

MASTERS SUBMISSION

Incidence of Musculoskeletal Problems among Instrumental Music Students

Owen Gray B.Sc. (Clin Sci)

Student Number 3047316

Primary supervisor: Dr Brian Nicholls D.O., M.A.

Victorian University
Osteopathic Medicine Department
c/o 301 Flinders Lane
Melbourne VIC 3000

Abstract

The incidence of musculoskeletal problems among instrumental music students in Australian is unknown. This study examined students who play musical instruments and are potentially at risk of developing problems, including pain and injury, related to their playing activities. Full-time instrument major students (N=88, aged 18 years and above, 57 male: 31 female) at the Victorian College of the Arts (VCA) completed the self-administered quantitative "Standardised Nordic Questionnaire for Analysis of Musculoskeletal Symptoms"¹ to ascertain the incidence of musculoskeletal 'trouble' (ache, pain, or discomfort) across nine body regions. These results were analysed in relation to gender and type of instrument played.

91% of participants (90% of females and 91% of males) reported problems at one or more times in at least one region during the previous 12 months. The regions with the highest reports of trouble were the neck (56%), one or both wrists/hands (56%), low back (51%), and the shoulder (47%). The regions of the body with the highest reported levels of problems for males were low back (54%), neck (51%) and wrists/hands (49%). Females reported problems in the wrists/hands (68%), neck (65%) and shoulders (61%)(Table 3). Certain problems were associated with particular instruments. 100% of double bassists reported low back trouble, while 90% of drummers and 80% of pianists reported wrist/hand problems (Table 4).

Musculoskeletal problems in instrumental music students are common, occurring at similar rates in both males and females. Low back problems in double bassists and wrist/ hand problems, in drummers and pianists particularly, were very common. To

better understand and manage instrumental music students, further study is necessary to understanding the factors that lead to these problems and factors (including exercise) that may prevent them.

Keywords: musculoskeletal problems, music students, self-administered, questionnaire, pain, Victorian College of the Arts.

Introduction

Those who play musical instruments are at risk of developing pain and injury related to their playing activities²⁻⁷. This is a serious issue if a person's chosen education or career involves playing a musical instrument. Performing Arts Medicine (PAM) - a new and rapidly evolving field within health care today - is a 'fundamentally interdisciplinary' field of specialised health care involving treatment and management of performing artists, and cannot be claimed by one medical area as its own⁸. The incidence of musculoskeletal problems among instrumental music students in Australian is unknown. To date, little research has been done into this interesting field in order to understand the patterns of where and when pain occurs and who is at greatest risk.

Hutson⁹ has outlined certain methods of classifying and evaluating manual work for biomechanical job analysis. A general, programmatic approach is recommended to reduce the inherent complexity associated with work systems, such as performing on a musical instrument. The primary elements of the classification method are to identify the prevalence and type of musculoskeletal problems that are of concern, either by

- 1) Passive surveillance - where frequent or serious injuries can be traced back to certain types of jobs, or even specific job tasks
- 2) Active surveillance - requiring ergonomic analysis;
- 3) Discomfort surveys (or questionnaires) - to identify and systematically document the type and prevalence of musculoskeletal problems in a work group.

- 4) Analysis of job factors that expose or raise the risk of incurring specific musculoskeletal problems.

Since discomfort questionnaires play such an important role, the current research has employed this approach.

Several studies have provided information about the prevalence and type of musculoskeletal problems among instrumental musicians²⁻⁷. No published studies were found regarding musical instruments that employed the active surveillance approach.

Fry² conducted the earliest study in 1986. Based in the United Kingdom, 219 professional symphony orchestra musicians were interviewed and examined by the researcher in a clinical setting. The participants were graded from grade 1 (regular pain in one site while playing that ceases when the musician stops playing) to grade 5 (loss of capacity to use hand because of severity of disabling pain and loss of muscle function, pronounced tenderness to palpation). This study showed an average of over 50% of professional symphony orchestra players with painful overuse injury. These results range from percussionists (36%) and brass players (39%), to woodwind (70%) and string players (75%).

Fry³ also conducted the only Australian study in the following year using the same methodology in this study, again looking at the prevalence of 'overuse syndrome' and highlighting the importance of understanding and learning how to prevent pain, injury and even disability in students earlier rather than later. 116 students were interviewed and examined by the researcher in a clinical setting across seven Australian tertiary

performing music schools. Overall the rate of overuse (injury) was 9.3% of students, ranging from 5% to 21% across the schools. The incidence of overuse (injury) syndrome ranged from brass (7%), string (8%) and keyboard players (9%), to percussionists (9%) and woodwind players (13%). Males and females were equally represented in the mild injury groupings. However, moderate to severe injury groupings demonstrated that three women were affected for every man. The study also reported an almost 100% correlation between the onset of symptoms and an increase in both the time and intensity of music practiced. There are no results given to support this view, only the researchers own observations, interpretations and opinions. Both of these studies by Fry²⁻³ failed to diagnose the types of injuries. The studies also categorised subjects into one of five groups of instruments, neglecting the unique differences required to perform each individual instrument.

