

Musicians' Cramp:

Instrumental and Gender Differences

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Abstract—Musicians' cramp is a disorder characterized by its task specificity and gender bias; male musicians have a higher prevalence of this disorder than females. Previous epidemiological studies on musicians' cramp have demonstrated that certain instrumental groups are more prone to develop this disorder than others. These studies, however, have not accounted for the gender distribution in healthy musicians. Therefore, the current study investigated 2,661 healthy musicians collected from eight music conservatories within Germany. These controls were compared with 183 patients (154 males) with musicians' cramp in an outpatient clinic at the Institute for Music Physiology and Music Medicine (IMMM), Hannover, Germany (1994–2000). Comparisons between groups (musicians' cramp and controls) were made for gender and instrumental groups (keyboard, strings, woodwind, brass, plucking, and percussion). Results were consistent with earlier studies suggesting that particular instrumental groups were more at risk for developing musicians' cramp than others. When gender was not a factor, both woodwind and plucking (guitar) instrumentalists were more likely to develop musicians' cramp, while musicians playing string and percussion instruments were less likely to develop musicians' cramp. Musicians playing keyboard and brass instruments were not significantly different than expected. When gender was included in the analyses, the following pattern was revealed: the number of male patients with musicians' cramp was greater than expected, even when the number of healthy male musicians was accounted for; the opposite was found for female patients. Furthermore, when gender was also included in the instrumental analyses, male musicians were more likely to have musicians' cramp than females in keyboard, string, woodwind, and plucking instruments. The only instrumental group without a gender bias for symptoms were the brass instruments. These results suggest that male musicians are more likely to develop musicians' cramp within certain instrumental groups, and may reflect a general predisposition for male musicians to develop this disorder. The ages at onset of symptoms were not different between the males and females in this sample. The current study demonstrates a clear association between gender, instrumental groups, and the presentation of dystonic symptoms. *Med Probl Perform Art* 18: 21–26, 2003.

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Dystonia is a syndrome characterized by sustained muscle contractions, frequently causing twisting and repetitive movements, or abnormal postures.^{1–3} Dystonia can affect any part(s) of the body, including the arms, legs, trunk, neck, eyelids, face, or vocal cords. When symptoms are limited to a single limb, for example, a hand or digit(s), the condition is diagnosed as focal dystonia.^{4,5} Focal dystonia is often task-specific and may occur in many domains, including writing, playing a sport, or playing an instrument. Unlike other repetitive strain injuries (RSIs or overuse syndromes), focal dystonia is primarily painless. Focal dystonia in musicians is often referred to as musicians' cramp, and the symptoms typically occur in the mid to late 20s (late-onset dystonia) and often result in ending a professional musical career.⁶

When playing a particular musical instrument, high spatial-temporal synchrony or asynchrony is necessary. For each instrumental group, there are distinct constraining factors.⁷ For example, to play a flute, both hands require precise synchronization of the fingers to produce a note. In contrast, when playing the violin, the spatial-temporal constraints employed for the bowing hand are different from those for the fingering hand. The different requirements of the instruments may be a factor influencing the prevalence of musicians' cramp.⁸

In addition to the effects of instrument type, there appears to be a large gender difference in patients with musicians' cramp. As far as the authors are aware, there are only five other studies with sample sizes greater than 20 that focus on musicians' cramp.⁶ These studies are summarized in Table 1. There is a clear gender bias, with males outnumbering females by a ratio of at least 2:1.

Besides the greater number of male patients with musicians' cramp, Table 1 also shows that the ages of onset of symptoms may be different across males and females. With relation to musicians, aside from this current paper, only two studies have investigated differences in age of onset between the sexes.^{8,9} These studies revealed conflicting results: reported that females had an earlier onset (32 ± 10 years) than males (40 ± 10 years).⁸ In contrast, Lederman reported earlier onset for males (32 ± 8 years) than females (38 ± 15 years).⁹ It has been proposed that the gender differences may demonstrate first, the positions that males and females reach in their careers; and, second, that some instruments have larger numbers of one gender playing them than the other (e.g., there are more professional male guitarists than females).⁸

TABLE 1. Demographics of the Research Investigating Focal Dystonia among Musicians (Studies with More Than 20 in the Sample Size)

Study	Sample Size	Years of Sample	Mean Age at Onset	Male (M):Female (F) Ratio
Altenmüller (1998) ¹⁸	50	1995–1996	—	3:1 (M 31; F 9)
Brandfonbrener (1995) ⁸	58	1985–1995	M: 40 ± 10; F: 32 ± 10	3:1 (M 43; F 15)
Charnes (1992) ¹⁹	73		33 ± 8*	2:1 (M 47; F 22)
Lederman (1991) ⁹	41	1979–1989	M: 32 ± 8; F: 38 ± 8	2:1 (M 29; F 13)
Lim and Altenmüller (present study)	183	1994–2000	M: 34 ± 9; F: 33 ± 8	6:1 (M 154; F 29)
Newmark and Hochberg (1987) ²⁰	57	1980–1985	41.7 (range 17–70)*	3:1 (M 41; F 16)

*Age was not separated by gender.

