefly mentioned but has not been fully investigated internationally or locally. Therefore, the full impact of financial stress on musicians with regard to injury and emotional distress requires attention.

References:

Abreu-Ramos, A.M. and Micheo, M. 2007. Lifetime Prevalence of Upper-body Musculoskeletal Problems in a Professional-level Symphony Orchestra: Age, Gender, and Instrument-specific Results. *Medical Problems of Performing Artists*, 22:97–104.

Ackermann, B. and Adams, R. 2003. Physical characteristics and pain patterns of skilled violinists. *Medical Problems of Performing Artists*, 18 (2), 65 - 71.

Altenmueller, E. and Jabusch, H. 2009. Focal hand dystonia in musicians: phenomenology, aetiology, and psychological trigger factors. *Journal of Hand Therapy*, 22:144–55.

Andrews, E. Ossification. 1997. In: *Healthy practice for musicians*. London, UK: Rhinegold Publishing Limited.

Barrowcliffe, K.D. 1999. The Knowledge of Playing-Related Injuries Among University Music Teachers. M.Sc. thesis, The University of Western Ontario.

Bejjani, F. J., Kaye, G. M. and Beham, M. 1996. Musculoskeletal and neuromuscular conditions of instrumental musicians. *Archives of Physical Medicine and Rehabilitation* [online], 77:406-413.
Available from: http://www.sciandmed.com/mppa/journalviewer.aspx?issue=1172&article=1705&action=1 [Accessed 28 April 2009].

Bejjani, F.J. 1993. Performing artists' occupational disorders. In DeLisa, J.A. and Gans, B.M. (eds.) *Rehabilitation medicine*. Philadelphia: Lippincott. pp. 1165-1190.

Bejjani, F.J., Stnchin, S. and Winchester, R. 1984. Effect of joint laxity on musician's occupational disorders [abstract]. *Journal of Clinical Research*, 32:660A

Bernard, R.H. 2000. *Social Research Methods*. Sage Publications, Inc. ISBN 076191403X.

Berque, P and Gray, H. 2002. The Influence of Neck–Shoulder Pain on Trapezius Muscle Activity among Professional Violin and Viola Players: An Electromyographic Study. *Medical Problems of Performing Artists* [online], 17:68–75. Available at: http://www.sciandmed.com/mppa/journalviewer.aspx?issue=1084&article=942&action=1 [Accessed on 28 April 2009].

Bird H. 1992. Musculoskeletal problems encountered in musicians*. International Society of Study Tension in Performance Journal*, 7:4-5.

Blum, J. and Ahlers, J., 1995. Verletzungen und Rehabilitation. *Medizische Probleme bei Musikern*.. Georg Thieme Verlag: Stuttgart, pp. 163-175.

Boshuizen, H. Verbeek, J., Broersen, J. and Weel, A. 1992. Do smokers get more back pain? *Spine*, 18: 35-40.

Brandfonbrener, A.G., 2006. Special issues in the medical assessment of musicians. *Physical Medicine and Rehabilitation Clinics of North America*, 17 (4), 747 - 753.

Brandfonbrener, A.G. 1991. Performing Arts Medicine: An Evolving Specialty. *Music Educators Journal* [online], 77(5):21-25. Available at: http://links.jstor.org/sici?sici=0027-4321%28199101%2977%3A5%3C21%3AMTCMAM%3E2.0.CO%3B2-C [Accessed 21 April 2009].

Brink, H. 2006. *Fundamentals of Research Methodology for Health Care Professionals*. 2nd edition. Juta and Company: Cape Town.

British Medical Association. 1993. *Complementary medicine, new approaches to good practice*. Oxford, England: Oxford University Press.

Burkholder, K. R. and Brandfonbrener, A. G. 2004. Performance-Related Injuries among Student Musicians at a Specialty Clinic. *Medical Problems of Performing Artists*, 19(3): 116-122.

Brusky, P. 2009. Performance Related Musculoskeletal Disorders in Bassoon Players. PhD in Performance, Sydney Conservatorium of Music, The University of Sydney.

Caldron, P.H., Calabrese, L.H., Clough, J.D., Lederman, R.J., Williams, G. and Leatherman, J. 1986. A survey of musculoskeletal problems encountered in high level musicians. *Medical Problems of Performing Artists*, 1:136–139.

Cayea, D. and Manchester, R. 1998. Instrument-Specific Rates of Upper-Extremity Injuries in Music Students. *Medical Problems of Performing Artists*, 13(1): 19.

Chan, R.F., Chow, C., Lee, G.P., To, L., Tsang, X.Y., Xeni, Y., Yeung, E. and Yeung, S.S. 2000. Self perceived exertion level and objective evaluation of neuromuscular fatigue in a training session of orchestral violin players. *Applied Ergonomics*, 31(4):335 - 41.

Chansirinukor, W., Wilson, D., Grimmer, K. and Dansie, B. 2001. Effects of backpacks on students: Measurement of cervical and shoulder posture. *Australian Journal of Physiotherapy*, 47: 110-116.

Chong, J., Lynden, M., Harvey, D. and Peebles, M. 1989. *Occupational Health Problems of Musicians. Canadian Family Physician*, 35: 2341 – 2348.

Christian, I. 2010. Telephonic Interview by Quinton Hohls. Durban University of Technology, 18 February, 09:30.

Črinvec, R. 2004. Assessment of Health Risks in Musicians of the Slovene Philharmonic Orchestra, Ljubljana, Slovenia. *Medical Problems of Performing Artists* [online], 19:140–145. Available at: http://www.sciandmed.com/mppa/journalviewer.aspx?issue=1110&article=1181&action=1 [Accessed 21 April 2009].

Davies, C., 2002. Musculoskeletal pain from repetitive strain in musicians: insights into an alternative approach. *Medical Problems of Performing Artists*, 42-49.

Dawson, W.J., 2007. The bibliography of performing arts medicine: A 10-year retrospective review (part II). *Medical Problems of Performing Artists*. 22: 153-159.

Dawson, W.J. 2005. Intrinsic muscle strain in the Instrumentalist. *Medical Problems of Performing Artists*, 20: 66 – 69.

Dawson, W.J. 2001. Upper Extremity Overuse in Instrumentalists. *Medical Problems of Performing Artists*, 16(2): 66-71.

Dawson, W.J. 1990. Upper extremity injuries in high level instrumentalists: An end result study. *Medical Problems of Performing Artists*, 5:109–112.

Dommerholt, J. 2009. Performing arts medicine - Instrumentalist musicians Part I - General considerations. *Journal of Bodywork & Movement Therapies*, 13: 311-319

Dommerholt, J. and Norris, R.N. 1997. *Physical therapy management of the instrumental musician*. Physical therapy for the performing artist, part II; Music and dance. In: Gallagher, S.P. (Ed.), Orthopaedic Physical Therapy Clinics of North America., Vol. 6. W.B. Saunders Company, Philadelphia, pp. 185-206.

Durban Chamber Choir. 2009. Interviewed by Quinton Hohls. Durban Girls College, 27 April, 18:30.

Dyer, C. 1997. *Beginning Research in Psychology*: A practical guide to research methods and statistics. Blackwell Publishers Ltd. Oxford.

Eisenberg, D.M., Kessler, R.C. 1993. Unconventional medicine in the United States: prevalence, costs and patterns of use. *New England Journal of Medicine*, 328: 246 – 252.

Esterhuizen, T. 2010. Interviewed by Quinton Hohls. University of KwaZulu Natal, Durban. 24 Jaunary, 10:30.

Esterhuizen, T. 2009. Telephonic interviewed by Quinton Hohls. Durban. 4 November, 13:00.

Fishbein, M., Middlestadt, S.E., Ottati, V., Straus, S. and Ellis, A. 1988. Medical Problems Among ICOSM Musicians: Overview of a National Survey. *Medical Problems of Performing Artists*, March: 41-48.

Fjellman-Wiklund, A., Grip, H., Andersson, H., Karlsson, J.S. and Sundelin, G. 2003. EMG trapezius muscle activity pattern in string players: Part II - Influences of basic body awareness therapy on the violin playing technique*. International Journal of Industrial Ergonomics*, 33:357–367.

Fjellman-Wiklund, A. and Sundelin, G. 1998. Musculoskeletal discomfort of music teachers: an eight-year perspective and psychosocial work factors. International *Journal of Occupational and Environmental Health*, 4:89–98 .

Fry, H.J. 1989. Overuse syndrome in instrumental musicians. *Seminars in Neurology*, 9(2):136-45.

Fry, H.J.H. 1988. Patterns of over-use Seen in 658 Affected Instrumental Musicians. *International Journal of Music Education*, 11(1): 3-16.

Fry, H.J.H. 1987. Prevalence of overuse (injury) syndrome in Australian music schools. *British Journal of Industrial Medicine*, 44:35-40.

Fry, H.J.H. 1986. Incidence of overuse syndrome in the symphony orchestra. *Medical Problems of Performing Artists*, 1:51-55.

Gabrielson, A. 1992. *The Psychology of Music*. 2nd edition. New York: Academic Press.

Gasenzer, E.R. and Parncutt, R. 2006. How do Musicians deal with their Medical problems? Ninth International Conference on Music Perception and Cognition, Alma Mater Studiorum University of Bologna, Italy, August 22-26 2006.

Grindea, C. 1987. Tension in Performance. *Music Teacher* [online], 66:41 -2. Available at: http://www.collectionscanada.gc.ca/obj/s4/f2/dsk1/tape9/PQDD_0003/MQ42049.pdf [Accessed on 28 April 2009].

Hagberg, M., Thiringer, G. and Brandström, L. 2005. Incidence of tinnitus, impaired hearing and musculoskeletal disorders among students enrolled in academic music education - a retrospective cohort study. *International Archives of Occupational and Environmental Health*, 78: 575–583.

Heming, M.J.E. 2004. Occupational injuries suffered by classical musicians through overuse. *Clinical Chiropractic*, 7: 55 - 66.

Hochberg, F.H., Leffert, R.D., Hellner, M. and Merriman, L. 1983. Hand difficulties among musicians. *Journal of the American Medical Association*, 249:1869-72.

Hoppmann, R. A. and Ekman, E.F. 1999. Arthritis in the Aging Musician. *Medical Problems of Performing Artists*, 14(2): 80.

Hoppman, R.A. and Patrone, N.A. 1989. A review of musculoskeletal problems in instrumental musicians. *Seminars in Arthritis and Rheumatism*, 19:117-26.

Jakobs, L.M. 2009. Interviewed by Quinton Hohls. School of Music, University of KwaZulu Natal, Durban, 6 May, 12:30.

Jarvholm, U., Palmerud, G., Karlsson, D., Herberts, P. and Kadefors, R. 1991. Intramuscular pressure and electromyography in four shoulder muscles. *Journal of Orthopaedic Research,* 9 (4), 609 – 619

Johnson, C. 2005. On the subjects of human subjects. *Journal of Manipulative and Physiological Therapeutics*, 28: 79 – 80.

Kampmeier, V.R. 2000. The Impact of RSI on Creativity in Musicians [online]. B.Mus (Hons), Guildhall School of Music and Drama. Available at: http://www.free2create.com/dissertation.pdf (Accessed 21 April 2009).

Kaneko, Y., Lianza, S. and Dawson, W.J. 2005. Pain as an Incapacitating Factor in Symphony Orchestra Musicians in São Paulo, Brazil. *Medical Problems of Performing Artists*, 20: 168 - 174.

Kapandji, A.I. 2000. Anatomy of the spine. In: Tubiana, R., Amadio, P.C. (eds.), *Medical Problems of the Instrumentalist Musician. London*: Martin Dunitz, pp. 55-68.

Katz, M. 2006. *The Violin: A Research and Information Guide*, Routledge.

Kennedy, M. and Bourne, J. (eds.) 1996. *The Concise Oxford Dictionary of Music.* 4th ed. USA: Oxford University Press.

Khalsa, S.B.K., Shorter, S.M., Cope, S., Wyshak, G. and Sklar, E. 2009. Yoga Ameliorates Performance Anxiety and Mood Disturbance in Young Professional Musicians. *Applied Psychophysiological Biofeedback*, 34:279–289

Kirkaldy-Willis, W.H. and Burton, C.V. 1999. Managing Low Back Pain. 4th ed. New York: Churchill Livingstone.

Kivimaki, M. and Jokinen, M. 1994. Job perceptions and well-being among symphony orchestra musicians: A comparison with other occupational groups. *Medical Problems of Performing Artists*, 9:73-76.

Korovessis, P., Koureas, G., Zacharatos, S. and Papazisis, Z. 2005. Backpacks, Back Pain, Sagittal Spinal Curves and Trunk Alignment in Adolescents: A Logistic and Multinomial Logistic Analysis (Abstract). *Spine* [online], 30 (2): 247-255. Available at: http://journals.lww.com/spinejournal/Abstract/2003/05010/The_Association_of_Backpack_Use_and_Back_Pain_in.15.aspx (Accessed 15 February 2010)

Lamb-Cook, S.J. and Lamb, N. 2001. *Guide to Teaching Strings*. 7th ed. McGraw-Hill Humanities: New York.

Lambert, C.M. 1992. Hand and upper limb problems of instrumental musicians. *British Journal of Rheumatology*, 31:265-71.

Lapane, K.L., Quilliam, B.J., and Hughes, C.M. 2007. A Comparison of Two Distribution Methods on Response Rates to a Patient Safety Questionnaire in Nursing Homes. *Journal of American Medical Directors Association*, 8: 1-6.

Larsson, L.G., Baum, J., Mudholkar, G.S. and Kollia, G.D. 1993. Benefits and disadvantages of joint hypermobility among musicians. *New England Journal of Medicine*, 329:1079-82.

Lederman, R.J. 1993. Entrapment neuropathies in instrumental musicians. *Medical Problems of Performing Artists*, 8:35-9.

Lederman, R.J. 1988. Occupational cramp in instrumental musicians. *Medical Problems of Performing Artists*, 3:45-51

Lederman, R.J. 1986. Nerve entrapment syndromes in instrumental musicians. *Medical Problems of Performing Artists*, 1:45- 48.

Lederman, F.J. and Calabrese, L.H. 1986. Overuse syndromes in instrumentalists. *Medical Problems of Performing Artists*, 1:7-11.

Leino-Arjas, P. 1998. Smoking and musculoskeletal disorders in the metal industry: A Prospective study. *Occupational and Environmental Medicine*, 15(12): 828.

Liggins, C. 2006. Auxiliary Therapeutics. Durban University of Technology.

Lockwood, A.H. 1988. Medical problems in secondary school-aged musicians. *Medical Problems of Performing Artists*, 3:129-32.

Maffulli, N. and Maffulli, F. 1991. Transient entrapment neuropathy of the posterior interosseous nerve in violin players. *Journal of Neurology, Neurosurgery and Psychiatry*, 54:65-7.

Manchester, R.A. and Park, S. 1996. A case-control study of performance-related hand problems in music students. *Medical Problems of Performing Artists*, 11:20-23.

Manchester, R.A. and Flieder, D. 1991. Further observations on the epidemiology of hand injuries in music students. *Medical Problems of Performing Artists*, 6:11-4.

Manchester, R.A. 1988. The incidence of hand problems in music students. *Medical Problems of Performing Artists*, 3:15-8.

Markison, R. E. 1994. *Hands on Fire. Keyboard*, April: 93-110.

Mattlin, V. 2007. *Cello Playing for Music Lovers*: A Self-Teaching method. Self Published.

Menuhin, Y. 1986. *The Complete Violinist*. Summit Books: New York.

Middlestadt, S.E. and Fishbein, M. 1989. The prevalence of severe Musculoskeletal problems among Male and Female Symphony Orchestra String Players. *Medical Problems of Performing Artists*, March: 41 – 48.

Miller, G., Peck, F. and Watson, J.S. 2002. Pain Disorders and Variations in Upper Limb Morphology in Music Students. *Medical Problems of Performing Artists*, 17:169 – 172.

Molsberger, A.E., Hille, E., Molsberger, F. and Schulitz, K.P. 1989. Der Künstler als orthopädischer Patient (the artists as orthopaedic patient). *Deutsches Ärzteblatt*, 33: 2292 - 2295.

Moore, K.L. and Dalley, A.F. 1999. Clinically oriented Anatomy. 4th ed. Philadelphia: Lippincott, Williams and Wilkins.

Moore, A., Wells, R. and Ranney, D. 1991. Quantifying exposure in occupational manual tasks with cumulative trauma disorder potential. *Ergonomics*, 34(12):1433—53.

Morgan, D.L. 1998. *The Focus Group Guidebook*. California: Sage Publications

Mouton, J., 1996. *Understanding Social research*, J.L. van Schaik Publishers, Pretoria, South Africa.

Newmark, J. and Lederman, F.J. 1987. Practice doesn't necessarily make perfect: incidence of overuse syndromes in amateur instrumentalists. *Medical Problems of Performing Artists*, 2:142-4.

Nolan, W.B. and Eaton, R.G. 1989. Thumb problems of professional musicians. *Medical Problems of Performing Artists*, 4:20-4.

Norris R. 1993. The musician's survival manual: a guide to preventing and treating injuries in instrumentalists. International Conference of Symphony and Opera Musicians. St. Louis: MMB Music, Inc. 1993.

Palmer, K. Synddall H., Cooper, C and Coggon, D. 2003. Smoking and musculoskeletal disorders: Findings from a British national survey. *Annals of the Rheumatic Diseases*, 62 (1): 33-36.