Only one discomfort questionnaire⁴ was found in the literature. Using a prospective questionnaire approach, this study of 249 tertiary students at one university looked at both instrumental and non-instrumental students to find any differences between instrumental and non-instrumental students, and for a relationship between individual instruments and specific sites of pain. Students completed a survey concerning the presence and site of musculoskeletal pain, habitual activities (including practising a musical instrument) and demographic characteristics. This study was based on the national reference standard, the U.S. Health and Nutritional Examination Survey (HANES 1)¹⁰.

The students who played an instrument showed nearly twice the incidence of upper body pain, compared to students who did not play an instrument. Of note, female violin players showed 23 times the risk of upper body pain and 14 times the risk of

shoulder pain compared with male violinists. This study demonstrated that those at especially high risk of developing pain were women who play the violin. This is cause for concern as almost 80% of violinists surveyed were women. The guitar students, 85% being male, showed almost 14 times the risk of elbow pain compared with students who did not play guitar.

This study looked at a variety of characteristics that may have predisposed or maintained the onset of pain. The only statistically significant factor that distinguished instrumentalists with pain from those without was the number of hours spent each week in physical activities other than playing an instrument. The authors of that study proposed that regular exercise may have a protective effect on the body, but acknowledged that this could not be established by that study.

The original questionnaire ¹⁰ asked participants to report if they had experienced pain *most days* in the preceding month. Inconsistencies arose in the subsequent study ⁴ when the questionnaire was modified. Participants were instead asked to report pain they experienced *at least two days* in the preceding month. This subsequent study could no longer be compared with the national results obtained by the original questionnaire. This questionnaire is only available in English, and has not been used in any study outside the United States of American. The proposed research will introduce a standardised questionnaire ¹ that has not been used in this field previously. This questionnaire is well-designed and tested with international reliability and validity in many languages for studies to be compared throughout the world.

A later study ⁵, a retrospective analysis of patients at a health care institution, investigated instrument-specific rates of upper-extremity injury in music students. Results were calculated for the 513 performance major students that presented to the university's health service with performance-related upper-extremity injuries over 14 academic years. The overall injury rate was determined to be 8.3 injuries per 100 performance major student years (8.3%). The instruments associated with the highest injury rates were the harp (17.1%), guitar (13.6%) and piano (13.1%). All Harp players were female. Female double bassists reported the equal highest injury rate and were more than twice as likely as the males to develop an injury (17.1 vs. 8.0%). Women had a higher overall injury rate than men (8.9 vs. 5.9%). The instruments associated with the lowest rates of injuries were all the brass instruments – French horn, tuba, trumpet, euphonium and trombone (1.7 to 3.1%).

A similar study ⁶ looked at the rates and types of injuries, treatment outcomes and effectiveness for musicians, ballet dancers, actors, visual artists and creative writers. 17% of musicians (13 of 77 students) in the school (7 piano, 5 violin and one flute) were treated for various overuse injuries in one year. The most common regions affected were the elbow and forearm (62%), neck and shoulder (54%), and the hand and wrist (23%). By comparison 43% of all dancers experienced injuries, most commonly the foot/ankle (89%), leg (63%), hip (38%), knee/back (25%) and arm/shoulder (13%). 19% of actors sought treatment for a diversity of injuries. Of those seeking help the only common injury to occur was ankle sprain (38%). The visual artists and creative writers reported little or no performance related injuries.

The only study ⁷ on secondary school music students, which looked at the cumulative prevalence of injuries in this population, showed problems to be more common in students who played large string instruments, such as 'cello and double bass (78%) compared with students playing smaller string instruments, such as violin and viola (42%). These students were younger than participants in other studies. Their smaller size and not being as physically strong may account for these differences.

The purpose of this study was to investigate the incidence of musculoskeletal pain among full-time instrumental music students at the Victorian College of the Arts (VCA). The incidence and site of pain for individuals across gender and instrument distribution was examined, showing which regions of the body were most affected and the students at the highest risk of developing pain and potential future disability.

The study uses a standardised questionnaire ¹ with demonstrated reliability and validity that aims to be used for further studies internationally. This study should help direct in-depth research in the future, indicating specific groups to focus further research on, to better understand the unique problems encountered by instrumental musicians. Results may also be of benefit to medical care providers, music teachers and students in better understanding injury among instrumentalists.