This paper focuses on patients with musicians' cramp seen over a seven-year period (1994–2000) at an outpatient clinic in Hannover (Germany). The first aim of this current study was to investigate whether different instrumental groups affect the prevalence rates of musicians' cramp. Second, the effect of gender on the prevalence of musicians' cramp was also examined by comparing the patients' records with those of eight music conservatories in Germany.

The healthy musicians from eight music conservatories were investigated, and it is acknowledged that these students are somewhat younger than the patients; however, it is impossible to trace the final employment destination of musicians. Music conservatories are the last major contact point where statistical information was available. Musicians belonging to the orchestra unions were an alternative control group. However, this sample has the disadvantage of being biased toward certain instrumental groups, for example, string, woodwind, and brass are well represented in the orchestra unions, but musicians playing keyboard, percussion, and plucking instruments are not. Therefore, there was a trade-off between younger controls that represented all instrumental groups versus older controls that were less representative. Because instrumental groups and gender were the two main "risk factors" examined in this paper, it was felt that the benefit of investigating younger controls with all instrumental groups represented outweighed that of investigating older but less representative controls. It should be noted that this paper is based on findings among German orchestral musicians and music students and for this reason might not apply to musicians in other countries and from different cultures.

METHODS

Eight of 12 music conservatories replied to e-mails sent to them. Three music conservatories did not reply and one conservatory had issues regarding the privacy of the information. Information about the number of students enrolled in the academies during 2000 was requested. The data were also separated by gender and instrument. The following music conservatories participated: Berlin, Cologne, Hamburg, Hannover, Leipzig, Rostock, Saarbrücken, Sachsen, and Weimar (alphabetical order). While the total number enrolled would have been ideal for this investigation, not all conservatories were able to supply such data; therefore, only new students from 2000 were examined. It was assumed that the enrollment for 2000 was similar to that for the previous years, and

by using eight music conservatories, any biases should be minimal. All patient data from the Institute for Music Physiology and Music Medicine (IMMM) from 1994 to 2000 were examined; however, only patients with a clear diagnosis of musicians' cramp are reported.

For analyses, both standard and multidimensional chi-square (χ^2) tests were employed.¹⁰ For the gender analyses, the calculations took into account the greater number of males in the sample than females. Some instruments were not well represented in the patients and, therefore, unless stated otherwise, instruments were categorized in the following manner: *keyboard* (accordion, piano, harpsichord, organ, and keyboard); *string* (violin, viola, cello, and double bass); *woodwind* (flute, clarinet, oboe, bassoon, saxophone, and recorder); *brass* (trumpet, tuba, horn, and trombone); *plucking* (guitar and harp); and *percussion* (drums).

PATIENTS

All 183 patients were professional musicians; the ages at symptom onset for males (34 ± 9 years) and females (34 ± 8 years) were similar. The majority of the patients with musicians' cramp were right-handed (96%).¹¹ Five patients were left-handed (3%) and two patients were ambidextrous (1%). The professional positions held by the musicians were defined as soloists (53%), orchestral (21%), pedagogical (educational; 16%), combined (solo and pedagogical; 7%), and other (e.g., professional jazz musicians; 3%).

Eighteen patients reported a history of either writers' or musicians' cramp in their relatives (10%). In addition, 50 (27%) had tremor and, similarly, 48 musicians reported changes in the sensibility of their hands (26%). In relation to the onset of symptoms, most musicians reported a gradual onset (75%), while others reported rapid onset (10%); 5% experienced fluctuating symptoms; and, finally, some patients (9%) experienced additional symptoms, including paresthesia.

The major symptoms were: coordination problems of the fingers (flexion and extension of fingers, 66%); coordination problems in the hand or arm (20%); and coordination problems of the embouchure (14%). These symptoms were limited to the right hand in the majority of patients (50%), followed by the left hand (29%), and both hands (7%); the remaining musicians had problems with their lips (14%). From the eight music conservatories, there were 2,661 musicians: 1,180 males and 1,471 females.