Palmerud, G., Forsman, M., Sporrong, H., Herberts, P. and Kadefors, R. 2000. Intramuscular pressure of the infra- and supraspinatus muscles in relation to hand load and arm posture. *European Journal of Applied Physiology*, 83(2-3): 223-230.

Pascarelli, E.F. and Hsu, Y. 2001. Understanding Work-Related Upper Extremity Disorders: Clinical Findings in 485 Computer Users, Musicians, and Others. *Journal of Occupational Rehabilitation*, 11:1.

Peterson, R. 2010. Telephonic Interview by Quinton Hohls. Durban University of Technology, 18 February, 09:45.

Rardin, M.A. 2007. The effects of an injury prevention intervention on playing related pain, tension, and attitudes in the high school string classroom. Doctoral Degree of Musical Arts (Music Education), University of Southern California

Roach, K.E. Martinez, M.A. and Anderson, N. 1994. Musculoskeletal pain in student instrumentalists: A comparison with the general student population. *Medical Problems of Performing Artists*, 9: 125 – 130.

Roehmann, F.L. 1991. Making the connection: Music and Medicine. *Music Educators Journal* [online], 77(5):21-25. Available at: http://links.jstor.org/sici?sici=0027-4321%28199101%2977%3A5%3C21%3AMTCMAM%3E2.0.CO%3B2-C [Accessed 21 April 2009].

Rosenthal, E. 1987. The Alexander technique - what it is and how it works. *Medical Problems of Performing Artists*, 2:53

Roset-Llobet, J., Dolors Rosinés-Cubells, D. and Saló-Orfila, J.M. 2000. Identification of Risk Factors for Musicians in Catalonia (Spain). *Medical Problems of Performing Artists*, 15: 167-174.

Rozmaryn, L.M. 1993. Upper extremity disorders in performing artists. *Maryland Medical Journal*, 42:255-60.

Rush, M.L. 2003. A Resource Guide for the Injured String Player. Doctoral Dissertation [online], The Florida State University. Available at: http://etd.lib.fsu.edu/theses/available/etd-11112003-050037/unrestricted/MLR.Prelims.pdf [Accessed 21 April 2009].

Sadeghi, S., Kazemi, B., Shooshtari, S.M.J., Bidari, A. and Peyman Jafari, P. 2004. A high prevalence of cumulative trauma disorders in Iranian instrumentalists. *BioMed Central Musculoskeletal Disorders*, 5:35.

Salant, P and Dillman, D. 1994. *How to conduct your own survey*. United States of America: John Wiley & Sons Inc.

Sandin, K.J. 1989. The neuromusculoskeletal problems of instrumental musicians: a review. *Current Concepts in Rehabilitative Medicine*, 5:22-29.

Sataloff, R.T., Brandfonbrener, A. and Lederman, R.J. 1991. *Textbook of Performing Arts Medicine*. New York: Raven Press.

Schäcke, G., et al. 1986. Muskel-Skelet-Bechwerden bei Orchester-musikern. *Fortschritte in Medizine*, 6:126-128.

Steptoe, A. 1991. The links between stress and illness. *Journal of Psychosomatic Research*, 35:633-644.

Sternbach, D. 1993. Addressing stress-related illness in professional musicians. *Maryland Medical Journal*, 42:283-288.

Stoeber, J. and Eismann, U. 2007. Perfectionism in young musicians; relations with motivation, effort, achievement, and distress. *Personality and Individual Differences*, 43, 2182 - 2192.

Taddey, J.J. 1992. Musicians and temporomandibular disorders: prevalence and occupational etiologic considerations. *Journal of Craniomandibular Practice*, 10:241-4.

Travell, J. G., Simons, D.G and Simons, L.S. 1999. *Myofascial Pain and Dysfunction: The Trigger Point Manual*. 2nd ed. Philadelphia: Lippincott, Williams and Wilkins.

Turner-Stokes, L. and Reid, K. 1999. Three-dimensional motion analysis of upper limb movement in the bowing arm of string playing musicians. *Clinical Biomechanics*, 14:426–433.

United States of America. Department of Labour. 2007. Musician, singers, and related workers [online]. Available at: http://www.bls.gov/oco/ocos095.htm [Accessed 21 March 2009].

Van der Linde, A. 2010. Telephonic Interview by Quinton Hohls. Durban University of Technology, Durban, 21 January, 20:00.

Van der Linde, A. 2009. Interviewed by Quinton Hohls. Durban Music School, Durban, 23 February 16:00.

Vizniak, N. A. 2007. *Quick Reference Clinical Consultant Physical Assessment Manual*. 2nd edition. Canada: Professional Health Systems.

Warrington, J., Winspur, I. and Steinwede, D. 2002. Upper-Extremity Problems in Musicians Related to Age. *Medical Problems of Performing Artists* 17(3): 131-134.

Watson, P. and Valentine, E. 1987. The practice of complementary medicine and anxiety levels in a population of musicians. *Journal of the International Society for the Study of Tension in Performance*, 1(4):25–30.

World Health Organisation. 2008. Prepared by the Counsel for International Organisations of Medical Sciences (CIOMS). Geneva: International ethical guidelines for epidemiological studies.

Williamon, A. and Thompson, S. 2006. Awareness and incidence of health problems among conservatoire students. *Psychology of Music*, 34 (4): 411-430.

Winspur, I. 2003. Advances in objective assessment of hand function and outcome assessment of the musician's hand. *Hand Clinic*, 19 (3), 483-493.

Wristen, B.G. 1998. Overuse injuries and piano techniques: A Biomechanical Approach. Doctoral Dissertation, Texas Technical University.

Wu, S. J. 2007. Occupational Risk Factors for Musculoskeletal Disorders in Musicians: A Systematic Review. *Medical Problems of Performing Artists* [online], 22: 43 - 51. Available from: http://www.sciandmed.com/mppa/journalviewer.aspx?issue=1172&article=1705&action=1 [Accessed 28 April 2009].

Yeung, E. Chan, W., Pan, F., Sau, P., Tsui, M., Yu, B. and Zaza, C. 1999. A Survey of Playing-related Musculoskeletal Problems among Professional Orchestral Musicians in Hong Kong. *Medical Problems of Performing Artists* (online), 14:43–4. Available from: http://www.sciandmed.com/mppa/journalviewer.aspx?issue=1097&article=1078&action=1 [Accessed 21 April 2009].

Yoshimura, E., Fjellman-Wiklund, A., Paul, P.M., Aerts, C. and Chesky, K. 2008. Risk Factors for Playing-related Pain among Piano Teachers. *Medical Problems of Performing Artists*, 23:107 – 113.

Zaza, C. 1998. Playing-related musculoskeletal disorders in musicians: a systematic review of incidence and prevalence. *Journal of the Canadian Medical Association*, 158:1019-25.

Zaza, C., Charles, C. and Muszynski, A. 1998. The meaning of playing-Related Musculoskeletal disorders to Classical Musicians. *Social Science and Medicine*, 47(12): 2013-2023.

Zaza, C. and Farewell, V.T. 1997. Musicians' Playing-Related Musculoskeletal Disorders: An Examination of Risk Factors. *American Journal of Industrial Medicine*, 32(3): 292-300.

Zaza, C. 1992. Playing-related health problems at a Canadian music school. *Medical Problems of Performing Artists*, 7:48–51.

Zetterberg, C., Backlund H., Karlsson, J., Werner, H. and Olsson, L. 1998. Musculoskeletal Problems among Male and Female Music Students. *Medical Problems of Performing Artists*, 13(4): 160.

Appendix A1:

Quinton Hohls <quinton.hohls@gmail.com>

Quinton Hohls Research

2 messages

Quinton Hohls <quinton.hohls@gmail.com> **Mon, Nov 2, 2009 at 2:26 PM**
To: education@kznpo.co.za

Dear Mr Peterson

Please find the letter of request attached

Yours sincerely

Quinton Hohls

KwaZulu Natal Philharmonic.doc
23K

Department of Chiropractic and Somatology
Chiropractic Programme
Durban University of Technology
Durban
4001
2 November 2009

KwaZulu Natal Philharmonic Orchestra
3rd Floor
29 Acutt Street
Durban
4001

To whom it may concern

Re: Request for permission to conduct research on the string players of the KwaZulu Natal Philharmonic Orchestra

I am currently enrolled as a Master's Degree chiropractic student at the Durban University of Technology. I would like to conduct my research on professional string players of the South African philharmonic orchestras.

Internationally there is literature indicating the incidence and prevalence of musculoskeletal injuries sustained by professional string musicians, however in South African there is a paucity of this information. Due to the unique environment and training of musicians in South Africa I believe that it is important to document what is occurring locally so that we can understand the injuries occurring in our local musicians.

The research will require the string musicians from the three main orchestras in South Africa to fill out a questionnaire, which will take around 15 minutes to complete. I will personally be in attendance during the administration of the questionnaire, thus being able to answer any questions regarding the contents thereof. The participation of the string players will be voluntary, and confidentiality will be maintained at all times. The outcome of the research will available to all who participate in the study.

Please may I request approximately 30min of the orchestras time to meet with them and explain my research, distribute and complete the questionnaires to the string players.

Yours sincerely
Quinton Hohls
If you require any further details, please do not hesitate to contact me on:
031 373 2205

or my research supervisors

Dr Laura Wilson
M.Tech: Chiropractic (TN)
Tel. 031 373 2923
Dr Ashley Ross
M.Tech: Homoeopathy (TN), B. Mus. (Cum Laude) (UCT)
031 373 2542

Robert Petersen <education@kznpo.co.za> **Fri, Nov 6, 2009 at 9:46 AM**
To: Quinton Hohls <quinton.hohls@gmail.com>

Dear Quinton

Thank you for your e-mail.

We can endorse this research project as long as it is voluntary. Please let me know when you would like to schedule this.

Kind regards

Robert

Appendix A2

Department of Chiropractic and Somatology
Chiropractic Programme
Durban University of Technology
Durban
4001
3 November 2009

Johannesburg Philharmonic Orchestra
SAMET House
18 Evelyn Avenue
Bordeaux
Randburg

To whom it may concern

Re: Request for permission to conduct research on the string players of the Johannesburg Philharmonic Orchestra

I am currently enrolled as a Master's Degree chiropractic student at the Durban University of Technology. I would like to conduct my research on professional string players of the South African philharmonic orchestras.

Internationally there is literature indicating the incidence and prevalence of musculoskeletal injuries sustained by professional string musicians, however in South African there is a paucity of this information. Due to the unique environment and training of musicians in South Africa I believe that it is important to document what is occurring locally so that we can understand the injuries occurring in our local musicians.

The research will require the string musicians from the three main orchestras in South Africa to fill out a questionnaire, which will take around 15 minutes to complete. I will personally be in attendance during the administration of the questionnaire, thus being able to answer any questions regarding the contents thereof. The participation of the string players will be voluntary, and confidentiality will be maintained at all times. The outcome of the research will available to all who participate in the study.

Please may I request 30 minutes of the orchestra's time to meet with them and explain my research, distribute and complete the questionnaires to the string players.

Yours sincerely
Quinton Hohls
If you require any further details, please do not hesitate to contact me on:
031 373 2205

or my research supervisors
Dr Laura Wilson
M.Tech: Chiropractic (TN)
Tel. 031 373 2923
Dr Ashley Ross, M.Tech: Homoeopathy (TN), B. Mus. (Cum Laude) (UCT)
Tel. 031 373 2542

JOHANNESBURG PHILHARMONIC ORCHESTRA

5 November 2009

Quinton Hohls
Department of Chiropractic and Somatology
Chiropractic Programme
Durban University of Technology
Durban
4001

By e-mail

Dear Quinton

Thank you for you request to do research on the string players of the Johannesburg Philharmonic Orchestra.

You are very welcome to do so. Please contact me to discuss our schedule to find a mutually suitable time.

With best wishes
Andrea

Andrea Erasmus
JPO Orchestra Manager

Appendix A3

Department of Chiropractic and Somatology
Chiropractic Programme
Durban University of Technology
Durban
4001
21 April 2009

Cape Philharmonic Orchestra
Artscape
DF Malan Street
Foreshore
Cape Town
8000

To whom it may concern

Re: Request for permission to conduct research on the string players of the Cape Philharmonic Orchestra

I am currently enrolled as a Master's Degree chiropractic student at the Durban University of Technology. I would like to conduct my research on professional string players of the South African philharmonic orchestras.

Internationally there is literature indicating the incidence and prevalence of musculoskeletal injuries sustained by professional string musicians, however in South African there is a paucity of this information. Due to the unique environment and training of musicians in South Africa I believe that it is important to document what is occurring locally so that we can understand the injuries occurring in our local musicians.

The research will require the string musicians from the three main orchestras in South Africa to fill out a questionnaire, which will take around 15 minutes to complete. I will personally be in attendance during the administration of the questionnaire, thus being able to answer any questions regarding the contents thereof. The participation of the string players will be voluntary, and confidentiality will be maintained at all times. The outcome of the research will available to all who participate in the study.

Please may I request 30 minutes of the orchestra's time to meet with them and explain my research, distribute and complete the questionnaires to the string players.

Yours sincerely
Quinton Hohls
If you require any further details, please do not hesitate to contact me on:
031 373 2205

or my research supervisors

Dr Laura Wilson
M.Tech: Chiropractic (TN)
Tel. 031 373 2923
Dr Ashley Ross
M.Tech: Homoeopathy (TN), B. Mus. (Cum Laude) (UCT)
031 373 2542

Gmail by Google

Quinton Hohls <quinton.hohls@gmail.com>

RE: Quinton Hohls - Durban University of Technology - Research on professional orchestras in South Africa

1 message

Ivan Christian <ivan@cpo.org.za> **Tue, May 12, 2009 at 11:45 AM**
To: quinton.hohls@gmail.com

Dear Quinton

Thank you for your email addressed to the CEO, Mr Louis Heyneman, which has been passed on to me for reply.

The CEO does give his permission for you to conduct research on the string players of the Cape Philharmonic Orchestra, but this has to be on a strictly voluntary basis and the management cannot compel participation or use official working time for such an endeavour.

Just a word of caution: the musicians of the CPO have been requested to participate in various questionnaires and surveys before and the response has always been extremely poor. As recently as a couple of weeks ago the musicians were asked by a medical student to participate in a questionnaire regarding potential hearing problems and related issues in the music profession. Not one single musician responded.

I would not want you to travel to Cape Town and find that you have completely wasted your journey and expense. I will pass your letter on to the Deputy Concertmaster of the CPO, Patrick Goodwin, and ask his opinion as to what he thinks the reaction of his colleagues may be. Patrick himself can be contacted directly at rickpatwingood@gmail.com

Yours sincerely

Ivan

Ivan Christian

General Manager

Cape Philharmonic Orchestra

PO Box 4040, Cape Town 8000

Tel: +27 21 410 9809; Fax: +27 21 425 1009

ivan@cpo.org.za

http://www.cpo.org.za/

Please consider the environment before printing this email

From: Quinton Hohls [mailto:quinton.hohls@gmail.com]
Sent: 10 May 2009 04:32 PM
To: louis@cpo.org.za
Subject: Quinton Hohls - Durban University of Technology - Research on professional orchestras in South Africa

Please find attached a letter of request regarding research on professional orchestras in South Africa

Yours Faithfully

Quinton Hohls

Appendix B1

Quinton Hohls <quinton.hohls@gmail.com>

Research on Professional String musicians in South Africa

2 messages

Quinton Hohls <quinton.hohls@gmail.com> **Tue, Apr 28, 2009 at 8:13 PM**
To: czaza@wlu.ca

Good Morning Dr Zaza,

I am currently a 6th year student at the Durban University of Technology (DUT), in Durban, South Africa. I am in the process in completing my Masters Degree in Chiropractic, and as a part of the requirements to complete our masters we have to submit a dissertation. I have decided to conduct my research on professional string musicians in South Africa, in which I intend to investigate musculoskeletal conditions and injuries experienced by these musicians in the South African context.

My research is quantitative in nature, and I intend to conduct the research by using a questionnaire. However, endless searches on the Internet for a questionnaire on which I will be able to model mine, have been fruitless. In searching though, your name was cited over and over again as a researcher in this highly specialized field.

I thus have a request. Would you be able to forward a questionnaire that you have used in previous studies conducted on professional musicians, which I would be able to mold accordingly . I also intend to use a simple diagram of the human body on which the musicians will be able to mark where on their body they are experiencing problems. If you have also used these in the past, would you be able to forward that information as well.

Full, referenced recognition will be given to the use of any material that you forward.

Any assistance offered would be greatly appreciated. Your research has already helped me tremendously.

Yours faithfully

Quinton Hohls
+27 83 383 9479
quinton.hohls@gmail.com

Christine Zaza <czaza@wlu.ca> **Wed, Apr 29, 2009 at 3:47 AM**
To: quinton.hohls@gmail.com
Cc: czaza@rogers.com

Hello, and thank you for your email and kind comments. I wrote that questionnaire many years ago, and I don't believe that I still have it electronically (only as a hard copy). So I will have it scanned, then send it to you electronically and hope that it works! I'm at the end of a term over here, and am marking final exams, so it may be next week before I am able to send it.

I know you're not planning to do a qualitative study, but it would be interesting to see if professional South African string musicians' definition of an injury would be similar to Canadian musicians' definition of an injury. If you decide that you want to add that question on your questionnaire as an open-ended question (just a thought), just let me know, and I'll send you the wording that I used.