Materials and Methods

Ethical approval for the study was obtained from the Faculty of Human Development Human Research Ethics Committee at Victoria University. Questionnaires were distributed to 220 students currently enrolled at the Victorian College of the Arts (VCA). Most students of classical music were not available, as they had already finished classes for the year. Students who were not enrolled full-time at VCA, who did not major on a musical instrument, and were not 18 years of age or above were asked not to participate and were excluded from the study.

During class time the researcher informed the students about the study. All students in the classes were handed a questionnaire pack containing an "Information to Participants" letter, a self-administered questionnaire and a self-addressed, reply-paid envelope in which to return the questionnaires once completed. As outlined in the information to participants letter (Appendix 1), participation was voluntary and not connected to the requirements of their course. Students could respond at a later time without being personally identified by returning the completed questionnaires to the researchers via the attached reply paid, return addressed envelope. To ensure anonymity, participants were asked that no identifying information be recorded on the survey, and participants were free to withdraw at any time during the course of the study without prejudice. Completion and return of the survey was held to imply consent to participation. This research was conducted according to the ethical requirements of the institutions involved, in addition to those of Victoria University.

The first section of the questionnaire asked about demographics – confirming the participant was 18 years of age or older and enrolled full-time at the VCA, and asked the participant’s gender and primary instrument played. The second section contained the self-administered quantitative questionnaire “Standardised Nordic Questionnaire for Analysis of Musculoskeletal Symptoms”¹. This questionnaire has been standardised and tested for reliability and validity in English and the four Nordic languages (Danish, Finnish, Norwegian and Swedish). The questionnaire has been used in over 100 different projects with more than 50 000 persons have responded to this questionnaire. Based on this solid record the questionnaire appears the best choice for this study.

This questionnaire is in three parts. Part One of the questionnaire asked the participant to report if they had experienced any ‘trouble’ (ache, pain or discomfort) at least once over the past 12 months for each of the nine major regions of the body. Part Two asked if this had stopped them from doing their normal work. Part Three asked if they had experienced this trouble in the last seven days. Parts Two and Three are conditional response questions – all respondents that answered yes to any one of the nine questions in Part One must also fully complete the corresponding questions in Parts Two and Three.

Descriptive statistics of this population were obtained by entering data into a Windows Excel spreadsheet to calculate the frequency of pain for variables of gender, instrument and incidence of pain. Statistical analysis involved tallying the number of students, their gender, instrument played, and the regions of the body in which they experienced pain.

Results

Of the 220 questionnaires distributed, 91 were returned (41% response rate). All but three of these responses met the inclusion criteria: 2 were not completed at all, and one was excluded, as the student did not major on an instrument. There were 88 eligible responses left for analysis in this study. The group consisted of 57 males and 31 females, comprising 18 classical music students, 39 contemporary music students and a mixture of 31 brass students from the classical and contemporary streams.

The number of participants and gender distribution for each instrument is outlined below (Table 1 and Figure 1). Groups having sample sizes less than four (oboe, flute, clarinet, violin, viola 'cello and harp) are not singularly discussed but still included in the overall analysis. Males made up 65% of the participants in this study, and both trumpeters and electric bassists were entirely male groups. Drummers and classical guitarists were predominantly male groups, having only one female in each group. French horn players were the only sizable group that had a greater number of females than males.

The prevalence of problems reported by all instrumentalists during the previous 12 months was 91%, with 9% of students having reported no problems in the previous 12 months. The gender distribution was very similar with 9 % of males and 10 % of females each giving no report of problems over the past 12 months (Table 2 and Figure 2).

The regions most affected overall (Table 3) were the neck (56%), one or both wrists/hands (56%), the low back (51%), and the shoulder (47%). The most common regions for males to be affected were the low back (54%), the neck (51%) and the wrists (49%). Females were most affected at the wrist (68%), the neck (65%), the shoulders (61%) and the low back (45%)(Figure 3). Of the 19 females that experienced shoulder pain, 68% reported bilateral shoulder pain, 18% reported left and 18% reported right shoulder pain.

56% of students reported pain in the wrist and hand. Of these, 22% were affected only in the right wrist, 33% only in the left, while 45% reported pain in both wrists. Wrist and hand pain was higher in females than males: 68% of females and 49% of males reported wrist/hand pain (Table 2). Problems associated with particular instruments tended to affect the wrist and hand region most commonly. 90% of drummers, 80% of pianists, and 75% of electric bassists and classical guitarists reported their wrists and hands were affected (Table 4).

Neck pain was also higher in females than males. 65% of females and 51% of males reported neck pain in the previous 12 months (Table 3 and Figure 3). 75% of electric guitarists and electric bassists, 73% of French horn players, and 71% of saxophonists reported neck pain (Table 4).