TABLE 2. The Numbers and Percentages of the Instrument Groups Separated into Cohorts (Controls and Patients)

	Keyboard	String	Woodwind	Brass	Plucking	Percussion	Total
Controls	777 (92%)	918 (97%)	412 (91%)	266 (92%)	198 (85%)	80 (100%)	2,651 (92%)
Patients	54 (6%)	31† (3%)	42† (9%)	22 (8%)	34† (15%)	0* (0%)	183 (8%)
Total	831	949	454	288	232	80	

*p < 0.05.

†p < 0.01.

RESULTS

Preliminary analysis showed a significant interaction between the localization of dystonic symptoms and instrumental group ($\chi^2_{(16)} = 135.16$; $p < 0.01$). Not surprisingly, brass players were more likely than players of other instruments to have focal dystonia in the lip compared with other areas ($\chi^2_{(1)} = 54.58$; $p < 0.01$). This was not the case for woodwind players ($\chi^2_{(1)} = 1.78$; n.s.). Keyboard players were more likely also to experience both flexion and extension problems than expected ($\chi^2_{(1)} = 4.62$; $p < 0.05$).

In the following sections, the interactions of the three-way multidimensional chi-square analysis with instrument, gender, and group are reported ($\chi^2_{(5)} = 47.5$; $p < 0.01$).

Interaction between Instrument and Group

The first significant interaction in the three-way multidimensional chi-square analysis involved: instrument and group (dystonia or not) ($\chi^2_{(5)} = 53.86$; $p < 0.01$). Gender was not a factor in this analysis. Each instrumental group was subsequently examined separately and the patients and controls were divided (Table 2). Multiple two-by-two chi-squares were employed to investigate the interaction (e.g., keyboard players and not keyboard players with patients and controls).

The observed and expected numbers of patients with musicians' cramp were not significantly different within two instrumental groups: keyboard (54 for both observed and expected; $\chi^2_{(1)} = 0.00$; n.s.) and brass (observed 22 and expected 19; $\chi^2_{(1)} = 0.00$; n.s.). In contrast, the number of patients with musicians' cramp (31) was significantly less than expected (61) for string players ($\chi^2_{(1)} = 22.49$; $p < 0.01$). During the period 1994 to 2000, there was not a single

patient who was a percussionist, and this number (0) was thus less than the expected 5 for this analysis ($\chi^2_{(1)} = 5.32$; $p < 0.05$). Both the woodwinds and plucked instrumental groups had a greater numbers of patients with musicians' cramp than expected, given the number of people in the sample playing within these groups ($\chi^2_{(1)} = 6.53$; $p < 0.05$ and $\chi^2_{(1)} = 26.30$; $p < 0.01$, respectively). For the woodwinds, there were 42 patients with musicians' cramp, and this was significantly greater than the expected 29; for plucked instruments, 34 patients had musicians' cramp, and this was significantly greater than the expected 15 (all patients with musicians' cramp were guitarists and not harp players).

Interaction between Instrument and Gender

In this analysis, gender was a factor, and the distribution of gender with instrumental groups was investigated. This interaction was significant ($\chi^2_{(5)} = 295.81$; $p < 0.01$) and was further investigated by separating each of the instrumental groups by gender (Table 3). As with the earlier analyses, multiple two-by-two chi-squares were employed (e.g., keyboard players as a group rather than keyboard players with males and females separated).

For both keyboard and string instruments, the proportion of male musicians was less than expected ($\chi^2_{(1)} = 41.54$; and $\chi^2_{(1)} = 36.94$; both $p < 0.01$, respectively); the opposite was true of the females ($\chi^2_{(1)} = 12.00$; and $\chi^2_{(1)} = 10.67$; both $p < 0.01$, respectively). There was no effect of gender for the woodwind instruments ($\chi^2_{(1)} = 0.76$; and $\chi^2_{(1)} = 0.68$; both n.s., respectively). In contrast, for brass, plucked, and percussion instruments, the proportion of males was greater than expected ($\chi^2_{(1)} = 74.78$; $\chi^2_{(1)} = 25.73$; and $\chi^2_{(1)} = 28.59$; all $p < 0.01$, respectively). Female players of these instruments were

TABLE 3. The Numbers and Percentages of the Instrument Groups, Separated by Musician Gender

	Keyboard	String	Woodwind	Brass	Plucking	Percussion	Total
Male	284† (34%)	387† (41%)	202 (44%)	231† (80%)	160† (69%)	70† (88%)	1,334 (47%)
Female	547† (66%)	562† (59%)	252 (56%)	57† (20%)	72† (31%)	10† (12%)	1,500 (53%)
Total	831	949	454	288	238	80	

*p < 0.05.