Since I work on contract at WLU, my email may not work after this term (i.e., after Apr. 30), so please take note of my personal email address: czaza@rogers.com. I will email you the questionnaire from there.

All the best,
Christine

>>> Quinton Hohls <quinton.hohls@gmail.com> 04/28/09 2:14 PM >>>
[Quoted text hidden]

Appendix B2

CODE: _____

PLAYING-RELATED HEALTH QUESTIONNAIRE

Christine Zazza
Ph.D. Candidate
Department of Health Studies
University of Waterloo

March 1994

CONFIDENTIAL

PILOT QUALITATIVE STUDY

FIRST INTERVIEW:

QUESTIONS

Start with Personal-Musical History

When did you start playing your instrument?
- At what age did you begin lessons?
- How did you pick your instrument?
- Do you come from a musical family?
  - what do they play?

Which teachers?
Which orchestras?
Which music schools?

Did/do you play other instruments?
Do you like/play jazz, or contemporary music?
Do you like to listen to music when not working?

Do you teach?
- how many students?
- what age?

Do you like to perform solo? what re. performance anxiety?
What's your view of beta blockers?
Do you teach your students re. performing?
- what?

Tell me about the orchestra you play in.
- any problems at work?
- do you like work?
- other work aside from orchestra?

Do you know anyone with playing-related physical problems?
- Any physical playing-related problems yourself?
- What do musicians do when they have a problem?
- What should a musician do when they have a problem?
- When is a problem a problem for a musician?
- Any of your students have problems?

1

CODE _____

SECTION A: DESCRIPTION OF SELF

Would you please provide the following details:

1 Today's date: Day _____ Month _____ Year 19 ___

2 The time now: _____ am ___ pm ___

3 Your date of birth: Day _____ Month _____ Year 19___

4 Sex: ___ Male ___ Female

5 Your weight _____ lbs. OR ___ kg.

6 Your height _____ ft. _____ in. OR _____ cm.

7 Are you: (please check one)

___ Left Handed ___ Right Handed ___ Both

8 Are you: ___ A non-smoker ___ A smoker

How much do you smoke per day ? _____

9 Do you engage in any physical activities, hobbies, or leisure activities on a regular basis, or seasonally?

___ NO ___ YES

If YES, please list them, and write down the approximate time you spend on each, per week:

SPORT OR HOBBY	HOURS PER WEEK
_____	_____
_____	_____
_____	_____

2

10 What is the highest level of education you have attained?

___ High school
___ Conservatory diploma
___ University undergraduate degree
___ Postgraduate studies
___ Other

11 Do you engage in any **non-music-related** work (i.e., work that does not require you to play your instrument) ?

___ NO ___ YES

If YES, please describe what you do **AND** approximately how much time you spend doing it per week:

WORK	AMOUNT OF TIME PER WEEK
_____	_____

12 Which of the following activities of daily living do you do on a regular basis ?

___ Meal preparation
___ Grocery Shopping
___ Outside Chores
___ Child Care
___ House cleaning
___ Driving

13 Do you regularly use a computer ?

___ NO ___ YES

If YES, Approximately how much time per WEEK do you spend:

TYPING (Wordprocessing) _____ Hour per week
PLAYING COMPUTER GAMES _____ Hours per week
USING A MOUSE _____ Hours per week
OTHER _____ Hours per week

14 Overall, how would you rate the state of your health? (Please circle)

1 2 3 4 5
POOR EXCELLENT

3

15 Have you ever broken any bones?

___ (0) NO ___ (1) YES (Please specify _____)

16 Are you taking any of the following on a regular basis: (Please check all that apply)

___ (1) Prescription or nonprescription medications

___ (2) Vitamins or minerals

___ (3) Herbal or holistic remedies

___ (4) Other (please specify) _____

17 Please state how often you see the following health professionals for your general health care:

	NA	LESS THAN 1 TIME/YEAR	1-2 TIMES/YEAR	1-2 TIMES/MONTH	3 OR MORE TIMES/MONTH
FAMILY DOCTOR					
CHIROPRACTOR					
NATUROPATH/ HOMEOPATH					
MASSAGE THERAPIST					
OTHER: _____					

NA = Not Applicable

18 Are you "double-jointed"? ___ (0) NO ___ (1) YES ___ (2) DON'T KNOW

19 Do you have any chronic health problems (e.g., high blood pressure)?

___ (0) NO ___ (1) YES

If YES, Please list

_____

4

SECTION B: MUSIC BACKGROUND

1 At what age did you begin lessons on an instrument? _____

2 What is (are) your main instrument(s): _____

(a) At what age did you start lessons on your main instrument(s)? _____

3 Aside from your main instrument, do you currently play other instruments?

___ (0) NO ___ (1) YES

If YES, please list the instruments you play, and indicate approximately how much time you spend playing each: (Use back of page if needed)

Instrument	Hours per week
_____	_____
_____	_____

4 Have you ever had instruction on preventing musicians' playing-related health problems such as tendonitis, etc.?

___ (0) NO ___ (1) YES

If YES,
(a) By whom (please check)

___ (1) Health Care Professional ___ (3) Colleague
___ (2) Music Teacher ___ (4) Other

(b) What type of instruction: (please all that apply)

___ (1) Lecture (1 hour) ___ (3) Course (several weeks)
___ (2) Workshop (2-3 hours) ___ (4) Other

(c) Did this instruction lead you to change any aspects of your playing? (e.g., practice habits, technique, playing position)

___ (0) NO ___ (1) YES If YES, please describe:

_____

5

5 How do you carry your instrument in its case: (Please check all that apply)

___ I don't carry my instrument

___ I use a shoulder strap on my: ___ Left Shoulder ___ Right Shoulder

___ I carry it by a handle in my: ___ Left Hand ___ Right Hand

___ I have wheels attached to my case

___ Other (Please specify) _____

6 How do you carry a:

Purse: ___ Left Shoulder ___ Right Shoulder
___ Left Hand ___ Right Hand

___ NA

Knapsack/
Briefcase: ___ Left Shoulder ___ Right Shoulder
___ Left Hand ___ Right Hand

___ NA

(NA = not applicable)

Playing Technique

1 Have you significantly changed your playing technique in the last 12 months?

___ NO ___ YES

2 Do you practise technical exercises specifically for finger independence (finger isolation)?

___ NO ___ YES

3 Do you sit especially high or especially low when you play?

___ NO ___ YES
___ HIGH ___ LOW

4 In the last 12 months have you had any of the following changes?

___ New Teacher
___ New Instrument
___ Change in Set up on Instrument (e.g., chair wedge, shoulder pad, instrument rest, leg rest, etc.)
___ Repertoire or Studies
___ Work
___ Other (Please specify)_____

SECTION C: OCCUPATIONAL INFORMATION

Are you a: ___(1) Professional Musician ___(2) Music Student

If you are a STUDENT, please SKIP to PAGE 12 (GREEN).

Professional Musicians

1 What is your main occupation? (Please check all that apply)

___(1) Teacher ___(2) Performer ___(3) Other

2 How many years have you been working as a professional musician? _____

3 Do you: ___(1) Teach ___(2) Coach ___(3) Conduct

4 How many hours per week do you usually teach, coach, or conduct during academic or work season?

___(1) 0 hrs
___(2) 1-5 hrs
___(3) 6-10 hrs
___(4) 11-15 hrs
___(5) 16 plus hrs

5 Please fill in the week below with your typical schedule of teaching, coaching, or conducting, during academic/work season.

DAYS OF WEEK	# HOURS PER DAY TEACHING, COACHING OR CONDUCTING
Mon.	
Tue.	
Wed.	
Thurs.	
Fri.	
Sat.	
Sun.	

6 How much does your total individual practice time vary from day to day?

Not at All 1 2 3 4 5 A Great Deal

7 In general, how satisfied are you with your work as a musician? (Please circle)

VERY UNSATISFIED 1 2 3 4 5 VERY SATISFIED

8 In general, what do you enjoy most about your work as a musician?

_____

_____

9 If you could change anything about your work to make it more enjoyable, what would you like most to change?

_____

_____

10 Do you play in any of the following? (Please check all that apply)

___(1) Symphony Orchestra
___(2) Theatre Orchestra
___(3) Chamber Ensemble
___(4) Freelance
___(5) Other (please specify)

If you play in a symphony or theatre orchestra or ensemble, please continue to the next page.

If you do NOT play in a symphony or theatre orchestra or ensemble, please SKIP to SECTION D (IVORY) on page 15.

Symphony, Theatre Orchestral, or Ensemble Musicians

11 How long have you been a contracted musician with a professional orchestra or ensemble?

___(1) Less than 2 years
___(2) 2-5 years
___(3) 6-10 years
___(4) 11-20 years
___(5) More than 20 years

12 Please describe your position in the orchestra:

___(1) Principal ___(2) Assistant Principal ___(3) Associate Principal ___(4) Section Player

13 Do you have tenure?

___ NO (0) ___ YES (1)

If YES, how long have you had tenure in your present orchestra? _____

14 Do you currently look for openings in other orchestras?

___ NO (0) ___ YES (1)

15 In the last 12 months, have you performed any auditions?

___ NO (0) ___ YES (1)

If YES, How many auditions have you played in the past 12 months? _____

16 How many more years do you hope to stay with your current orchestra?

___(1) 1-5 years ___(2) 6-10 years ___(3) >10 years

17 Aside from regular work with your orchestra, how much other professional performance work do you do during the orchestra season?

___(0) I do not do other playing work at all
___(1) I do other playing work **rarely or very occasionally**
___(2) I do other playing work **often** (1-3 times a month)
___(3) I do other playing work **weekly** (4 or more times a month)

18 How many weeks is your orchestra contracted for in your season?

___(1) Under 30 weeks
___(2) 30 - 35 weeks
___(3) 36-40 weeks
___(4) 41-45 weeks
___(5) Over 45 weeks

19 How many regular contracted players play in your orchestra?

___(1) 30 or less
___(2) 31-60
___(3) 61-80
___(4) 81-100
___(5) over 100

20 On average, how many services per week do you have?

___(1) 5 or 6
___(2) 7 - 8 1/2
___(3) 9 or more
___(4) Other

21 On average, about how many **solo** or **chamber** performances have you played per year during the past 3 years?

___(0) 0
___(1) 1-5
___(2) 6-15
___(3) 16-25
___(4) more than 25

11

22 In which range is your salary from your orchestra:

___(1) $ 0 - $14,999 per year
___(2) $15,000 - $19,999 per year
___(3) $20,000 - $29,999 per year
___(4) $30,000 - $39,999 per year
___(5) $40,000 - $49,000 per year
___(6) $50,000 - $59,000 per year
___(7) $60,000 - $69,000 per year
___(8) $70,000 or more per year

23 How long is your sick leave provision in your contract? _____

24 Do you have any other provisions that affect sick leave (e.g., sick days are cumulative over time)?

___(0) NO ___(1) YES ___(2) DON'T KNOW

25 Do you have disability benefits in your contract?

___(0) NO ___(1) YES ___(2) DON'T KNOW

26 Are disability benefits optional in your contract?

___(0) NO ___(1) YES ___(2) DON'T KNOW

27 How satisfied are you with your sick leave provisions?

1 2 3 4 5
VERY UNSATISFIED ... VERY SATISFIED

Please go SECTION D (IVORY) on page 15

12

MUSIC STUDENTS

1 Where do you study?

___(1) University ___(2) Conservatory ___(3) Other (Please state)_____

2 What is your main Program of Study (Major):

___(1) Performance
___(2) Music History
___(3) Music Education
___(4) Other (Please specify)_____
___(5) Music Therapy
___(6) Music Theory
___(7) General Music Degree

3 What year are you in? _____ YEAR

4 Do you play professionally as well?

___(0) NO ___(1) YES

If YES,

How often do you play? _____

What type of jobs do you play? _____

5 Do you teach? ___(0) NO ___(1) YES

If YES, How many hours per week do you teach?

_____

6 How many hours per day do you usually spend in **individual PRACTICE time** on your instrument in the following situations:

During school term _____

Day before a lesson _____

Day before a playing exam or audition _____

During summer break _____

13

7 How much does your total individual practice time vary from day to day?

1 2 3 4 5
Not at All A Great Deal

8 Do you play in ensembles (either at school or outside school)?

___ NO (0) ___ YES (1)

If YES, please list the ensembles you play in _____

_____

9 How many **solo** or **chamber** performances have you played this school year?

___ None (0) ___ 1-3 (1) ___ 4 or more (2)

10 How satisfied are you with your **music teacher**?

1 2 3 4 5
VERY UNSATISFIED VERY SATISFIED

11 How satisfied are you with the **music program** at your school?

1 2 3 4 5
VERY UNSATISFIED VERY SATISFIED

14

12 What do you enjoy most about your studies in music?

_____

_____

13 If you could change any 2 things about your school program to make it more enjoyable what would you like most to change?

_____

_____

Future Goals:

14 Do you hope to be a professional musician?

___ NO (0) ___ YES (1)

If YES, please check all that apply:

___ (1) Music Teacher ___ (2) Performer ___ (3) Other

15 Do you plan to further your studies in music after you complete this program?

___ NO (0) ___ YES (1)

Please continue with SECTION D (IVORY) on the next page.

15

SECTION D: PLAYING-RELATED MUSCULOSKELETAL PROBLEMS

For the purpose of this study, a **PLAYING-RELATED MUSCULOSKELETAL PROBLEM** is defined as:

Pain, weakness, numbness, tingling, or other symptoms that arise from playing, and that interfere with your ability to play your instrument at the level you are accustomed to. (Pain or any other symptoms that are caused by an accident or other non-playing-related event are not considered to be a playing-related musculoskeletal problem.)

1(a) Have you experienced a playing-related musculoskeletal problem in the parts of the body listed in the chart below, **DURING THE LAST 12 MONTHS?** (Please check YES or NO and specify RIGHT, LEFT or BOTH where applicable.)

NECK ___(0) No ___(1) Yes	**UPPER BACK** ___(0) No ___(1) Yes ___(1) Left Side ___(2)Right Side ___(3)Both Sides
FACE (Please specify ___JAW or ___EMBOUCHURE) ___(0) No ___(1) Yes ___(1) Left Side ___(2) Right Side ___(3) Both Sides	**LOWER BACK** (small of the back) ___(0) No ___(1) Yes ___(1) Left Side ___(2)Right Side ___(3)Both Sides
SHOULDER or UPPER ARM ___(0) No ___(1) Yes ___(1) Left Side ___(2) Right Side ___(3) Both Sides	**HIPS, THIGHS, or BUTTOCKS** ___(0) No ___(1) Yes ___(1) Left Side ___(2)Right Side ___(3)Both Sides
ELBOWS or FOREARMS ___(0) No ___(1) Yes ___(1) Left ___(2) Right ___(3) Both	**ONE or BOTH KNEES** ___(0) No ___(1) Yes ___(1) Left ___(2) Right ___(3) Both
WRISTS, HANDS, or FINGERS ___(0) No ___(1) Yes ___(1) Left ___(2) Right ___(3) Both	**ANKLES or FEET** ___(0) No ___(1) Yes ___(1) Left ___(2) Right ___(3) Both

16

1(b) **CURRENTLY**, do you have a playing-related musculoskeletal problem (i.e., any pain, weakness, numbness, tingling, or other symptoms from playing that interfere with your ability to play your instrument at the level you are accustomed to)?

___ YES (1) ___ NO (0)

Do you worry about getting a playing-related musculoskeletal problem?

Not At All 1 2 3 4 5 Very Frequently

Have you ever had a playing-related musculoskeletal problem, as defined above?

___ NO (0) ___ YES (1)

What was it ? _____

When did it begin? _____

When did it subside? _____

Please go to SECTION E (BLUE) on page 24

2 Do you believe this problem is because of playing?

___ NO (0) ___ YES (1)

3 Please state what you believe caused the problem:

_____

4 How many different problems do you have? _____

5 Is this the first time you've had a playing-related musculoskeletal problem?

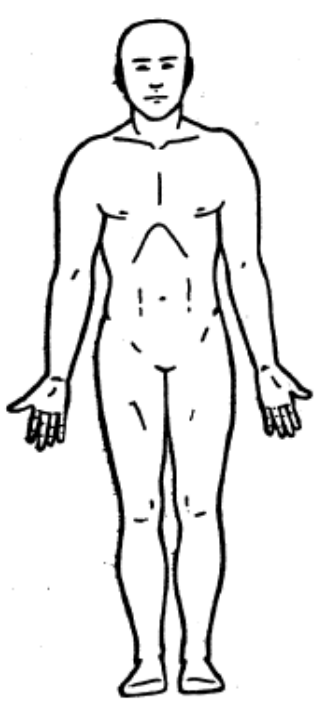
___ NO (0) ___ YES (1)

6 How long have you had this playing-related musculoskeletal problem? _____

7 Using the diagram below, please indicate where you feel symptoms related to your playing-related musculoskeletal problem(s):

- Please use X's to cover the area where you feel pain, discomfort or other symptoms
- Please circle any areas of tingling or loss of feeling

Example:



8 Thinking of the most severe current problem you are experiencing, please **circle** the number on these scales that best describes your experience with playing-related musculoskeletal problems.

FREQUENCY SCALE

0 = no problem ever

1 = had a problem once but it is gone now

2 = problem occurs occasionally, during or after playing

3 = problem occurs usually, during or after playing

4 = problem always occurs, during or after playing

5 = problem affects many activities of daily living as well as playing

6 = problem affects all activities of daily living as well as playing

7 = problem affects all activities of daily living and I cannot play at all because of problem

Please circle the number on this scale which best describes how **severe** this problem is.