Several instruments were associated with higher levels of problems in certain regions. 100% of double bassists reported low back trouble, 90% of drummers and 80% of pianists reported wrist/hand trouble. The largest gender inequality for a particular

instrument was with the saxophone. 100% (3 from 3) of females and only 50% (2 from 4) of males reported problems in the neck region (Table 4).

Students that reported problems in Part One of the questionnaire (problems within a specific region within the last 12 months) were asked to qualify this by ticking a box in Parts Two and Three of the questionnaire. The majority of participants did not complete these sections accurately or did not answer them at all. These results were therefore intentionally excluded from this analysis.

Discussion

There are two distinct streams of study at the college: classical students and contemporary/ improvisational students. Classes are conducted separately and in different ways. Except for brass instrument players, very few classical students were able to participate in the study. This was due to data collection dates falling outside of all but the brass students' classes. The only instruments that were found in both streams were the trumpet and trombone. Since numbers were small, these instruments were grouped together for data analysis purposes.

It is difficult to compare the results of this study with other studies, due to differences in study design and the nature of questions asked. The high levels of problems reported by participants (yield) can be attributed to the wording of the question itself. This questionnaire asked if individuals had experienced 'trouble' in a particular area during the past 12 months. 'Trouble' was defined to include ache, pain or discomfort, widening the parameters of terminology for perceived differences between individuals. This may not only explain the high yield of results, but also why males and females reported similar incidence of problems.

A discomfort survey is neither diagnostic nor definitive in its design. The purpose of discomfort surveys is to identify and systematically document the type and/or prevalence of musculoskeletal problems in a work group. The word 'trouble' would be a more useful word to use in this study as it has a broader definition than the word 'pain'. While used in other studies, the word pain may be too narrow and limited a word to use in a general questionnaire. This might impact findings to include only

those individuals who perceive their problem as pain, but excluding those who perceive their problem as an 'ache' or 'discomfort' or who have a strong negative association with the word pain. The questionnaire ¹ used in the present study was chosen as it used the word trouble, a more useful word that allows a broader range of findings and more suitable for use in a general questionnaire to describe the population being studied.

This study was conducted during the final two weeks of classes for the year. Students are expected to be at the peak of their performance ability for the year at this time, and would most likely be doing a large amount of practice. This may artificially increase the yield of results as the participants may remember recent problems more clearly than problems they experienced some months back. It was expected that Part Three of the questionnaire would clarify this, however most participants failed to correctly complete this section. This was either due to receiving poor instructions from the persons distributing the questionnaire, or from not reading or not fully understanding the instructions on the questionnaire itself. This high rate of incorrect completion of Part Three deemed it unsuitable for analysis.

The study by Fry ³, looking at the prevalence of 'overuse syndrome' in 116 students across seven Australian tertiary performing music schools, categorised sites of pain into hand/ wrist (54%), arm (elsewhere) (34%) and spine (20%). In the current study, the results were hand /wrist (56%), the arm (63%), and the spine- neck (56%), upper back (40%) and lower back (51%). Similar results were found for the wrist/hand and it appears that wrist/hand problems reported in the current study might reflect overuse injuries as outlined by Fry, more so than in the rest of the arm or in the spine. Arm problems were almost twice as common in the current study when compared with the

study by Fry³. Problems in the spine were almost three times as common in the present study also. These differences may be explained by the methodologies of the two studies. Fry was looking for overuse (injury) syndrome in his students at the time of questioning and examination. The current study was simply asking if the student had experienced any trouble (ache, pain or discomfort) at least once in the previous twelve months.

Further research is needed on the wrists/hands that will incorporate both discomfort surveys and physical assessment in the one study. This would allow deeper understanding by contrasting objective findings – diagnosing conditions in the area, testing for functional ability and the incidence of overuse (injury) syndrome - and correlate these with the subjective findings from the discomfort surveys.

Fry³ also found that males and females were equally represented in the mild injury groupings. This supports the current study, which found a similar incidence between males and females reporting trouble (91% and 90% respectively). Fry further classified injuries into moderate to severe injury groupings. In the more severe groupings he demonstrated that three women were affected for every man. The current study only looked for the *incidence* of musculoskeletal pain and not the *severity* of such problems. As such it did not discriminate between mild and serious injury, so a comparison in this respect cannot be made.

The only other prospective study⁴ on tertiary students looked for a relationship between individual instruments and specific sites of pain. 249 students, both instrumental and non-instrumental students, completed a survey concerning the presence and site of musculoskeletal pain, habitual activities (including practising a

musical instrument) and demographic characteristics. The students who played an instrument showed nearly twice the incidence of upper body pain, compared to students who did not play an instrument. 40.0% of instrumentalists and 31% of non-instrumentalists experienced neck pain. 34.4% of instrumentalists and 12.7% of non-instrumentalists experienced wrist/hand pain. 5.6% of instrumentalists and 1.9% of non-instrumentalists experienced elbow pain. The current study differs in that instrumentalists reported incidences of 56% for both neck and wrist/ hand pain. Possible reasons for this difference were not investigated in either the current study or the previous study, but again the methodologies differed. The previous study asked students if they experienced pain at least two days in the previous months. The current study has broader parameters and asks the student if they experienced trouble (ache, pain or discomfort) at least once in the previous 12 months. These differences were not unexpected.