†p < 0.01.

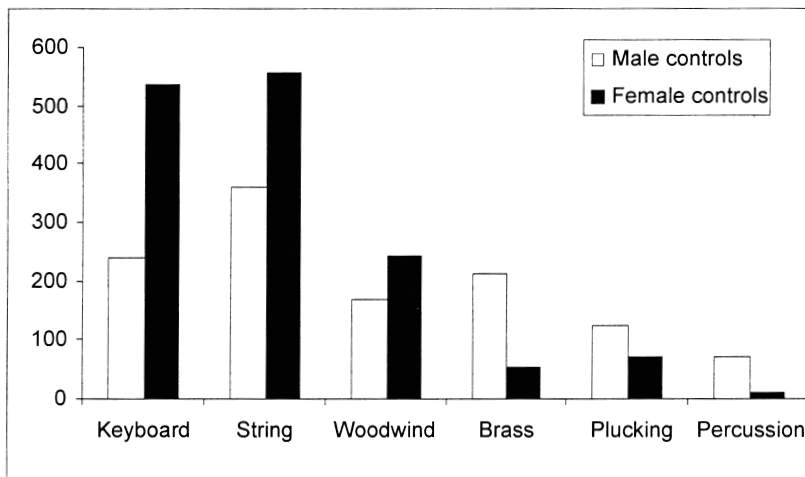


FIGURE 1. The number of musicians from eight conservatories (2000) separated by gender and instrumental groups.

fewer than expected ($\chi^2_{(1)} = 66.51$; $\chi^2_{(1)} = 22.88$; and $\chi^2_{(1)} = 25.42$; all $p < 0.01$; respectively).

Interaction between Gender and Group

The third interaction involved gender and group (with and without musicians' cramp) ($\chi^2_{(1)} = 107.97$; $p < 0.01$). The number of males with musicians' cramp was 154; and in total there were 1,334 males (11.54%); for females, the number was 29 and the total number of female musicians was 1,500 (1.93%). The ratio of male:female was 6:1.

Interaction between Instrument, Gender, and Group

The final interaction was also significant ($\chi^2_{(5)} = 47.40$; $p < 0.01$, Figures 1 and 2) and involved all three factors: instrument, gender, and group. This interaction was further examined by separating the instruments by gender and group (e.g., keyboard players only, with male and females and patients and controls).

For all instrumental groups, the proportions of male and female controls were not significantly different (all χ^2 statistics were less than 3.45; n.s.). In contrast, the patient data

were significantly different. For the keyboard instruments, the proportions of male and female patients were significantly different ($\chi^2_{(1)} = 48.26$; $p < 0.01$). That is, the number of male patients was higher than expected (43 patients and 18 expected), while that for females was lower (11 patients compared with 36 expected). For the string instruments, there was a gender difference for patients ($\chi^2_{(1)} = 20.40$; $p < 0.01$); there were more males (25) than expected (13) and fewer female patients (6) than expected (18).

The results were the same for woodwind ($\chi^2_{(1)} = 17.09$; $p < 0.01$) and plucked instruments ($\chi^2_{(1)} = 15.30$; $p < 0.01$). The number of males with musicians' cramp (32) was greater than expected (19); and females (10) were fewer than expected (23). For plucked instruments, the number of male patients (34) was greater than expected (23); there were no occurrences of females with musicians' cramp who played either the guitar or harp (the expected number of female patients was 11). Because there were no patients in the clinic who played percussion instruments, it was not possible to determine the expected number of patients with dystonia. Unlike the rest of the instrumental groups, the only group that did not show any significant differences in gender and dystonia were musicians who played brass instruments. This was the case for

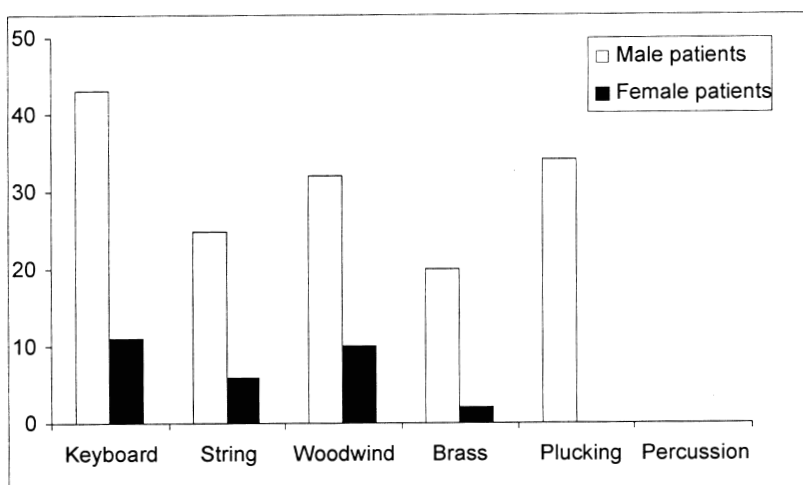


FIGURE 2. The number of patients with musicians' cramp (1994-2000) separated by gender and instrumental groups.