SEVERITY SCALE

0 = no negative symptoms

1 = mild noticeable symptoms

2 = discomforting symptoms

3 = troublesome symptoms

4 = distressing symptoms

5 = severe symptoms

6 = debilitating symptoms

7 = unbearable symptoms

X

19

9 Have you seen a health care professional about this problem?

___ NO (00) ___ YES (01)

If YES, please check all that apply and indicate how many you have seen:

___(01) Family Medical Doctor
___(02) Chiropractor
___(03) Medical Specialist
___(04) Other (please specify) _____
___(05) Physiotherapist
___(06) Occupational therapist

What diagnosis (or diagnoses) were you given?

_____

10 Have you **decreased your playing time** because of this problem?

___ NO (00) ___ YES (01)

11 Have you **stopped playing** for any period of time because of this problem?

___ NO (00) ___ YES (01)

Are you playing again ? ___ NO (00) ___ YES (01)
How much time per day do you play now ? _____

How long did you stop for? _____

12 Are you playing as much as you would like to play?

___ NO (00) ___ YES (01)

20

These next questions refer to your playing activities right **BEFORE** you experienced a problem. That is, **a few days or a few weeks before** you noticed symptoms. Please provide as much information as you can.

13 **BEFORE** you began experiencing symptoms of a problem, did you take **breaks** during individual practice sessions?

___ NO (00) ___ YES (01)

Approximately how **often** _____

Approximately how **long** was each break _____

What did you **do** during your break _____

14 **BEFORE** you began experiencing symptoms of a problem, did you **physically warm up without your instrument** before a practice session? (e.g., movement exercises, stretching, etc.)

___ NO (00) ___ YES (01)

___(01) OCCASIONALLY ___(02) USUALLY ___(03) ALWAYS

15 **BEFORE** you began experiencing symptoms of a problem, did you **warm up on your instrument** before a practice session? (e.g., slow scales, buzzing on mouthpiece, long tones, etc.)

___ NO (00) ___ YES (01)

___(01) OCCASIONALLY ___(02) USUALLY ___(03) ALWAYS

16 **BEFORE** you began experiencing symptoms of a problem, did you do a **physical cool down after** you practised or played your instrument? (e.g., stretches, body movement, etc.)

___ NO (00) ___ YES (01)

___(01) OCCASIONALLY ___(02) USUALLY ___(03) ALWAYS

21

17 **BEFORE** you began experiencing symptoms of a problem, how **stressful** was your work/study?

1 2 3 4 5
NOT AT ALL STRESSFUL — VERY STRESSFUL

18 **BEFORE** you began experiencing symptoms of a problem, how **stressful** was your life in general?

1 2 3 4 5
NOT AT ALL STRESSFUL — VERY STRESSFUL

19 **BEFORE** you began experiencing symptoms of a problem, were you playing **more** than usual?

___ NO (00) ___ YES (10)

20 **BEFORE** you began experiencing symptoms of a problem, were you playing **less** than usual?

___ NO (00) ___ YES (01)

21 **BEFORE** you began experiencing symptoms of a problem, did you just return from a break away from playing? (e.g., a summer holiday, Christmas break, a long illness, other work)

___ NO (00) ___ YES (11)

22 **BEFORE** you began experiencing symptoms of a problem, did you change any of the following?

___ (10) New Teacher
___ (09) Instrument
___ (08) Change in set up on instrument (e.g., chair, shoulder pad, instrument rest, leg rest etc.)
___ (07) Repertoire or Studies
___ (06) Work
___ (05) Other (Please specify) _____

22

23 **BEFORE** you began experiencing symptoms of a problem, how much did you practise each day?

(Because a musician's playing schedule varies from day to day, it can be difficult to say how many hours you play on average. Therefore, please describe how much playing you did on a very busy day of playing during school or work season, as well as on a light playing day during school or work season.)

BUSY PLAYING DAY

Individual Practise: _____

Rehearsal: _____

Performing: _____

LIGHT PLAYING DAY:

Individual Practise: _____

Rehearsal: _____

Performing: _____

24 Using the chart below, please indicate which was more typical for you in a 7 day week, busy days or slow days? Please fill out the example of a week's schedule during your school or work season reflecting how many busy days compared to light playing days **BEFORE you began experiencing a problem.**

TOTAL PLAYING TIME = Individual practice + Rehearsing + Performing.

DAYS OF WEEK	TOTAL PLAYING TIME
Mon.	
Tue.	
Wed.	
Thurs.	
Fri.	
Sat.	
Sun.	

25 Have you changed your **playing technique** because of this problem?

___ NO ___ YES

What have you changed about your playing technique?

_____

26 Have you changed your **playing position** because of this problem?

___ NO ___ YES

What have you changed about your playing position?

_____

27 If you play a double reed instrument, how many hours/WEEK did you spend working on reeds?

_____ Hours per Week

28 If you would like to describe any other details about your playing **BEFORE** your symptoms began, please use this space.

_____

_____

_____

_____

The remainder of the questions in this questionnaire refer to your CURRENT playing and other activities.

PLEASE CONTINUE WITH SECTION E (BLUE) on the next page

SECTION E: CURRENT PRACTICE HABITS

1 How many hours a day do you usually practise your main instrument(s) during academic or work season?

(Because a musician's playing schedule varies from day to day, it can be difficult to say how many hours you play on average. Therefore, please describe how much playing you might do on a very busy day of playing and a very light during your current or most recent school or work season.)

BUSY PLAYING DAY

Individual Practise: _____

Rehearsal: _____

Performing: _____

LIGHT PLAYING DAY:

Individual Practise: _____

Rehearsal: _____

Performing: _____

2 Using the chart below, please indicate which is more typical for you during school or work season? In other words, please give an example of a week's schedule during your school or work season reflecting how many busy days compared to light playing days you might have.

TOTAL PLAYING TIME = Individual practice + Rehearsing + Performing

DAYS OF WEEK	TOTAL PLAYING TIME
Mon.	
Tue.	
Wed.	
Thurs.	
Fri.	
Sat.	
Sun.	

3 If you play a double reed instrument, how many hours/WEEK do you spend working on reeds?

_____ Hours per Week

4 Could you describe what you **do** during a typical individual practice session? Please indicate how much time you spend practising certain material in your practice session, and the order in which you practise the material?

(e.g., 1st Repertoire: 2 minutes; Then Studies: 2 minutes; Then Break: 1 minute; Then Technique: 2 1/2 hours, etc.)

_____

_____

_____

_____

_____

5 Do you take **breaks** during individual practice sessions?

___ NO (01) ___ YES (02)

___(03) OCCASIONALLY ___(04) USUALLY ___(05) ALWAYS

(a) In general, approximately how **long** is your break ?

___(06) Less than 5 minutes
___(07) 5 - 10 minutes
___(08) 11 - 15 minutes
___(09) 16-20 minutes
___(10) > 20 minutes

(b) In general, approximately how **often** do you usually break?

___(11) Break after 20 - 30 minutes
___(12) Break after 45 minutes
___(13) Break after 60 minutes
___(14) Break after 2-3 hours
___(15) Other (please specify)_____

(c) What do you **do** during your break? _____

6 Do you **physically warm up without your instrument** before a practice session ? (i.e., movement exercises, stretching, etc.)

___ NO (01) ___ YES (02)

___(03) OCCASIONALLY ___(04) USUALLY ___(05) ALWAYS

7 Do you **warm up on your instrument** before a practice session? (e.g., slow scales, buzzing on mouthpiece, open strings, long tones, etc.)?

___ NO (01) ___ YES (02)

___(03) OCCASIONALLY ___(04) USUALLY ___(05) ALWAYS

8 Do you do a **physical cool down** after you practise or play your instrument (e.g., stretches, body movement, etc.)?

___ NO (01) ___ YES (02)

___(03) OCCASIONALLY ___(04) USUALLY ___(05) ALWAYS

9 **In the last 12 months**, have you significantly changed any of your practice habits?

___ NO (01) ___ YES (02)

If YES, What have you changed? _____

10 **In the last 12 months**, did you have a long break away from playing? (e.g., a summer holiday, Christmas break, a long illness, other work)

___ NO (01) ___ YES (02)

11 **In the last 12 months**, have you significantly changed your **playing technique**?

___ NO (0) ___ YES (1)

What have you changed about your playing technique?

_____

12 **In the last 12 months**, have you significantly changed your **playing position**?

___ NO (0) ___ YES (1)

What have you changed about your playing position?

_____

SECTION F: PERFORMANCE ANXIETY AND OCCUPATIONAL STRESS

1 Currently, how stressful is your **work/study** in general?

NOT STRESSFUL AT ALL 1 2 3 4 5 VERY STRESSFUL

2 How much stress do the following people give you?

	NO STRESS					A GREAT DEAL OF STRESS	
Your Music Teacher	1	2	3	4	5		___ NA
Your Conductor	1	2	3	4	5		___ NA
Your Stand Partner	1	2	3	4	5		___ NA
Your Section leader	1	2	3	4	5		___ NA

3 Currently, how stressful is your **life** in general?

NOT AT ALL STRESSFUL 1 2 3 4 5 VERY STRESSFUL

4 Have you ever experienced anxiety related to music performance (i.e., performance anxiety)?

___ NO (0) ___ YES (1)

___ (1) OCCASIONALLY ___ (2) USUALLY ___ (3) ALWAYS

5 Do you consciously do something to deal with **performance anxiety?**

___ NO (00) ___ YES (01)

___(01) OCCASIONALLY ___(02) USUALLY ___(03) ALWAYS

6 Do you consciously do something to help you deal with stress or anxiety **in general?**

___ NO (00) ___ YES (01)

___(01) OCCASIONALLY ___(02) USUALLY ___(03) ALWAYS

7 What symptoms of performance anxiety or stress have you experienced during the last 12 months? (Please check all that you've experienced)

Physical	**Mental**
___(01) Tremors	___(09) Worry
___(02) Diarrhoea	___(10) Panic
___(03) Sweaty Hands	___(11) Concentration problems
___(04) Cold Hands	___(12) General nervousness
___(05) Urge to Urinate	___(13) Lack of confidence
___(06) Breathing Problems	___(14) Fear
___(07) Increased Heart Rate	___(15) Memory Lapse
___(08) Co-ordination Problems	___(16) Other (Please specify) _____

___(17) Other (Please specify)_____

8 Please check those coping strategies that you currently use for the purpose of reducing performance anxiety and/or stress, then rate how effective you find each strategy in reducing performance anxiety.

	NO EFFECT	SOMEWHAT EFFECTIVE	VERY EFFECTIVE
___(01) Music Rehearsal/Practice	1	2	3
___(02) Music Warm-Up	1	2	3
___(03) Music Listening	1	2	3
___(04) Avoiding Certain Foods	1	2	3
___(05) Humour	1	2	3
___(06) Beta Blockers (e.g., Inderal)	1	2	3
___(07) Affirmation	1	2	3
___(08) Breathing Exercises	1	2	3
___(09) Visualization	1	2	3
___(10) Mind Control	1	2	3
___(11) Relaxation Techniques	1	2	3
___(12) Alcohol	1	2	3
___(13) Yoga or Meditation	1	2	3
___(14) Others:	1	2	3

_____

SECTION G: PERSONAL CHARACTERISTICS

A Listed below are some statements about playing and pain. Read each item and decide whether you agree or disagree and to what extent. If you **strongly agree**, circle 7; if you **strongly disagree**, circle 1; if you feel somewhere in between, circle any one of the numbers between 1 and 7. If you feel neutral or undecided the midpoint is 4. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. There are no right or wrong answers.

		DISAGREE			NO OPINION			AGREE
1	Musicians should play through pain.	1	2	3	4	5	6	7
2	I would stop or decrease my playing time if I have pain.	1	2	3	4	5	6	7
3	Pain is normal part of playing and is to be expected.	1	2	3	4	5	6	7
4	Musicians who have playing-related pain must be doing something wrong in their playing.	1	2	3	4	5	6	7
5	You have to experience some pain when you practise if you're going to improve.	1	2	3	4	5	6	7
6	If I had a playing-related pain problem I wouldn't tell my colleagues for fear of losing work.	1	2	3	4	5	6	7
7	If I had a playing-related pain problem I would tell my colleagues because they would understand and they might be able to help.	1	2	3	4	5	6	7
8	Playing in pain might hurt me but it's not going to harm me, so I may as well put up with the pain and play.	1	2	3	4	5	6	7

B Please read each item listed below and decide whether you agree or disagree and to what extent. If you **strongly agree**, circle 7; if you **strongly disagree**, circle 1; if you feel somewhere in between, circle any one of the numbers between 1 and 7. If you feel neutral or undecided the midpoint is 4. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. There are no right or wrong answers.

		STRONGLY DISAGREE			NO OPINION			STRONGLY AGREE
1	When I am working on something, I cannot relax until it is perfect.	1	2	3	4	5	6	7
2	One of my goals is to be perfect in everything I do.	1	2	3	4	5	6	7
3	Everything that others do must be of top-notch quality.	1	2	3	4	5	6	7
4	Those around me readily accept that I can make mistakes too.	1	2	3	4	5	6	7
5	Anything I do that is less than excellent will be seen as poor work by those around me.	1	2	3	4	5	6	7
6	It is very important that I am perfect in everything I attempt.	1	2	3	4	5	6	7
7	I have high expectations for the people who are important to me.	1	2	3	4	5	6	7
8	I strive to be the best at everything I do.	1	2	3	4	5	6	7
9	The people around me expect me to succeed at everything I do.	1	2	3	4	5	6	7
10	I demand nothing less than perfection of myself.	1	2	3	4	5	6	7
11	I can't be bothered with people who won't strive to better themselves.	1	2	3	4	5	6	7
12	I do not expect a lot from my friends.	1	2	3	4	5	6	7
13	Although they may not show it, other people get very upset with me when I slip up.	1	2	3	4	5	6	7
14	People expect nothing less than perfection from me.	1	2	3	4	5	6	7
15	It does not matter to me when a close friend does not try their hardest.	1	2	3	4	5	6	7

C A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to indicate how you **generally** feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

		ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
1	I feel pleasant	1	2	3	4
2	I tire quickly	1	2	3	4
3	I feel like crying	1	2	3	4
4	I wish I could be as happy as others seem to be	1	2	3	4
5	I am losing out on things because I can't make up my mind soon enough	1	2	3	4
6	I feel rested	1	2	3	4
7	I am "calm, cool, and collected"	1	2	3	4
8	I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
9	I worry too much over something that really doesn't matter	1	2	3	4
10	I am happy	1	2	3	4
11	I am inclined to take things hard	1	2	3	4
12	I lack self-confidence	1	2	3	4
13	I feel secure	1	2	3	4
14	I try to avoid facing a crisis or difficulty	1	2	3	4
15	I feel blue	1	2	3	4
16	I am content	1	2	3	4
17	Some unimportant thought runs through my mind and bothers me	1	2	3	4
18	I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
19	I am a steady person	1	2	3	4
20	I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

D Here are a number of words that describe feelings and emotions. Please indicate to what extent you generally feel this way; that is, how you feel on average. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. There are no right or wrong answers. Use the following scale to record your answers:

1 = Not at all
2 = A little
3 = Moderately
4 = Quite a bit
5 = Extremely

1	Interested:	1	2	3	4	5
2	Distressed:	1	2	3	4	5
3	Excited:	1	2	3	4	5
4	Upset:	1	2	3	4	5
5	Strong:	1	2	3	4	5
6	Guilty:	1	2	3	4	5
7	Scared:	1	2	3	4	5
8	Hostile:	1	2	3	4	5
9	Enthusiastic:	1	2	3	4	5
10	Proud:	1	2	3	4	5
11	Irritable:	1	2	3	4	5
12	Alert:	1	2	3	4	5
13	Ashamed:	1	2	3	4	5
14	Inspired:	1	2	3	4	5
15	Nervous:	1	2	3	4	5
16	Determined:	1	2	3	4	5
17	Attentive:	1	2	3	4	5
18	Jittery:	1	2	3	4	5
19	Active:	1	2	3	4	5
20	Afraid:	1	2	3	4	5

35

E These 11 statements below refer to your **life in general.** Please circle **YES** or **NO** for each of the following statements to describe how you feel on average. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. There are no right or wrong answers.

1	Do you have to turn things over and over in your mind for a long time before being able to decide what to do?	YES	NO
2	Do you often have to check things several times?	YES	NO
3	Do you ever have to do things over again a certain number of times before they seem quite right?	YES	NO
4	Do you have difficulty making up your mind?	YES	NO
5	Do you have to go back and check doors, cupboards, or windows to make sure they are really shut?	YES	NO
6	Do you dislike having a room untidy or not quite clean for even a short time?	YES	NO
7	Do you take great care in hanging and folding your clothes at night?	YES	NO
8	Do you like to keep a certain order to undressing and dressing or washing or bathing?	YES	NO
9	Do you like to put your personal belongings in set places?	YES	NO
10	Do you like to get things done exactly right down to the smallest details?	YES	NO
11	Are you the sort of person who has to pay a great deal of attention to details?	YES	NO

36

F These 5 statements refer to **how you practise your instrument in general.** Please circle **YES** or **NO** for each of the following statements to describe how you feel on average. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. There are no right or wrong answers.