The study⁴ reported no statistically significant difference between instrumentalists who did and who did not report pain with respect to the number of days of practice per week, hours of practice per day and per week, or consecutive hours of practice, hours of sleep per night, and hours spent sitting, standing, and driving. The only statistically significant difference was in the amount of physical activity per week. Instrumentalists who did not have pain reported 26 hours of physical activity per week, compared to 17.3 hours reported by those who reported pain. Due to the cross sectional design of the study it was not firmly establish whether injury stopped students from participating in physical activity, or if exercise prevented injury. While it was beyond the scope of the current study to investigate this further, it is worth considering if regular exercise has a protective effect on the body as part of future studies.

As discussed previously, the study by Fry³ proposed a 100% correlation existed between the onset of 'overuse' syndrome, and an increase in both duration and intensity of practice. His proposal appears to contradict the findings of the above study⁴. An increase in duration and intensity of practice may not cause an appreciable difference in the pain in the short term, but in the long term may lead to the development of overuse (injury) syndrome. This possibly suggests that pain is not always part of the typical course of the development of the 'overuse' syndrome during the early stages.

The study by Cayea and Manchester⁵ on instrument-specific rates of upper-extremity injury in music students found the overall injury rate of the students to be 8.3 injuries per 100 students (8.3%). These values cannot be compared directly with the results of this study, as the current study asked for the incidence of trouble (ache, pain or discomfort) at least once in the previous 12 months. In the Cayea and Manchester study, the instruments associated with the high rates of injury by were the guitar (13.6%) and the piano (13.1%). Both of these instruments were associated with high incidences or reported trouble in the current study. Female double bass players were 50% more likely to be injured than males, and equalled the top incidence of injury (17.1%) in the Cayea and Manchester study. The current study also showed the highest incidence of problems in double bass players (100%), affecting the low back specifically. This may be due to the prolonged flexed spinal posture assumed to play the instrument and the sheer weight and size of the instrument when carrying and lifting it during transport.

Miller and Moea⁶ studied the rates and types of injuries in a University Performing Arts Medical Clinic. They found that 17% of musicians, 43% of dancers and 19% of actors sought treatment. The musicians experienced more upper limb injuries, while the dancers and actors experienced predominantly lower limb injuries. This is consistent with the findings by Roach, Martinez and Anderson⁴ that found instrumentalists twice as likely to experience upper limb pain than non-instrumentalists. This makes sense since the upper limbs are needed to play these instruments. According to Miller and Moea, the regions most affected were the elbow and forearm (62%), neck and shoulder (54%) and the hand/ wrist (23%). In the current study it is difficult to make direct comparisons. The forearm was not classified with the elbow but with the wrist/hand, and the neck and shoulder were classified separately. Despite this confusion, the results are similar and current study is supported by these results. The regions most affected in the current study were the neck (56%), the wrist/ hand (along with the forearm)(56%) and also the shoulder (48%)(Table 3). The elbow scored very low in the current study, which is largely due to the way the forearm is classified in the two studies.

A study by Lockwood⁷ of secondary school students showed problems to be higher among students that played the larger string instruments, 'cello and double bass (78%), than the smaller string instruments, such as the violin and viola (42%). The current study had samples of violin, viola and 'cello too small for such a comparison. In the current study the double bass was associated with the highest incidence of problems. Lockwood suggested that the younger students smaller size and lower physical strength might account for these differences. This suggestion is not supported by the current study. Interestingly, the study by Cayea and Manchester⁵ has larger

numbers of both male and female double bass players than the current study and highlights the gender differences between double bass players well. Female double bass players were 50% more likely to develop injury compared with their male counterparts. Assuming the males in their study were physically stronger and larger than the females then this may actually support the claim that size and physical strength play a role in predisposing or preventing a person from developing musculoskeletal problems. This finding would influence the understanding of all the studies examined in this paper ²⁻⁷, especially the overuse (injury) syndrome studied by Fry ²⁻³, and the significance of number of hours spent each week in physical activities other than playing an instrument in the study by Roach, Martinez and Anderson ⁴. Further investigation may reveal that regular exercise may protect the body from pain and injury.

In future studies there is need for a questionnaire which is simple for everyone to use, internationally standardised and broadly accepted for wider use. The questionnaire used in the current study ¹ appeared to have posed appropriate questions, but verbal and written instructions for completing the survey were perhaps unclear, misunderstood or simply ignored. Part One of the questionnaire, asking individuals to report problems in the previous 12 months, was answered well. Parts Two and Three of the questionnaire required conditional responses – for each of the nine distinct regions of the body where a problem was reported in Part One, everyone was expected to answer the corresponding questions in Parts Two and Three. These subsequent questions were answered incorrectly, incompletely or simply ignored by most participants. As such, Parts Two and Three were intentionally left out of the data

analysis. This section of the questionnaire clearly requires modification if it is to have any value in future research into this area.

It was beyond the scope of this research project to ask questions related to cause of injury. This is best left to a larger or more in-depth research project. Future research should perhaps focus on identifying the causes of the hand, wrist and finger pain experienced by instrumentalists, especially drummers and pianists.

Conclusion

Full-time instrumentalists at the Victorian College of the Arts (VCA) completed the self-administered quantitative questionnaire asking about the incidence and site of 'trouble' (ache, pain, and discomfort) across gender and type of instrument distribution. 90% of females and 91% of males reported problems at one or more times in at least one region during the previous 12 months. The regions most affected were the neck (56%), wrist/hand (56%), low back (51%) and shoulder (47%). The gender distribution of problems for males was low back (54%), neck (51%), and wrists/ hands (49%). Females reported problems at the wrists/ hands (68%), neck (65%) and shoulders (61%). Certain problems were associated with particular instruments: 100% of double bassists reported low back trouble, 90% of drummers and 80% of pianists reported wrist/hand trouble.

There is need for a simple to use and broadly accepted questionnaire to be adopted for future studies that is internationally standardised and tested for reliability and validity in languages other than English. Future research is needed into the possible causes of hand, wrist and finger pain experienced by instrumentalists, especially for drummers and pianists.

Acknowledgements. Thanks to Associate Professor Tony Gould, Angela Duff, and Rebecca Lumb from the Victorian College of the Arts for their assistance.

References

1. Kuorinka I: Standardised Nordic questionnaire for the analysis of musculoskeletal symptoms *Applied Ergonomics* 18(3): 233-237, 1986.
2. Fry HJH. Incidence of overuse syndrome in the symphony orchestra *Med Probl Perform Art* 1:51-55, 1986.
3. Fry HJH: Prevalence of overuse (injury) syndrome in Australian music schools *Br J Ind Med* 44:35-40, 1987.
4. Roach KE, Martinez MA, Anderson N: Musculoskeletal pain in student instrumentalists: a comparison with the general student population *Med Probl Perform Art* 9:125-130, 1994.
5. Cayea D, Manchester RA: Instrument-specific rates of upper-extremity injuries in music students *Med Probl Perform Art* 13:19-25, 1998.
6. Miller C, Moa G: Injury characteristics and outcomes at a performing arts school clinic *Med Probl Perform Art* 9:120-124, 1998.
7. Lockwood AH: Medical problems in secondary school- aged musicians *Med Probl Perform Art* 3:129-132, 1988.
8. Pascarelli EF, Bishop CJ: Performing arts medicine: the status of the specialty within an evolving health care system *Med Probl Perform Art* 9:63-66, 1994.
9. Hutson MA. *Work-related upper limb disorders-recognition and management* Butterworth Heinemann, Oxford, 1997.
10. Cunningham LS, Kelsey JL: Epidemiology of musculoskeletal impairments and associated disability. *Am J Public Health* 74: 574-579, 1984.

TABLE 1. Gender distribution of instruments

Instrument	Total number	Gender	
		Male	Female
Trombone	12	8	4
French Horn	11	2	9
Drums	10	9	1
Piano	10	6	4
Classical Guitar	8	7	1
Trumpet	7	7	0
Saxophone	7	4	3
Electric Guitar	4	3	1
Electric bass	4	4	0
Double bass	4	3	1
Oboe	3	0	3
Flute	2	0	2
Clarinet	1	1	0
Tuba	1	1	0
Violin	1	0	1
Viola	1	1	0
'cello	1	0	1
Harp	1	1	0
Total	88	57	31