1	When practising your instrument, do you often have to check things several times?	YES	NO
2	When practising your instrument, do you ever have to do things over again a certain number of times before they seem quite right?	YES	NO
3	When practising your instrument, do you have difficulty making up your mind?	YES	NO
4	When practising your instrument, do you like to get things done exactly right down to the smallest details?	YES	NO
5	When practising your instrument, are you the sort of person who has to pay a great deal of attention to details?	YES	NO

THANK YOU VERY MUCH.

ALL RESPONSES WILL BE KEPT STRICTLY CONFIDENTIAL.

Appendix B3

Playing Related Musculoskeletal Questionnaire - Quinton Hohls, 20410817

Section A
Description of Self

1) Date of Birth

Day Month Year

2) Sex

Male___ Female___

3) Race (for statistical purposes)

White___
Black___
Indian____
Coloured____
Asian____
Other (please specify):_____

4) Height ____m

5) Weight ____kg's

6) Are you:

Right handed_____ Left handed____ Both____

7) Are you

A smoker____ Non-smoker_____

8) What is your country of Origin?_____

9) What is your Qualification

Bachelor of Music____
Masters in Music____
PhD____
Other (please specify):_____

10) What year did you obtain your Qualification:_____

11) Did you obtain your qualification from a South African University?

Yes_____ No_____

a) If "Yes", please specify from which University you obtained your qualification

_____

b)i) If "No", in which country did you obtain your qualification?

_____

b)ii) From which University, in that country, did you obtain your qualification?

_____

12) Do you engage in any regular physical activites or hobbies (e.g. gym routine, jogging etc.)?

Yes_____ No_____

If "Yes", please list them and how many hours per week you engage in these activities

Sport or Hobby	Hours per Week
_____	_____
_____	_____
_____	_____
_____	_____

Section B:
Musical Background

1) At what age did you first begin lessons on an instrument?_____years

2) At what age did you first begin playing in a professional orchestra?_____years

3) What String instrument are you playing in this orchestra?

Violin_____
Viola_____
Cello_____
Double Bass_____
Harp_____

3)a) At what age did you start playing the string instrument you are currently playing in this orchestra?

_____years

4) Aside form your string instrument, do you currently play any other instruments?

No____ Yes_____

4)a) If "Yes", please list the instruments you play, and indicate how much time you spend playing each:

Instrument	Hours per

	week
_____	_____
_____	_____
_____	_____
_____	_____

5) Have you ever received instruction on preventing musicians' playing related health problems such as tendonitis, etc?

Yes_____ No_____

If "Yes"

a) By Whom: (please tick)

i) Health Care Professional_____

ii) Music Teacher_____

iii) Colleague_____

iv) Part of curriculum at University_____

v) Other_____

b) What type of instruction: (please all that apply)

i) Lecture (1 Hour)_____

ii) Workshop (2-3 Hours)_____

iii) Course (several weeks)_____

iv) Other____

c) Was this instruction given a specific technique name (e.g. Alexander Technique)

Yes____ No_____

If "Yes" please specify_____

d) Did this instruction lead you to change any aspects of your playing?
(e.g. practice habits, technique, playing position)
No_____ Yes_____

If "Yes" please describe: _____

If "No", why not?_____

6) How do you carry your instrument in its case: (please tick all that apply)

i) I don't carry my instrument___
ii) I use a shoulder strap on my: Left Shoulder_____ Right Shoulder_____
iii) I carry it by handle in my: Left Hand_____ Right Hand_____
iv) I have wheels attached to my case_____
v) Other (Please specify)_____

Playing Technique

1) Have you significantly changed your playing technique in the last 12 months
Yes_____ No_____

2) Do you practise technical exercises specifically for finger independence (finger isolation)
Yes_____ No_____

3) When playing, do you sit especially
High_____ or Low_____

4) Do you physically warm up **without your instrument** before a practice session?
(e.g. stretching, movement exercises etc.)

Yes_____ No_____

If "Yes", do you do this:
Occasionally_____
Usually_____
Always_____

5) Do you warm up **on your instrument** before a practice session? (e.g. slow scales, long tones etc.)

Yes_____ No_____

If "Yes", do you do this:
Occasionally_____
Usually_____
Always_____

6) Do you peform a **physical cool down** after you practised or played your instrument?
(e.g. Stretches, body movement etc.)

Yes_____ No_____

If "Yes", do you do this:
Occasionally_____
Usually_____
Always_____

Section C
Occupational Information

1) What is your main occupation? (please tick all that apply)

Performer_____
Teacher_____
Other_____

2) How many years have you been working as a professional musician?
_____years

3) Do you give music lessons/teach with the instrument you are playing in this orchestra?
Yes_____ No_____

3)a) If "Yes", how many hours per week do you teach during an academic term?
0 hrs___
1-5 hrs___
6-10 hrs___
11-15 hrs____
16 hrs plus____

4) Do you play in any other music orchestras, ensembles, bands, or freelance?
Yes_____ No_____(if "No", proceed to Question 5)

4)a) If "Yes", how many hours per week do you play in these additional capacities?
0 hrs___
1-5 hrs___
6-10 hrs___
11-15 hrs____
16 hrs plus____

5) Do you engage in any non-music related work (i.e. work that does not require you to play your instrument)?

Yes_____ No_____(if "No", proceed to Question 6)

5)a) If "Yes" please specify_____

5)b) How many hours per week do you perform this work?

0 hrs___
1-5 hrs___
6-10 hrs___
11-15 hrs____
16 hrs plus____

6) What is your salary range from this orchestra?

R0 - R4,999_____
R5000 - R9999_____
R10000 - R14999_____
R15000 - R19999_____
R20000 - R24999_____
R25000 + _____

7) What is you salary range from any other combined additional income (from teaching, other orchestras, freelancing etc.)?

R0 - R4,999_____
R5000 - R9999_____
R10000 - R14999_____
R15000 - R19999_____
R20000 - R24999_____
R25000 + _____

Section D
Playing-Related Musculoskeletal Problems

For the purposes of this study, a playing-related musculoskeletal problem is defined as:
"Pain, weakness, numbness or tingling, or other symptoms that arise from playing, and that interfere with your ability to play your instrument at the level you are accustomed to.
(Pain or any other symptoms that are caused by an accident or other non-playing-related event are NOT considered to be a playing-related problem)"?

1)a) Have you experienced a playing-related musculoskeletal problem in the parts of the body listed in the table below, **DURING THE LAST 12 MONTHS?** (Please tick Yes or No and specify Right, Left or both where applicable.)

i) Neck:

Yes____ No____
Left Side____
Right Side____
Both Sides_____

ii) Face: (Please specify: Jaw____ or Embouchure_____)

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

iii) Shoulder or Upper Arm:

Yes____ No_____
Left Side____

Right Side____
Both Sides_____

iv) Elbows or Forearms:

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

v) Wrist, Hands or Fingers:

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

vi) Upper Back:

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

vii) Lower Back (small of back):

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

viii) Hips, Thighs or Buttocks:

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

ix) One or Both Knees:

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

x) Ankles or Feet:

Yes____ No_____
Left Side____
Right Side____
Both Sides_____

1)b) CURRENTLY, do you have a playing-related musculoskeletal problem (i.e. any pain, weakness, numbness, tingling or other symptoms from playing that interfere with your ability to play to your instrument at the level you are accustomed to?

Yes_____
If "Yes" please proceed to **Question 2**

No_____
If "No" please proceed to **Question 1 c**

1)c) Do you worry about getting a playing-related musculoskeletal problem?

(please tick appropriate level)

Never_____
Seldom_____
Often_____
Very Often_____

1)d) **Have you <u>ever</u> had** a playing-related musculoskeletal problem, as defined above?

Yes_____ No____
If " Yes"
i) What was it?_____
ii) When did it begin?_____
ii) When did it subside?_____
(Please proceed to section D)

2) Do you believe this problem is because of playing?

Yes_____ No_____

3) Please state what you believe caused this problem?

_____

4) How many different problems do you have?_____

5) Is this the first time you have had a playing-related musculoskeletal problem?

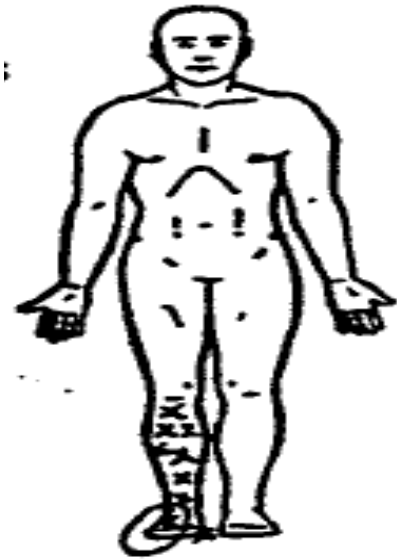
Yes_____ No_____

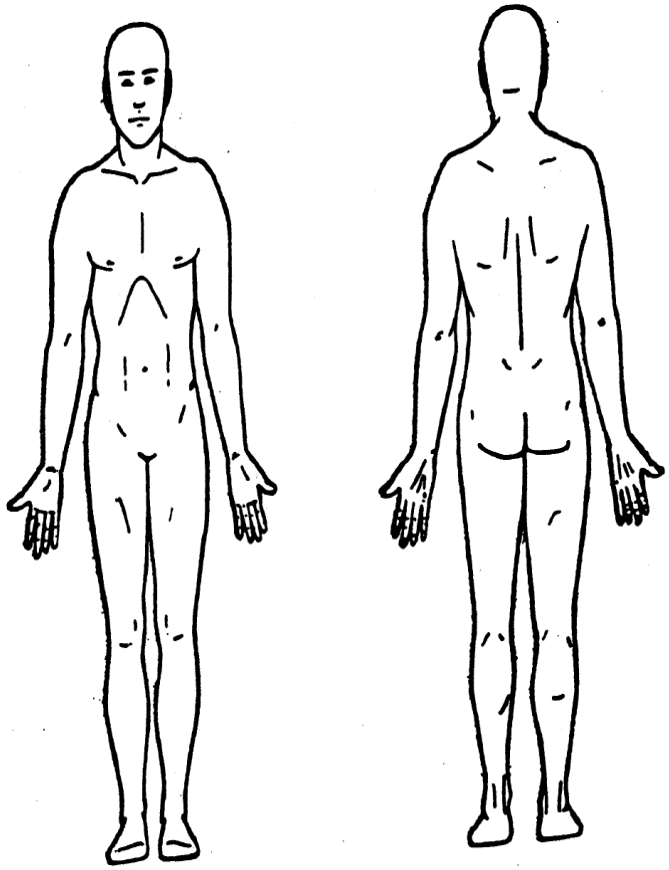
6) How long have you had this playing related musculoskeletal problem?

7) Using the diagram below, please indicate where you feel symptoms related to your playing-related musculoskeletal problem(s):

Please use X's to cover the are where you feel pain , discomfort or other symptoms
Please circle any areas of tingling or loss of feeling

Example:





8) Thinking of the most severe current problem you are experiencing, please circle the number on these scales that best describes your experience with playing-related musculoskeletal problems.

A) Frequency Scale

0 = no problem ever
1 = had a problem once, but now it is gone
2 = problem occurs occasionally, during or after playing
3 = problem occurs usually, during or after playing
4 = problem always occurs, during or after playing
5 = problem affects many activities of daily living as well as playing
6 = problem affects all activities of daily living as well as playing
7 = problem affects all activities of daily living and I cannot play at all because of the problem

Please circle the number on this scale which best describes how severe this problem is

B) Severity Scale

0 = no negative symptoms
1 = mild noticeable symptoms
2 = discomforting symptoms

3 = troublesome symptoms
4 = distressing symptoms
5 = severe symptoms
6 = debilitating symptoms
7 = unbearable symptoms

9) Have you seen a health care professional about this problem?

Yes_____ No_____

9)a) If "Yes" please tick all that apply

Family medical doctor_____
Chiropractor_____
Homoepath_____
Medical Specialist_____
Physiotherapist_____
Occupational Therapist_____
Other (please specify)_____

9)b) What diagnosis were you given?_____

10) Have you decreased your playing time because of his problem?

Yes_____ No_____

11) Have you stopped playing for any time period because of this problem?

Yes_____ No_____

If "Yes" How long did you stop for?_____

12) Are you playing as much as you would like to play?

Yes_____ No_____

13) Have you changed your playing technique because of this problem?

Yes_____ No_____

If "Yes", what have you changed about your playing technique?

_____

14) Have you changed your playing position because of this problem

Yes_____ No_____

If "Yes", what have you changed about your playing position?_____

These next few questions refer to your playing activities right BEFORE you experienced a problem. That is, a few days or a week before you noticed symptoms.

15) BEFORE you began experiencing symptoms of a problem, did you take breaks during practice sessions?

Yes_____ No_____

16) BEFORE you began experiencing symptoms of a problem, did you physically warm up **without your instrument** before a practice session? (e.g. stretching, movement exercises etc.)

Yes_____ No_____

If "Yes", was this done:

Occasionally_____

Usually_____
Always_____

17) BEFORE you began experiencing symptoms of a problem, did you warm up **on your instrument** before a practice session? (e.g. slow scales, long tones etc.)

Yes_____ No_____

If "Yes", was this done:
Occasionally_____
Usually_____
Always_____

18) BEFORE you began experiencing symptoms of a problem, did you do a **physical cool down** after you practised or played you instrument? (e.g. Stretches, body movement etc.)

Yes_____ No_____

If "Yes", was this done:
Occasionally_____
Usually_____
Always_____

19) BEFORE you began experiencing symptoms of a problem, how stressful was your work?
(Please circle the appropriate number)

NOT AT ALL STRESSFUL VERY STRESSFUL

1 2 3 4 5

20) BEFORE you began experiencing symptom of a problem, were you playing **more** than usual?

Yes____ No____

21) BEFORE you began experiencing symptoms of a problem, were you playing **less** than usual?

Yes____ No____

22) BEFORE you began experiencing symptoms of a problem, did you just return from a break away from playing? (e.g. Christmas break, leave, other work, long illness)

Yes____ No____

Section D
Personal Characteristics

Listed below are some statements about pain and playing. Read each item and decide whether you agree or disagree and to what extent. If you Strongly agree, circle 7; if you strongly disagree, circle 1; if you feel somewhere in between, circle any of the numbers between 1 and 7. If you feel neutral or undecided, the midpoint is 4. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.
There are no right or wrong answers.

	Disagree			**No Opinion**			
1) Musicians should play through pain	1	2	3	4	5	6	7
2) I would stop or decrease my playing time if I have pain	1	2	3	4	5	6	7
3) Pain is a normal part of playing and should be expected	1	2	3	4	5	6	7

4) Musicians who have playing-related pain, must be doing something wrong in their playing	1	2	3	4	5	6	7
5) You have to experience some pain when you practice if you are going to improve	1	2	3	4	5	6	7
6) If I had a playing-related problem, I wouldn't tell my colleagues for fear of losing work	1	2	3	4	5	6	7
7) If I had a playing related problem, I would tell my colleagues because they would understand, and might be able to help	1	2	3	4	5	6	7
8) Playing in pain might hurt me, but its not going to harm me, so I may as well put up with the pain and play.	1	2	3	4	5	6	7

Open Ended Questions:

1) Do you consider playing related musculoskeletal problems a serious problem?

Yes_____ No_____

2) If "Yes", what makes (or would make) playing related musculoskeletal problems a serious problem?

_____

_____

_____

Appendix C1

Letter of information and Informed Consent

Title: An investigation into musculoskeletal disorders of professional orchestral string musicians in South Africa

Name of Researcher: Quinton Hohls (083 383 9479)
Name of Supervisor: Dr L Wilson (031 373 2094)
Name of Co-Supervisor: Dr A Ross (031 373 2514)
Name of Institution: Durban University of Technology

Welcome to my focus group, and thank you for your interest.

The purpose of a focus group is to stimulate members of a group's thinking, and encourage them to develop ideas about the topic (Salant and Dillman, 1994). This will enable critical assessment and analysis of questions presented in the questionnaire, as well as to add to, delete from or modify for clarity, the questions presented to the string musicians.

Introduction:

Musicians are the quintessential small-muscle athletes. To perform highly skilled music pieces requires coordinated physical movement often at very high rates of speed, physical and physiological endurance; and high stress to strive for the required perfection of a performing artist (Brandfonbrener, 1991). The capabilities and limits of each instrument are relatively constant, and are therefore, generally predictable. The most important and unpredictable variables however are the musicians themselves; people who are subject to many tangible as well as intangible stressors (Brandfonbrener, 1991).

Available data indicates that the prevalence of playing-related musculoskeletal disorders (PRMD's) in adult classical musicians is comparable to the prevalence of work-related musculoskeletal disorders for other occupational groups (Zaza, 1998). A study of playing related musculoskeletal problems among professional orchestral musicians in Hong Kong indicated a one-year prevalence of 64 % (Yeung et al., 1999). Zaza (1998) however found prevalence ranging between 39% and 47% in orchestral musicians.

Larson et al. (1993) found that string players in music conservatories were especially vulnerable to injury, with 77% of participants reporting problems during playing. This was also confirmed by ˇCrnivec (2004) in a study on the Slovene Philharmonic Orchestra in which cellists, double bass and harpists were most frequently affected by PRMD's, followed by violinists and violists.

A review of the literature has revealed that no such study has been conducted in South Africa. South African tertiary institutes provide little education on preventative techniques during their training, with little attention placed on technique adaptation to prevent injury (Jakobs, 2009). The purpose of this study would be to determine the profile of injuries experienced by South African professional string players, factors placing South African musicians at risk for injury, and comparing these results to foreign studies, and establishing possible reasons for any differences, if they occur.