Figure 1. Gender Distribution of Instruments

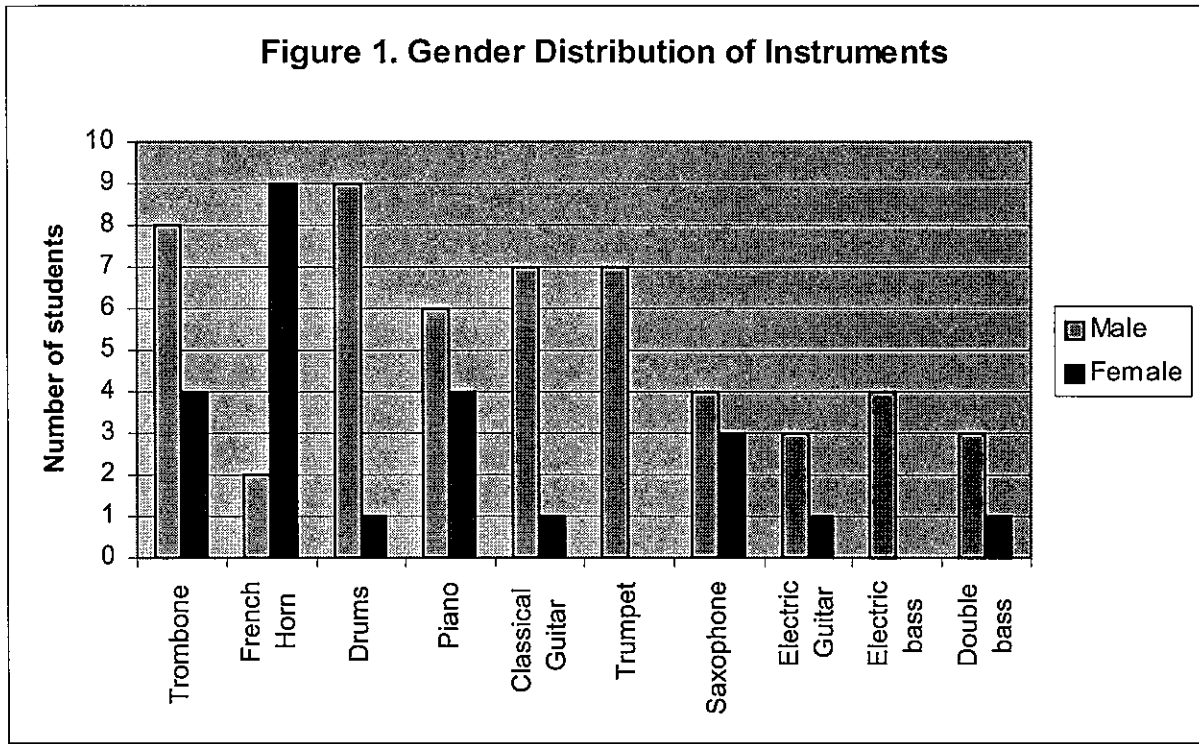


TABLE 2. Gender distribution of Problems

	Gender				Total	
	Male		Female		Number	%
	Number	%	Number	%		
Total	57	65	31	35	88	100
Number affected	52	91	28	90	80	91
Region affected						
Neck	29	51	20	65	49	56
Shoulders	23	40	19	61	42	48
Elbows	10	18	3	10	13	15
Wrist/ Hand	28	49	21	68	49	56
Upper Back	23	40	12	39	35	40
Low Back	31	54	14	45	45	51
Hips	2	4	5	16	7	8
Knees	8	14	5	16	13	15
Ankle/ Foot	7	12	1	3	8	9