Procedure:

You will be given time to read through the questionnaire. Please make any notes or comments you find appropriate. We will then go through the questionnaire together, at which stage each member will have a chance to comment.

Please be assured that your personal details as well as any information, which you furnish, will be treated confidentially. Please do not make any marks on the questionnaire that will link you to it. This will ensure anonymity.
Thank you for your time.

For any further questions, please contact:

Researcher: Quinton Hohls (083 383 9479)
Supervisor: Dr L Wilson (031 373 2094)
Co-Supervisor: Dr A Ross (031 373 2514)

Statement of Agreement to Participate in the Research Focus Group:

I, ……..(subjects full name), ID number……., have read thus document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by Quinton Hohls to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences; and my future health and relationship with the Durban University of Technology Chiropractic Day Clinic will not be compromised. I, therefore, voluntarily agree to participate in this focus group.

Subject's name (print):…….
Subject's signature:……. Date:……..
Researcher's name: Quinton Hohls
Researcher's signature:……. Date:……..
Supervisor's Name: Dr. Laura Wilson
Supervisor's signature:……... Date:……..

Appendix C2

CODE OF CONDUCT

This form needs to be completed by every member of the Focus Group prior to the commencement of the focus group meeting.

As a member of this committee I agree to abide by the following conditions:

1. All information contained in the research documents and any information discussed during the focus group meeting will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.
2. None of the information shall be communicated to any other individual or organisation outside this specific focus group as to the decisions of this focus group.
3. The information from this focus group will be made public in terms of a journal publication, which will in no way identify any participants of this research.

Member represents	Member's name	Signature	Contact Details

Appendix C4

Focus Group Transcript Summarised

3.3.1.3.1 Section A – Description of Self

Question 2: It was suggested that instead of asking the participants' 'sex', the participants' gender should be asked.

Question 3: A discussion developed around the issue of race, such as changing 'White' to 'Caucasian'. It was suggested to change 'Coloured' to 'Mixed Race'; the category of 'Coloured' was retained, as it is a classification found in South Africa.

Question 5: 'kgs' was changed to "kg's" to improve the grammatical appearance.

Question 7: A sub category was added to determine how many cigarettes were smoked per day, by the relevant participants.

Question 9: The wording of the question regarding their qualification was changed to read 'What is your highest musical qualification?", as musicians may have degrees in other fields. A category of 'Conservatory' was also added to the list of qualifications.

A question was added after Question 10, to ask from which category of institution the musician qualified from, such as a University, Conservatorium, School of Music, Technikon or Other.

Question 11: The word "University" was changed to "Institution", thus accommodating all categories of higher learning.

Question 12: It was suggested to ask what exercise the musicians were "currently" involved in, as the original question could be interpreted as asking if they engaged in physical activity over their entire life-span.

3.3.1.3.2 Section B - Musical Background

Question 1: It was recommended to ask at what age the musicians started playing “any” instrument

A question was added asking what instrument the musician first learnt to play

Question 2: this question was moved to after Question 3, to ask at what age they started playing the string instrument they were currently playing in the orchestra

Question 4: Rewording took place to ask if they play any other instruments professionally, after which a table would follow asking which instruments, and how many hours per week they perform with this instrument.

This question should not have been altered, although it was found in the final questionnaire. Even if not played professionally, other instruments played in an amateur capacity, should be considered, as this could contribute to the development of musculoskeletal injury.

Question 5: “specific instruction” was added to the question to clarify whether the instruction had been on a formal basis. Also added was whether the instruction was related to preventing physical injury “related to their instrument’.

When asked from whom they received instruction, an option of “Lecturer at University/Institution” was added. Also when asked in what context the instruction was give, it was recommended that the participants be allowed to ‘tick’ all options that apply to them.

Question 6: If a musician had wheels attached to their instrument for transport, it was suggested to additionally ask if they pulled or pushed the instrument, and whether this was with the right or left arm, or both.

3.3.1.3.2.1 Playing Technique

Question 3: This was changed to ask, that when they are “practicing” (not only playing in the orchestra), do they not only sit, but also enquire whether they stand.

Questions 4, 5 and 6: It was suggested to rather place options of what the musicians could do, in a table format, thus allowing easier statistical analysis than if each participant gave an individually written answer.

3.3.1.3.3 Section C – Occupational Information

Question 1: The question was reworded to ask what the musicians ‘considered’ to be their main occupation.

Question 3: The question was changed to ask that if they are teaching, what are they teaching, and options would be supplied in which more than one could be ticked.

Question 4: this was reworded to ask if they perform in any other musical context other than the philharmonic.
Questions 6 and 7: These both were seen as contentious, which could result in participants feeling uncomfortable having to reveal their income. Thus three “yes/no” questions were formulated, in which financial questions asked would determined if they felt their orchestral salary was sufficient, or if a combined salary from other work was sufficient; as well as a stress rating regarding their finances.

3.3.1.3.4 Section D – Playing related Musculoskeletal Problems

The accompanying statement regarding what the definition of a “Playing-related Musculoskeletal injury” meant, was recommended to be enlarged and made very clear to the participants.

Question 1: All list were to be tabulated to allow for easier reading

Question 1c: Instead of asking if they worried about getting injured, it was recommended to ask ‘how often’ they worried about getting injured.

Question 1d: Rewording in which they were asked if they had, in the past, ever suffered from an injury. Again a table format would allow the musician to indicate what the diagnosis was, the duration of the condition, and how recently they suffered from the condition.

Questions 2 to 6: Were recommended to be tabulated to allow for easier reading

Questions 8 “A” and “B”: the rating scales were reduced to 5 being the maximum level. This was to allow easier statistical analysis.

Question 9: Was recommended to be tabulated and options given to the musicians to allow for easier reading and analysis.

3.3.1.3.4 Section E – Personal Characteristics

All rating scales were reduced to a maximum rating of 5. Some minor word changes were recommended to clarify any statements.

The Focus group was very beneficial in the development of the questionnaire. A new questionnaire was then designed to be approved by the Department of Chiropractic and Somatology Research Committee meeting (Appendix D1)

3.3.1.4 Questionnaire amendments at the Department of Chiropractic and Somatology Research Committee meeting

Upon recommendation from the committee, the homunculi and the whole of Section E (Personal Characteristics) were removed from the questionnaire. These suggestions again arose out of concern for statistical analysis, and for simplification of the questionnaire, therefore being more aligned with the research objectives and aims.

Appendix D1

Section A: Description of Self						
Date of Birth						
Gender	Male			Female		
Race (as classified in your Identity Document)	Caucasian	Black	Indian	Coloured	Asian	
	Other:					
Height	meters					
Weight	kilograms					
Are you:	Right Handed		Left Handed		Both	
Do you smoke	Yes			No		
If yes, how many per day:	1-5	5-10	10-15	More than 20		
What is your country of Origin?						
What is your Highest Musical Qualification?						
	Bachelor of Music			Masters in Music		
	Doctorate in Music			Conservatory		
	Other: (please specify)					
What year did you obtain your Qualification?						
From which Category of Institution did you obtain your qualification?						
	University			Technikon		
	School of Music			Conservatory		
	Other: (please specify)					
Did you obtain your Qualification from a South African Institution?						
	Yes	Please specify from which Institution in South Africa:				
	No	In which country did you obtain your qualification:				
		From which Institution in that country did you obtain your qualification?				
Do you currently engage in any regular physical activity? (e.g. gym routine, jogging etc.)						
	Yes			No		
	If `Yes` please list them, and how many hours per week you engage in these activities:					
	Sport or Hobby 1 2 3 4			Hours per Week 1 2 3 4		

Section B : Musical Background			
1. At what age did you first begin to play any instrument?			years
2. What was the first instrument you learnt to play? (please specify)			
3. What string instrument are you playing in this orchestra?			
	Violin	Viola	
	Cello	Double Bass	
	Harp		
4. At what age did you start playing the string instrument you are currently playing in this orchestra:			
			years
5. Do you play any other instruments professionally?			
	Yes		No
	If 'Yes' please specify the instrument/s and how many hours per week you play this/these instrument/s		
	Instrument played	Hours per week played	
	1	1	
	2	2	
	3	3	
	4	4	
6. Have you ever received specific instruction on preventing physical injury related to playing your instrument (e.g. how to prevent a tendonitis or carpal tunnel syndrome)?			
	Yes	No (proceed to Question 7)	
	If 'Yes' please specify the following by ticking all that apply		
	From whom did you receive this instruction	What type of instruction did you receive	
	a. Health Care professional	a. Lecture (1 Hour)	
	b. Music Teacher	b. Workshop (2-3 hours)	
	c. Colleague	c. Course (several weeks)	
	d. Lecturer at University/institution	d. Other (specify below)	
	e. Other (specify below)		
	Was this instruction given a specific technique name (e.g. Alexander Technique)		
	Yes	No	
	If 'Yes' please specify the type of instruction:		
	Did this instruction lead to you changing any aspects of your playing? (e.g. practice habits, technique, playing position)		
	Yes	No	
	If 'Yes', please describe the change to your playing below	If 'No', please explain why you did not change your playing	
7. How do you carry your instrument in its case (please tick all that apply)			
	I don't carry my instrument		
	I use a shoulder strap over my:	Right Shoulder	Left Shoulder
	I carry it by handle in my:	Right Shoulder	Left Shoulder
	I have wheels attached to my case, and	Push my bag with my:	Right Arm
			Left Arm
		Pull my bag with my:	Right arm
			Left Arm
	Other (please specify below):		

Playing technique:

1. Have you significantly changed your playing technique in the last 6 months?

Yes	No

2. Do you practice technical exercises specifically for finger independence (finger isolation)

Yes	No

3. When practicing, do you

	Sit	Stand
	If you 'Sit', do you sit especially:	High
		Low

4. Before a practice session, what kind of exercises (Warm up's) do you perform **without your instrument**? (please tick all that apply)

Exercise	Time spent doing exercise (minutes)		I don't warm up
Stretching	Less than 5 min	More than 5 min	
Movement exercises	Less than 5 min	More than 5 min	
Yoga	Less than 5 min	More than 5 min	
Pilates	Less than 5 min	More than 5 min	
Meditation	Less than 5 min	More than 5 min	
Other: (please specify below)	Less than 5 min	More than 5 min	

5. Before a practice session, what kind of exercises do you perform **with your instrument**? (please tick all that apply)

Exercise	Time spent doing exercises (minutes)		I don't' warm up
Scales and Arpeggios	Less than 5 min	More than 5 min	
Slow scales	Less than 5 min	More than 5 min	
Long Tones	Less than 5 min	More than 5 min	
Phrases from the music to be practiced	Less than 5 min	More than 5 min	
Other: (please specify below)	Less than 5 min	More than 5 min	

6. Do you perform a physical cool down **after** you have practiced with your instrument?

Exercise	Time spent doing exercises (minutes)		I don't cool down
Stretches	Less than 5 min	More than 5 min	
Movement exercises	Less than 5 min	More than 5 min	
Meditation	Less than 5 min	More than 5 min	
Yoga	Less than 5 min	More than 5 min	
Pilates	Less than 5 min	More than 5 min	
Other (please Specify below)	Less than 5 min	More than 5 min	

7. My most common activity during rehearsal breaks is (maximum of 3 choices)

Smoke	Play Cards
Remain Seated	Stretching
Chat	Text messaging
Eat/Drink	Go for a Walk

Section C: Occupational Information:				
1. What do you consider to be your main occupation?				
Performing musician	Music Teacher	Other (please specify):		
2. How many years have you been working as a professional musician?				
		years		
3. If you are also working as a teacher, what are you teaching: (please tick all that apply)				
The instrument I play in this orchestra	Theory	I don't teach		
Other: (please specify)				
4. If you are engaged in practical teaching, how many hours per week are you teaching?				
0 hours	1 – 5 hours	6-10 hours	11 – 15 hours	16 hours plus
5. Do you perform in any other musical context, other than philharmonic (e.g. freelance, ensembles or bands) ?				
	Yes		No	
	If 'Yes', how many hours per week do you perform in these additional contexts?			
	0 hours	1 – 5 hours	6-10 hours	11 – 15 hours	16 hours plus
6. Do you engage in any non-music related work (i.e. work that does not require you to play your instrument)				
	Yes		No	
	If 'Yes', please specify:			
	How many hours per week do you perform this work?			
	0 hours	1 – 5 hours	6-10 hours	11 – 15 hours	16 hours plus
7. My salary from orchestral living is sufficient to cover my monthly expenses:				
Yes		No		
8. My orchestral salary and other sources of income are adequate for monthly expenses				
Yes		No		
9. On a scale of 1 to 5 (where 1 is no stress and 5 is severe stress), rate your financial stress level:				
1	2	3	4	5

Section D: Playing-Related Musculoskeletal Problems

For the purposes of this study, a playing related musculoskeletal problem is defined as**: "Pain, weakness, numbness or tingling, or other symptoms that arise from playing, and that interfere with your ability to play your instrument at a level that you are accustomed to."** (Pain or any other symptoms that are caused by an accident or other non-playing related event are NOT considered to a playing related problem)

1. Have you experienced a playing-related problem in the parts of the body listed in the table below, DURING THE LAST 12 MONTHS (please tick all the blocks that are applicable)

	No	Yes	Right Side	Left Side	Both Sides
Neck					
Face					
Jaw					
Shoulder or Upper Arm					
Elbows or Forearms					
Wrist, Hands or Fingers					
Upper Back (between the shoulder blades)					
Lower Back (small of back)					
Hips, thighs or buttocks					
Knees					
Ankles					

2. Currently, do you have any playing related musculoskeletal problems (i.e. any pain, weakness, numbness, tingling or other symptoms from playing that interfere with your ability to play your instrument at the level you are accustomed to)

Yes	No
	If 'No', how often do you worry about getting a playing related musculoskeletal problem as defined above? (please tick appropriate level)
	Never
	Seldom
	Often
	Very Often

3. In the past have you ever had a playing related musculoskeletal problem?

Yes	No

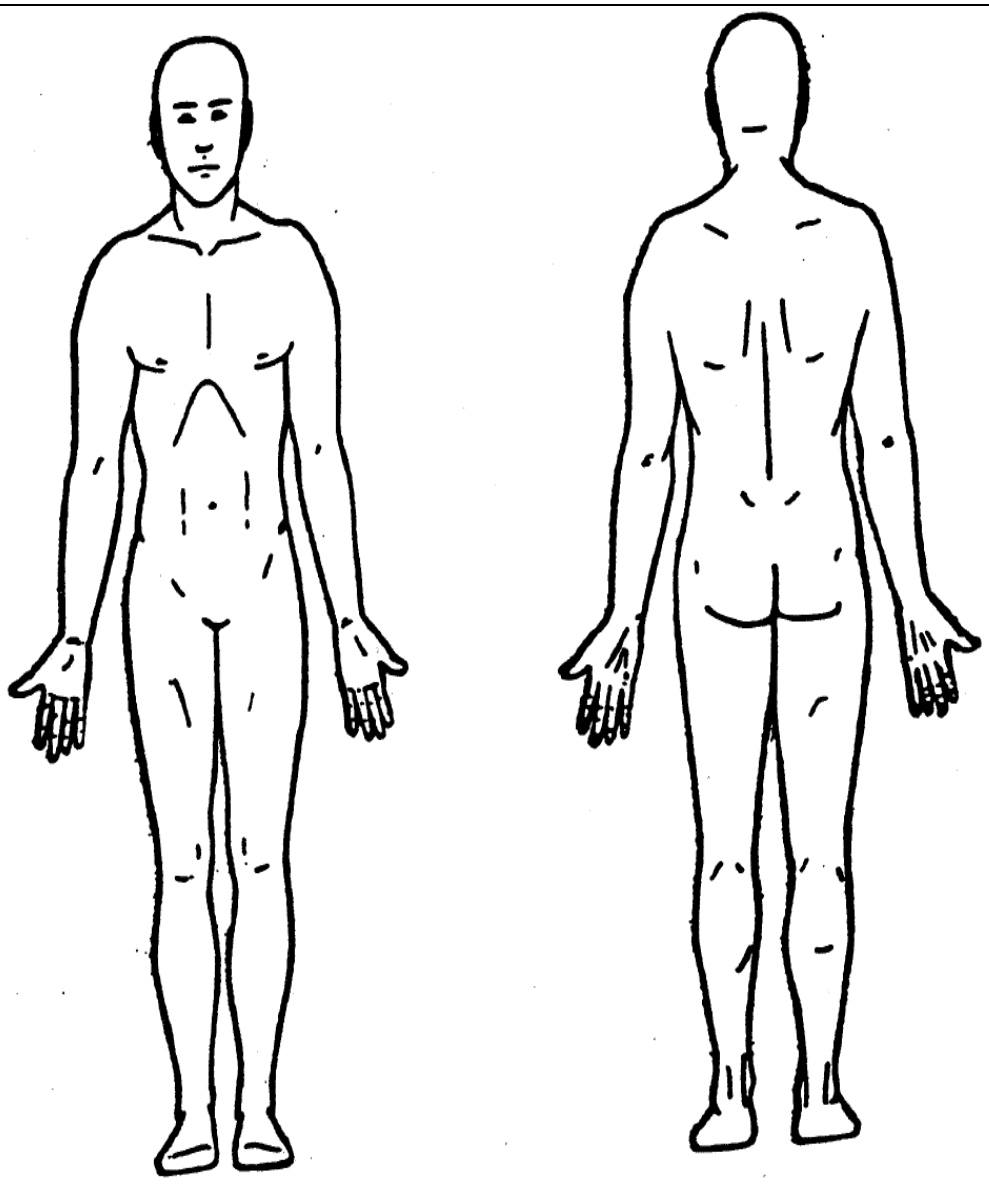
If 'Yes' please specify according to the following

Problem diagnosis	Duration of the Problem	When recently did you have this problem
1	1	1
2	2	2
3	3	3

If your answer to Question 2 was 'No' please proceed to Section D

If your answer to Question 2 was 'Yes' please continue with the following Questions

4. Using the Diagram below, please indicate where you feel symptoms related to your current playing related musculoskeletal problem/s. Please use X's to cover the area where you are feeling pain, discomfort or other symptoms. Please circle any areas of tingling or loss of feeling.