Figure 2. Gender Distribution of Problems

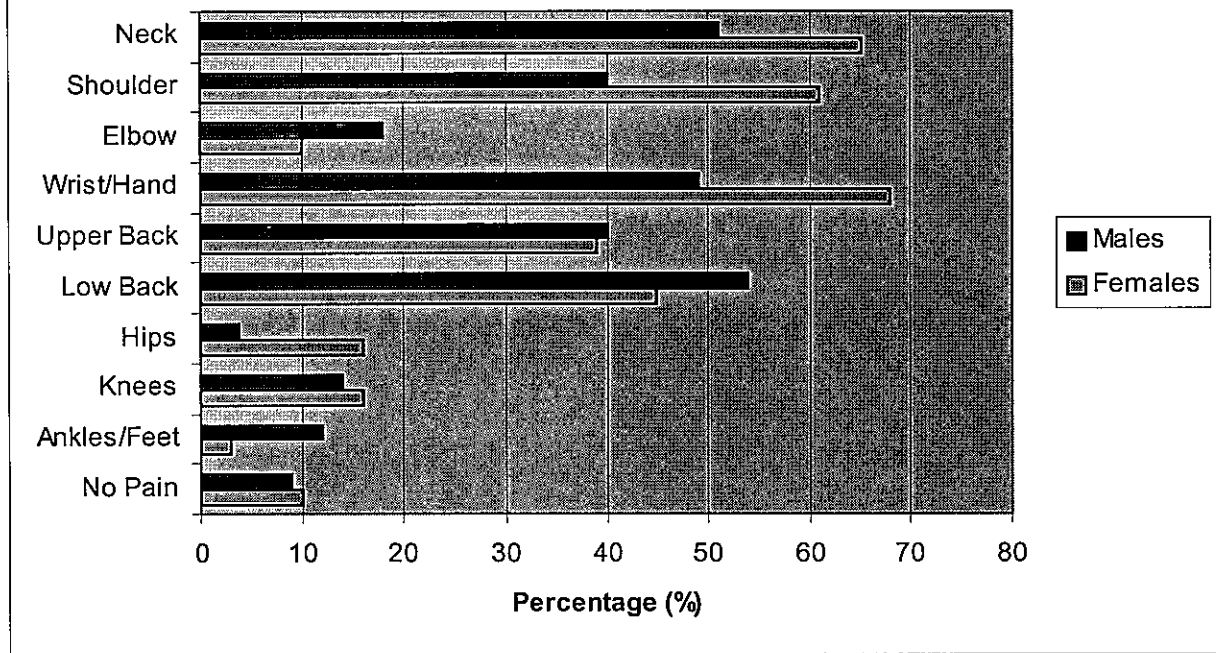


TABLE 3. Gender comparison of the regions most affected

Region	Males (%)	Females (%)	Total (%)
Neck	51	65	56
Shoulder	40	61	48
Wrist/ Hand	49	68	56
Low Back	54	45	51
No Pain	9	10	9

Figure 3. Regions with the Most Problems

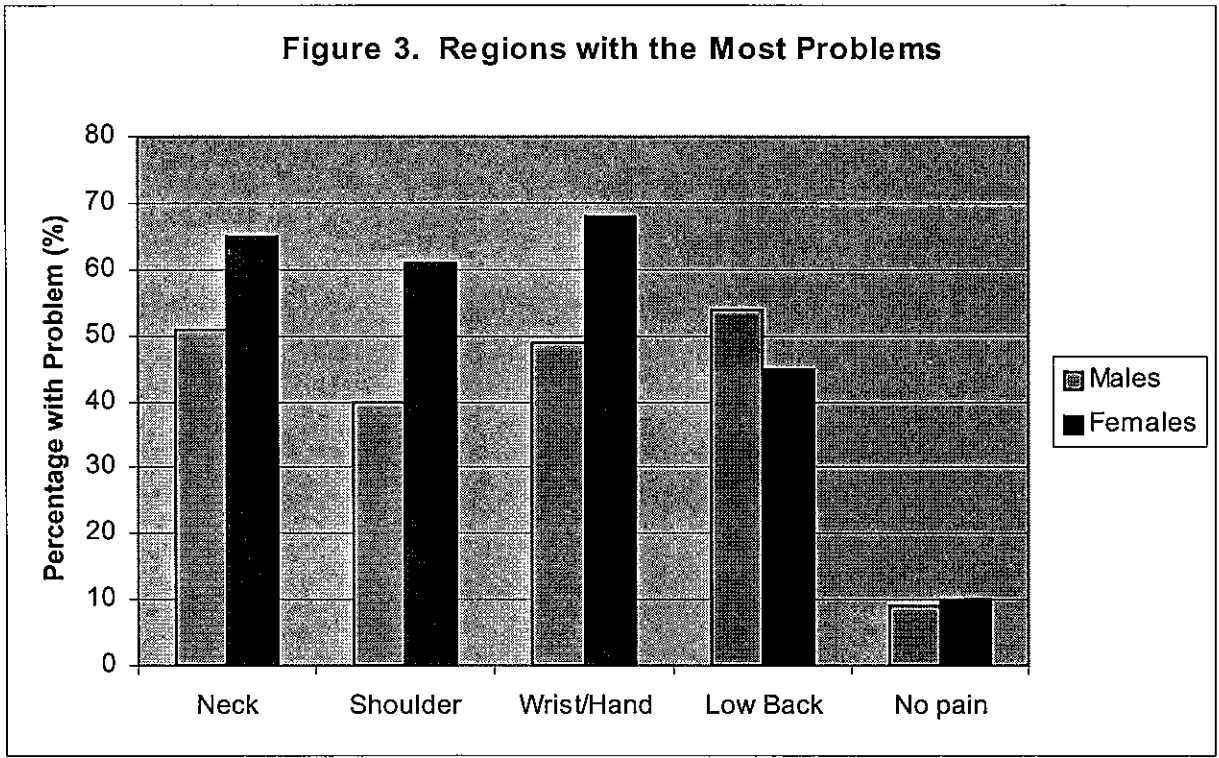


TABLE 4. Sites and Incidence of trouble for each instrument

Instrument	Incidence	Region
Double bass	100%	Low Back
Drums	90%	Wrist/ Hand
Piano	80%	Wrist /Hand
Electric Guitar	75%	Neck, upper and Lower Back
Electric bass	75%	Neck, low Back, wrist/ hand
Classical Guitar	75%	Low Back, wrist/ hand
Saxophone (all types)	71%	Neck - 50% males, 100% females.