5. Please circle the number on the scale which best describes how severe this problem is:				
No negative symptoms				Unbearable symptoms
1	2	3	4	5
6. Please circle the number on the scale which best describes how often does this affect your daily living and playing				
No problem ever				Problem affects all activities of daily living and I cannot play because of the problem
1	2	3	4	5
7. Have you ever seen a health care professional about this problem?				
Yes				No
If 'Yes', whom did you see about this problem (please tick all that apply)				Family Medical Doctor
				Chiropractor
				Homoeopath
				Medical Specialist
				Physiotherapist
				Occupational Therapist
				Other (please specify)
8. What diagnosis were you given?				

9. Did the treatment correct your problem?				
Yes			No	
10. Have you decreased your playing time because of this problem?				
Yes			No	
11. Have you stopped playing for any time period because of this problem?				
Yes			No	
a. For how long did you stop playing?				
12. Does this current problem prevent you from playing as much as you would like?				
Yes			No	
13. Have you changed your playing technique because of this problem?				
Yes			No	
a. What did you change about your playing technique			Sitting position	
			Bowing technique	
			Bowing hand position	
			Fingering technique	
			Neck position	
14. I believe the following factors contributed to my condition: (i.e. playing activities right before you experienced a problem)				
I was playing more than usual		Yes		No
I was playing less than usual		Yes		No
I had just returned from a break away from playing		Yes		No
15. Before you began experiencing symptoms of a problem did you:				
Take breaks during practice sessions		Yes		No
Physically warm up without our instrument before a practice session		Yes		No
Physically warm up on your instrument before a practice session		Yes		No
Physically cool down after you played a practice session		Yes		No
16. Before you began experiencing symptoms, how stressful was your work:				
Not at all Stressful				Very stressful
1	2	3	4	5

Section E: Personal Characteristics:

Listed below are some statements about pain and playing. Read each item and decide whether you agree or disagree and to what extent. If you strongly agree tick 5, or if you strongly disagree, tick 1. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. There is no right or wrong answer.

	Strongly Disagree				Strongly Agree
1. Musicians should play through pain	1	2	3	4	5
2. I would stop or decrease my playing time if I have pain caused by playing	1	2	3	4	5
3. Pain is a normal part of playing and should be expected	1	2	3	4	5
4. Musicians who have playing-related pain, must be doing something wrong in their playing	1	2	3	4	5
5. You have to experience some pain when you practice if you are going to improve	1	2	3	4	5
6. If I had a playing-related problem, I wouldn't tell my colleagues in case I loose work	1	2	3	4	5
7 If I had a playing related problem, I would tell my colleagues because they would understand, and might be able to help me	1	2	3	4	5
8. Playing in pain might hurt me, but its not going to harm me, so I may as well put up with the pain and play.	1	2	3	4	5
9. It is important to prevent playing related musculoskeletal problems	1	2	3	4	5
10. Playing related musculoskeletal problems shorten your playing career	1	2	3	4	5

Thank your for participating in this research.

Appendix D2

Please place a cross in box that best describes your answer, and where necessary, elaborate your answer in the space provided.						
A: Description of Self						
Date of Birth	day		month		year	
Gender	Male		Female			
Race (as classified in your Identity Document)	Caucasian	Black	Indian	Coloured	Asian	
	Other:					
Height	meters					
Weight	kilograms					
Are you:	Right Handed		Left Handed		Both	
Do you smoke	Yes		No			
If yes, how many per day:	1-5	5-10	10-15	More than 20		
What is your country of Origin?						
What is your Highest Musical Qualification?						
	Bachelor of Music		Masters in Music			
	Doctorate in Music		Conservatory			
	Other: (please specify)					
What year did you obtain your Qualification?						
From which Category of Institution did you obtain your qualification?						
	University		Technikon			
	School of Music		Conservatory			
	Other: (please specify)					
Did you obtain your Qualification from a South African Institution?						
	Yes	Please specify from which Institution in South Africa:				
	No	In which country did you obtain your qualification:				
		From which Institution in that country did you obtain your qualification?				

Do you currently engage in any regular physical activity? (e.g. gym routine, jogging etc.)		
	Yes	No
	If `Yes` please list them, and how many hours per week you engage in these activities:	
	Sport or Hobby 1 2 3 4	Hours per Week 1 2 3 4

Section B : Musical Background	
1. At what age did you first begin to play any instrument?	years
2. What was the first instrument you learnt to play? (please specify)	
3. What string instrument are you playing in this orchestra?	
Violin	Viola
Cello	Double Bass
4. At what age did you start playing the string instrument you are currently playing in this orchestra:	
	years
5. Do you play any other instruments professionally?	
Yes	No
If 'Yes' please specify the instrument/s and how many hours per week you play this/these instrument/s	
Instrument played	Hours per week played
1	1
2	2
3	3
4	4

6. Have you ever received specific instruction on preventing physical injury related to playing your instrument (e.g. how to prevent a tendonitis or carpal tunnel syndrome)?

Yes	*No* (proceed to Question 7)
If 'Yes' please specify the following by ticking all that apply	
From whom did you receive this instruction	**What type** of instruction did you receive
a. Health Care professional	a. Lecture (1 Hour)
b. Music Teacher	b. Workshop (2-3 hours)
c. Colleague	c. Course (several weeks)
d. Lecturer at University/institution	d. Other (specify below)
e. Other (specify below)	

Was this instruction given a specific technique name (e.g. Alexander Technique)	
Yes	No
If 'Yes' please specify the type of instruction:	

Did this instruction lead to you changing any aspects of your playing? (e.g. practice habits, technique, playing position)	
Yes	No
If 'Yes', please describe the change to your playing below	*If 'No', please explain why you did not change your playing*

7. How do you carry your instrument in its case (please tick all that apply)

I don't carry my instrument		
I use a shoulder strap over my:	Right Shoulder	Left Shoulder
I carry it by handle in my:	Right Hand	Left Hand
I have wheels attached to my case, and	Push my bag with my:	*Right Arm* / Left Arm
	Pull my bag with my:	*Right arm* / Left Arm
Other (please specify below):		

Playing technique:

1. Have you significantly changed your playing technique in the last 6 months?

Yes	No

2. Do you practice technical exercises specifically for finger independence (finger isolation)

Yes	No

3. When practicing, do you

	Sit	Stand
	If you 'Sit', do you sit especially:	High
		Low

4. Before a practice session, do warm up without your instrument **(e.g. stretching, yoga, meditation)?**

Yes	No

5. Before a practice session, what kind of exercises do you perform with your instrument**? (please tick all that apply)**

Exercise	Time spent doing exercises (minutes)		I don't' warm up
Scales and Arpeggios	Less than 5 min	More than 5 min	
Slow scales	Less than 5 min	More than 5 min	
Long Tones	Less than 5 min	More than 5 min	
Phrases from the music to be practiced	Less than 5 min	More than 5 min	
Other: (please specify below):			
	Less than 5 min	More than 5 min	
	Less than 5 min	More than 5 min	
	Less than 5 min	More than 5 min	
	Less than 5 min	More than 5 min	

6. Do you perform a physical cool down <u>after</u> you have practiced with your instrument (e.g. stretches, yoga, and meditation)?

Yes	No

7. My most common activity during rehearsal breaks is (maximum of 3 choices)

Smoke	Play Cards
Remain Seated	Stretching
Chat	Text messaging
Eat/Drink	Go for a Walk

Other (please specify):

Section C: Occupational Information:

1. What do you consider to be your main occupation?

Performing musician	Music Teacher
Other (please specify):	

2. How many years have you been working as a professional musician?

	years

3. If you are also working as a teacher, what are you teaching: (please tick all that apply)

The instrument I play in this orchestra	Theory	I don't teach
Other: (please specify)		

4. If you are engaged in practical teaching, how many hours per week are you teaching?

0 hours	1 – 5 hours	6-10 hours	11 – 15 hours	16 hours plus

5. Do you perform in any other musical context, other than philharmonic (e.g. freelance, ensembles or bands)?

	Yes			No	
	If 'Yes', how many hours per week do you perform in these additional contexts?				
	0 hours	1 – 5 hours	6-10 hours	11 – 15 hours	16 hours plus

6. Do you engage in any non-music related work (i.e. work that does not require you to play your instrument or teach music e.g. secretarial work, sports coaching etc.)

	Yes			No	
	If 'Yes', please specify:				
	How many hours per week do you perform this work?				
	0 hours	1 – 5 hours	6-10 hours	11 – 15 hours	16 hours plus

7. My orchestral salary is sufficient to cover my monthly expenses.

Yes	No

8. My orchestral salary and other sources of income are adequate for monthly expenses

Yes	No

9. On a scale of 1 to 5 (where 1 = no stress; and 5 = severe stress), rate your financial stress level:

1	2	3	4	5

D: Playing-Related Musculoskeletal Problems

For the purposes of this study, a playing related musculoskeletal problem is defined as**: "Pain, weakness, numbness or tingling, or other symptoms that arise from playing, and that interfere with your ability to play your instrument at a level that you are accustomed to."** (Pain or any other symptoms that are caused by an accident or other non-playing related event are NOT considered to a playing related problem)

1. Have you experienced a playing-related problem in the parts of the body listed in the table below, DURING THE LAST 12 MONTHS (please tick all the blocks that are applicable)

	No	Yes	Right Side	Left Side	Both Sides
Neck					
Face					
Jaw					
Shoulder or Upper Arm					
Elbows or Forearms					
Wrist					
Hands					
Fingers					
Upper Back (between the shoulder blades)					
Lower Back (small of back)					
Hips, thighs or buttocks					
Knees					
Ankles					

2. Currently (including the last 3 months) , do you have any playing related musculoskeletal problems (i.e. any pain, weakness, numbness, tingling or other symptoms from playing that interfere with your ability to play your instrument at the level you are accustomed to)

Yes	No
	If 'No', how often do you worry about getting a playing related musculoskeletal problem as defined above? (please tick appropriate level)
	Never
	Seldom (monthly)
	Often (weekly)
	Very Often (daily)

3. In the past in your professional career have you ever had a playing related musculoskeletal problem?

Yes	No

If 'Yes' please specify according to the following

Problem diagnosis	Duration of the Problem	How recently did you have this problem
1	1	1
2	2	2
3	3	3

If your answer to Question 2 was 'No' please hand in your Question Paper to the researcher

If your answer to Question 2 was 'Yes' please continue with the following Questions

4. Please circle the number on the scale which best describes how severe your current (worst) problem is:

No negative symptoms				Unbearable symptoms
1	2	3	4	5

5. Please circle the number on the scale which best describes how often this affects your daily living and playing

No problem ever				Problem affects all activities of daily living and I cannot play because of the problem
1	2	3	4	5

6. Have you ever seen a health care professional about this problem?	
Yes	No
If 'Yes', whom did you see about this problem (please tick all that apply)	Medical Doctor
	Chiropractor
	Homoeopath
	Medical Specialist
	Physiotherapist
	Occupational Therapist
	Other (please specify)
7. **What diagnosis were you given?** (if you have more than one problem, please list them all, starting with the most severe) a. b. c.	
The following questions are regarding your most severe current problem	
8. What **<u>treatment</u>** were you given for your problem? (please tick all that apply)	
a. Massage	b. Stretches
c. Joint manipulation/adjustment	d. Dry Needling/Acupuncture
i. Strapping	f. Electrotherapy (including Ultrasound)
j. Ice	g. Advised to Rest
k. Heat packs	h. Splinting
e. Medication/Remedy (please specify):	l. Other: (please specify)
9. **Did the treatment correct your problem?**	
Yes	No
10. **Have you decreased your playing time because of this problem?**	
Yes	No
11. **Have you stopped playing for any time period because of this problem?**	
Yes	No
a. For how long did you stop playing?	
12**. Does this current problem prevent you from playing as much as you would like?**	
Yes	No

13. **Have you changed your playing technique because of this problem?**					
Yes				No	
a. What did you change about your playing technique	Sitting position				
	Bowing technique				
	Bowing hand position				
	Fingering technique				
	Neck position				
	Other: (please specify)				
14. **I believe the following factors contributed to my condition: (i.e. playing activities right before you experienced a problem)**					
I was playing more than usual	Yes			No	
I was playing less than usual	Yes			No	
I had just returned from a break away from playing	Yes			No	
15. **Before you began experiencing symptoms of a problem did you:**					
Take breaks during practice sessions	Yes			No	
Physically warm up without our instrument before a practice session	Yes			No	
Physically warm up on your instrument before a practice session	Yes			No	
Physically cool down after you played a practice session	Yes			No	
16**. Before you began experiencing symptoms, how stressful was your work:**					
Not at all Stressful					Very stressful
1	2	3	4	5	

Thank your for participating in this research.

Appendix D3

Letter of information

Dear Sir/Madam

Welcome to my research, and thank you for your interest. I am a Master's student studying chiropractic at the Durban University of Technology.

Title of research: An investigation into performance related musculoskeletal disorders of professional orchestral string musicians in South Africa

Name of Researcher: Quinton Hohls
Name of Supervisor: Dr L Wilson, M.Tech. Chiropractic, CCEP
Name of Co-Supervisor: Dr A Ross, M.Tech: Homoeopathy, B. Mus (Cum Laude)

Background to the study:

Internationally there have been a number of studies which have been conducted on various types of orchestras and institutions in which the results have shown that musicians are at a particular risk for developing muscle and joint injury due to the repetitive movements required to play a string instrument, as well as other risk factors such as intensity of practice, physical activity and rest.

In South Africa we have a unique orchestral environment that could place the musician at greater risk of developing musculoskeletal problems. Therefore this study aims to determine the prevalence and risk factors of South African orchestral string musicians.

Outline of procedures:

This study will involve you filling out a questionnaire, which will take approximately 15 minutes to complete. Please do not make any markings on the

questionnaire which will identify who you are. Participation in this study is entirely voluntary and there will be no remuneration for completion of the questionnaire.

Risks and Costs to Participants:

Participation in this study will pose no risk to any of the participants. All information gathered will be kept confidential; no individual will be identified in the data. The results from the three orchestras will be combined and analysed as one group therefore no individual orchestra will be singled out. Thus there will be no risk of prejudice or employment loss from participation in the study.

There will be no cost for participating in this research.

Benefits of the study:

The results of this study will be made available to the public in the form of a published article in a journal and a dissertation that will be available in the Durban University of Technology library. Should any of the participants be interested in the results the researcher can be contacted and the results obtained.

Confidentiality:

Any information that is gained will be kept confidential at all times, only the researcher and supervisors will have access to the questionnaire. If you have any questions please contact me on tel. 083 383 9479, my supervisor tel. 031 373 2923, or the Faculty Of Heath Sciences Research Co-Ordinator, Mr. V. Singh, tel. 031 373 2701.

Thank you for your interest and participation in this research.

Yours sincerely,

_____ _____

Quinton Hohls Dr. L. Wilson

Appendix D4

Letter of information

Dear Sir/Madam

Welcome to my research, and thank you for your interest. I am a Master's student studying chiropractic at the Durban University of Technology.

Title of research: An investigation into performance related musculoskeletal disorders of professional orchestral string musicians in South Africa

Name of Researcher: Quinton Hohls
Name of Supervisor: Dr L Wilson, M.Tech. Chiropractic, CCEP
Name of Co-Supervisor: Dr A Ross, M.Tech: Homoeopathy, B. Mus (Cum Laude)

Background to the study:

Internationally there have been a number of studies which have been conducted on various types of orchestras and institutions in which the results have shown that musicians are at a particular risk for developing muscle and joint injury due to the repetitive movements required to play a string instrument, as well as other risk factors such as intensity of practice, physical activity and rest.

In South Africa we have a unique orchestral environment that could place the musician at greater risk of developing musculoskeletal problems. Therefore this study aims to determine the prevalence and risk factors of South African orchestral string musicians.

Outline of procedures:

This study will involve you filling out a questionnaire, which will take approximately 15 minutes to complete. Participation in this study is entirely voluntary and there will be no remuneration for completion of the questionnaire.

Please email the completed questionnaire directly to the researcher at quinton.hohls@gmail.com.

Risks and Costs to Participants:

Participation in this study will pose no risk to any of the participants. All information gathered will be kept confidential; no individual will be identified in the data. The results from the three orchestras will be combined and analysed as one group therefore no individual orchestra will be singled out. Thus there will be no risk of prejudice or employment loss from participation in the study.

There will be no cost for participating in this research.

Benefits of the study:

The results of this study will be made available to the public in the form of a published article in a journal and a dissertation that will be available in the Durban University of Technology library. Should any of the participants be interested in the results the researcher can be contacted and the results obtained.

Confidentiality:

Any information that is gained will be kept confidential at all times, only the researcher and supervisors will have access to the questionnaire. If you have any questions please contact me on tel. 083 383 9479, my supervisor tel. 031 373 2923, or the Faculty Of Heath Sciences Research Co-Ordinator, Mr. V. Singh, tel. 031 373 2701.

Thank you for your interest and participation in this research.
Yours sincerely,

_____	_____
Quinton Hohls	Dr. L. Wilson

Appendix D5

ETHICS CLEARANCE CERTIFICATE

[redacted]	Mr Quinton Rolf Hobbs	[redacted]	20410817
[redacted]	FHSEC 057/09	[redacted]	4/12/2009
[redacted]	M. Tech Chiropractic		
[redacted]	An investigation into performance related musculoskeletal disorders of professional orchestral string musicians in South Africa		

In terms of the ethical considerations for the conduct of research in the Faculty of Health Sciences, Durban University of Technology, this proposal meets with Institutional requirements and confirms the following ethical obligations:

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the DUT 186 and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. ***The following section must be completed if the research involves human participants:***

	YES	NO	N/A
❖ Provision has been made to obtain informed consent of the participants	x		
❖ Potential psychological and physical risks have been considered and minimised	x		
❖ Provision has been made to avoid undue intrusion with regard to participants and community	x		
❖ Rights of participants will be safe-guarded in relation to: - Measures for the protection of anonymity and the maintenance of Confidentiality.	x		
- Access to research information and findings.	x		
- Termination of involvement without compromise	x		
- Misleading promises regarding benefits of the research	x		

SIGNATURE OF STUDENT/RESEARCHER — 23/11/09 DATE

SIGNATURE OF SUPERVISOR/S — 23/11/09 DATE

SIGNATURE OF HEAD OF DEPARTMENT — 23/11/09 DATE

SIGNATURE: CHAIRPERSON OF RESEARCH ETHICS COMMITTEE — 30/11/2009 DATE

Appendix E

"D2" = Section D, Question 2: Currently (including the last 3 months) , do you have any playing related musculoskeletal problems (i.e. any pain, weakness, numbness, tingling or other symptoms from playing that interfere with your ability to play your instrument at the level you are accustomed to)

1) **Table E1**

Table E1 compares Current injury to demographic characteristics using the chi squared tests. The relationships were not significant at the 95% level ($p > 0.05$).

Table E1: Comparison of demographic characteristics with Current injury

		D2 (Current Injury)								
		Yes		No		Total		Chi-square	df	p
		n	%	n	%	n	%			
Gender	0	1	3.7	1	3.7	2.0	7.4	3.70	2	0.157
	Male	3	11.1	5	18.5	8.0	29.6			
	Female	13	48.1	4	14.8	17.0	63.0			
Race	Caucasian	16	59.3	8	29.6	24.0	88.9	4.13	3	0.248
	Black	0	0.0	1	3.7	1.0	3.7			
	Coloured	1	3.7	0	0.0	1.0	3.7			
	Other	0	0.0	1	3.7	1.0	3.7			
Handed	Right handed	15	55.6	9	33.3	24.0	88.9	0.73	2	0.693
	Left handed	1	3.7	1	3.7	2.0	7.4			
	Both	1	3.7	0	0.0	1.0	3.7			
Do you smoke?	Yes	6	22.2	1	3.7	7.0	25.9	2.10	1	0.148
	No	11	40.7	9	33.3	20.0	74.1			
Qualification	Bachelor of Music	10	37.0	5	18.5	15.0	55.6	0.56	2	0.757
	Masters in Music	3	11.1	3	11.1	6.0	22.2			
	Conservatory	4	14.8	2	7.4	6.0	22.2			
Exercise	Yes	14	51.9	8	29.6	22.0	81.5	0.02	1	0.879
	No	3	11.1	2	7.4	5.0	18.5			

2) **Table E2**

The data in Table E2 compares current injury to regular activity performed using the chi squared tests. The relationships were not significant at the 95% level (p>0.05).

Table E2: Comparison of regular activity with current injury

		Current injury				P value
		yes		no		
		Count	Row N %	Count	Row N %	
Gym	no	5	50.0%	5	50.0%	0.285
	yes	12	70.6%	5	29.4%	
Running	no	13	59.1%	9	40.9%	0.382
	yes	4	80.0%	1	20.0%	
Surfing	no	17	65.4%	9	34.6%	0.184
	yes	0	.0%	1	100.0%	
Walking	no	15	65.2%	8	34.8%	0.561
	yes	2	50.0%	2	50.0%	
Yoga	no	17	65.4%	9	34.6%	0.184
	yes	0	.0%	1	100.0%	
Golf	no	16	64.0%	9	36.0%	0.693
	yes	1	50.0%	1	50.0%	
Hiking	no	14	58.3%	10	41.7%	0.159
	yes	3	100.0%	0	.0%	
windsurfing	no	17	65.4%	9	34.6%	0.184
	yes	0	.0%	1	100.0%	
swimming	no	17	65.4%	9	34.6%	0.184
	yes	0	.0%	1	100.0%	
Cycling	no	17	65.4%	9	34.6%	0.184
	yes	0	.0%	1	100.0%	

3) **Table E3**

Table E3 shows that no specific injury site was associated with a specific instrument using the chi square tests.

Table E3: Comparison of instrument played in the orchestra and site of injury

		What instrument are you playing in this orchestra?								*p* value
		Violin		Viola		Cello		Double bass		
		Count	Column %	Count	Column %	Count	Column %	Count	Column %	
Neck	No	5	35.7%	2	28.6%	1	33.3%	1	33.3%	0.991
	Yes	9	64.3%	5	71.4%	2	66.7%	2	66.7%	
Face	No	13	92.9%	6	85.7%	3	100%	3	100%	0.810
	Yes	1	7.1%	1	14.3%	0	0%	0	0%	
Jaw	No	12	85.7%	4	57.1%	3	100%	2	66.7%	0.347
	Yes	2	14.3%	3	42.9%	0	0%	1	33.3%	
Shoulder	No	4	28.6%	2	28.6%	1	33.3%	1	33.3%	0.997
	Yes	10	71.4%	5	71.4%	2	66.7%	2	66.7%	
Elbow	No	12	85.7%	4	57.1%	3	100%	1	33.3%	0.129
	Yes	2	14.3%	3	42.9%	0	0%	2	66.7%	
Wrist	No	11	78.6%	6	85.7%	3	100%	2	66.7%	0.734
	Yes	3	21.4%	1	14.3%	0	0%	1	33.3%	
Hand	No	10	71.4%	5	71.4%	3	100%	2	66.7%	0.750
	Yes	4	28.6%	2	28.6%	0	0%	1	33.3%	
Fingers	No	10	71.4%	5	71.4%	3	100%	2	66.7%	0.750
	Yes	4	28.6%	2	28.6%	0	0%	1	33.3%	
Upper back	No	4	28.6%	2	28.6%	0	0%	0	0%	0.531
	Yes	10	71.4%	5	71.4%	3	100%	3	100%	
Lower back	No	5	35.7%	2	28.6%	2	66.7%	2	66.7%	0.523
	Yes	9	64.3%	5	71.4%	1	33.3%	1	33.3%	
hips	No	11	78.6%	6	85.7%	3	100%	3	100%	0.675
	Yes	3	21.4%	1	14.3%	0	0%	0	0%	

4) **Table E4**

Table E4 shows that neither musical training or musical history were significantly associated with current injury using chi square tests.

Table E4: Comparison of musical background and current injury

		D2 (Current Injury)						Chi-square	df	p
		Yes		No		Total				
		n	%	n	%					
First instrument learnt to play	Glockenspiel	0	0.0	1	3.7	1.0	3.7	3.57	6	0.735
	Piano	2	7.4	2	7.4	4.0	14.8			
	Piano/Guitar	1	3.7	0	0.0	1.0	3.7			
	Piano/Violin	1	3.7	1	3.7	2.0	7.4			
	Recorder	3	11.1	1	3.7	4.0	14.8			
	Recorder/Cello	1	3.7	0	0.0	1.0	3.7			
	Violin	9	33.3	5	18.5	14.0	51.9			
String instrument currently played in the orchestra	Violin	9	33.3	5	18.5	14.0	51.9	3.01	3	0.391
	Viola	3	11.1	4	14.8	7.0	25.9			
	Cello	3	11.1	0	0.0	3.0	11.1			
	Double Bass	2	7.4	1	3.7	3.0	11.1			
Other instruments professionally played	Yes	1	3.8%	2	7.7%	3	11.5%	1.140	1	0.286
	No	15	57.7%	8	30.8%	23	88.5%			
Specific instruction on preventing physical injury	Yes	8	29.6%	3	11.1%	11	40.7%	.759	1	0.384
	No	9	33.3%	7	25.9%	16	59.3%			
Specific Techniques name (e.g. Alexander)	Yes	4	44.4%	0	.0%	4	44.4%	3.51	2	0.173
	No	2	22.2%	3	33.3%	5	55.6%			
Instruction leading to a change in technique	Yes	4	50.0%	3	37.5%	7	87.5%	.686	1	0.408
	No	1	12.5%	0	.0%	1	12.5%			

5) **Table E5**

Table E5 shows that overall, very few respondents changed any aspect of playing, regardless of whether they had been inured or not.

Table E5: Aspects of playing that were changed after instruction by current injury

		D2 (Current Injury)					
		Yes		No		Total	
		n	%	n	%	n	%
Aspect of playing changed due to instruction	Better posture behind instrument	1	3.7	0	0.0	1	3.7
	More relaxed arms and shoulders. Engaging stomach more	1	3.7	0	0.0	1	3.7
	Position of neck, relaxation of shoulders and arms, sitting position	0	0.0	1	3.7	1	3.7
	Posture, Technique	0	0.0	1	3.7	1	3.7
	Posture, Usage of only necessary muscles, preferred use of back muscles	1	3.7	0	0.0	1	3.7
	Technique applied to playing in a master class	1	3.7	0	0.0	1	3.7
	Tension Release, Sitting position, Shoulder rest/chin rest adjusting	1	3.7	0	0.0	1	3.7
	Using Larger Muscle Groups, Strengthening, warming up joints	0	0.0	1	3.7	1	3.7

6) **Table E6**

Table E6 shows that Playing Technique was not significantly related to current injury at the 95% level (p>0.05) using chi squared tests.

Table E6: Comparison of Playing Technique and Current Injury

		D2								
		Yes		No		Total		Chi-square	df	p
		n	%	n	%					
Significant change in playing technique in the last 6 months	Yes	1	4.0%	0	.0%	1	4.0%	.586	1	0.444
	No	15	60.0%	9	36.0%	24	96.0%			
Practice of technical exercises specifically for finger independence	Yes	6	26.1%	6	26.1%	12	52.2%	1.245	1	0.265
	No	8	34.8%	3	13.0%	11	47.8%			
Body position during practicing	Sit	7	28.0%	2	8.0%	9	36.0%	2.127	2	0.345
	Stand	6	24.0%	3	12.0%	9	36.0%			
	Both	3	12.0%	4	16.0%	7	28.0%			
If seated in practice, how do they sit?	High	3	37.5%	1	12.5%	4	50.0%	.000	1	1.000
	Low	3	37.5%	1	12.5%	4	50.0%			
Warp up before practice without the instrument	Yes	3	12.5%	3	12.5%	6	25.0%	.533	1	0.465
	No	12	50.0%	6	25.0%	18	75.0%			

7) **Table E7**

Table E7: Comparison of Warm-up exercises performed before a practice session and current injury

Most (66.7%) of the string players used Scales and Arpeggios as a form of warm up; and of those, 40.7% were currently injured.

		D2 (Current Injury)				Total	
		Yes		No			
		n	%	n	%		
I do not warm up	Yes	2	7.4%	1	3.7%	3	11.1%
Scales and Arpeggios	Yes	11	40.7%	7	25.9%	18	66.7%
Less than 5 minutes	Yes	4	14.8%	2	7.4%	6	22.2%
More than 5 minutes	Yes	7	25.9%	5	18.5%	12	44.4%
Slow scales	Yes	7	25.9%	4	14.8%	11	40.7%
Less than 5 minutes	Yes	4	14.8%	1	3.7%	5	18.5%
More than 5 minutes	Yes	3	11.1%	3	11.1%	6	22.2%
Long scales	Yes	6	22.2%	3	11.1%	9	33.3%
Less than 5 minutes	Yes	3	11.1%	1	3.7%	4	14.8%
More than 5 minutes	Yes	3	11.1%	2	7.4%	5	18.5%
Phrases from the music to be practiced	Yes	9	33.3%	4	14.8%	13	48.1%
Less than 5 minutes	Yes	1	3.7%	0	0%	1	3.7%
More than 5 minutes	Yes	8	29.6%	4	14.8%	12	44.4%
Other warm up exercises	Finger Stretching	0	0%	1	3.7%	1	3.7%
	Jack de wet Exercises	0	0%	1	3.7%	1	3.7%
	Left Hand Exercises	1	3.7%	0	0%	1	3.7%
	Bowing exercises	1	3.7%	0	0%	1	3.7%
	Double Stops	0	0%	1	3.7%	1	3.7%

8) **Table E8**

The results in Table E8 show no relationship between a physical cool down and current injury at the 95% level (p>0.05).

Table E8: Comparison of performing a physical cool down after practice and current injury

		D2						Chi-square	df	p
		Yes		No		Total				
		n	%	n	%					
Physical cool down after practice	Yes	2	8.3%	2	8.3%	4	16.7 %	.320	1	0.572
	No	13	54.2 %	7	29.2 %	20	83.3 %			

9) **Table E9**

There were no trends seen in comparing activities during breaks and current injury

Table E9: Comparison of the most common activity during rehearsal breaks and current injury

		D2				Total	
		Yes		No			
		n	%	n	%		
Most common activity during breaks							
Smoke	Yes	4	14.8	0	0.0	4.0	14.8
Play cards	Yes	0	0.0	0	0.0	0.0	0.0
Remain seated	Yes	1	3.7	2	7.4	3.0	11.1
Stretching	Yes	3	11.1	1	3.7	4.0	14.8
Chat	Yes	10	37.0	3	11.1	13.0	48.1
Text messaging	Yes	1	3.7	1	3.7	2.0	7.4
Eat/Drink	Yes	12	44.4	7	25.9	19.0	70.4
Go for a walk	Yes	6	22.2	4	14.8	10.0	37.0
Put in Bowings	Yes	0	0.0	1	3.7	1.0	3.7

10) **Table E10**

Table E10 shows that Occupational information is not significantly associated with current injury (p>0.05) using chi squared tests.

Table E10: Comparison of occupational information and current injury

		D2						Chi-square	df	p
		Yes		No		Total				
		N	%	n	%					
Work considered to be main profession	Performing musician	15	55.6%	10	37.0%	25	92.6%	1.271	1	0.260
	Music teacher	2	7.4%	0	0%	2	7.4%			
Number of hours engaged in practical teaching	1-5 hours	8	38.1%	7	33.3%	15	71.4%	3.049	3	0.384
	6-10 hours	1	4.8%	1	4.8%	2	9.5%			
	11-15 hours	1	4.8%	0	.0%	1	4.8%			
	16 hours +	3	14.3%	0	.0%	3	14.3%			
Performance in other musical contexts (e.g. freelance, bands)	Yes	13	50%	8	30.8%	21	80.8%	.584	1	0.445
	No	4	15.4%	1	3.8%	5	19.2%			
Hours per week performing in additional context	1-5 hours	11	55%	6	30%	17	85%	.004	1	0.948
	6-10 hours	2	10%	1	5.0%	3	15%			
Engaged in Non-music related work	Yes	2	7.4%	0	0%	2	7.4%	1.27	1	0.260
	No	15	55.6%	10	37.0%	25	92.6%			
Orchestral salary sufficient to cover monthly expenses	Yes	6	22.2%	2	7.4%	8	29.6%	0.71	1	0.401
	No	11	40.7%	8	29.6%	19	70.4%			
Orchestral salary and other income Sufficient to cover monthly expenses	Yes	9	36%	4	16.0%	13	52%	.322	1	0.571
	No	7	28%	5	20.0%	12	48%			
Rating of financial stress	No stress	2	7.4%	1	3.7%	3	11.1%	1.54	4	0.819
	2	2	7.4%	2	7.4%	4	14.8%			
	3	4	14.8%	3	11.1%	7	25.9%			
	4	7	25.9%	2	7.4%	9	33.3%			
	Severe stress	2	7.4%	2	7.4%	4	14.8%			

11) **Table E11**

Table E11: Comparison of means between those with current injury and those without

	D2	N	Mean	Std. Deviation	p value
Age	Yes	17	35.5	12.3	
	No	10	39.8	10.9	0.373
	Total	27	37.11	11.768	
Height	Yes	17	1.5	0.6	
	No	10	1.7	0.1	0.084
	Total	27	1.5631	.46317	
Weight	Yes	17	64.8	22.0	
	No	10	59.9	23.7	0.697
	Total	27	62.96	22.293	
Starting age playing any instrument	Yes	17	6.2	1.8	
	No	10	7.3	2.9	0.290
	Total	27	6.59	2.291	
Starting age playing current string instrument	Yes	17	8.6	4.8	
	No	10	12.7	7.4	0.092
	Total	27	10.11	6.110	

There were no significant differences between those with and without current injury in terms of demographic variables ($p>0.05$) using independent t-tests.