both controls and patients ($\chi^2_{(1)} = 0.13$; and $\chi^2_{(1)} = 1.59$; both n.s.; respectively).

DISCUSSION

The distribution of musicians' cramp was not the same across instrumental groups. When the effect of instrumental group was investigated without gender as a factor, musicians' cramp occurred less than expected in musicians who played string or percussion instruments. A comparison within the stringed instruments showed that the lower incidence of musicians' cramp for these instruments was not due to any particular instrument. Musicians' cramp occurred more than expected in musicians who played woodwind and plucked instruments (particularly the guitar); and musicians playing keyboard and brass instruments were not different than expected. These results suggest that players of instruments within certain groups are at greater risk for developing musicians' cramp than are others.

In the stringed instruments, the probability of patients with musicians' cramp in the non-bowed or fret hand was 2.5%. Like those who play the stringed instruments, guitarists have similar movements in the fret hand; however, in the non-fret hand, the movements of the fingers are different between the instrumental groups. Unlike the stringed instruments, the incidence of musicians' cramp was greater in guitarists than expected. Therefore, a post-hoc examination was employed to investigate whether the incidence of musicians' cramp in the fret hand (primarily the left hand) in guitarists was similar to the incidence of musicians' cramp in the fret hand (also primarily the left hand) of the stringed instruments. Indeed, there was no significant difference between the incidence of musicians' cramp in the fret hands for the guitarists and stringed instruments ($\chi^2_{(1)} = 1.98$; n.s.). This result suggests the following: the incidences of musicians' cramp in the fret hand of the two instrumental groups are similar; the higher prevalence of musicians' cramp in guitarists may be due to the types of movements the plucking hand performs; or alternatively, the lower rates of musicians' cramp in string players may be due to the bowing movements of the stringed instruments. Collectively, these results suggest that the risk for developing musicians' cramp is related to specific types of movements performed when playing an instrument.

In the plucking hand of the guitarists, there is repeated touching of the sides of adjacent fingers. Musicians' cramp has been considered a disorder of repetitive stimulation of adjacent fingers.^{12,13} The repeated sensory stimulation in the plucking hand of the guitarist may interrupt the representation of the fingers in the somatosensory and motor areas of the brain, and is consistent with previously demonstrated changes in the representation of the fingers in patients with musicians' cramp.¹⁴ Further studies on cortical representation of fingers may assist in the prevention and treatment of musicians' cramp. For example, retraining the brain by either behaviorally restraining symptomatic fingers¹⁵ or preventing repetitive contact between adjacent fingers may prevent or

lessen the cortical "fusion" or "blurring" of the fingers.¹⁴ These treatments may, therefore, influence the severity of, or prevention of, dystonic symptoms.

When gender was a factor in the analyses, there were significant differences in the representation of males and females across their primary instruments. In this analysis, group was not a factor. Male musicians were less likely than females to play keyboards and string instruments, but more likely to play brass, plucked, and percussion instruments. These results were not unexpected and reflect the general bias of some instruments to be played by musicians of one sex over the other.⁸ In this study, female musicians did not play more woodwind instruments than males.⁸ It is likely that the differences found in these studies are due to both sample size and statistical procedures. In this study, chi-square statistics were calculated given the differences in males and females and, therefore, reflect sample proportions, whereas only numbers of musicians were reported in the other study.⁸

The second gender analysis investigated the interaction between gender and the group (with and without musicians' cramp). In this study, the gender bias was consistent with previous studies (Table 1). What is not known from previous studies is whether this gender bias is simply a result of more male musicians playing at higher levels or due to some underlying predisposition. In order to investigate whether male musicians are more susceptible to developing musicians' cramp, the proportions of males and females from eight music conservatories were used as a comparison.

Gender was also a factor in this analysis and when comparing the patients with the conservatory students, male patients were more likely than female patients to have musicians' cramp in keyboard, string, woodwind, and plucked (guitar) instruments. The only instrument group that was not affected by gender was brass. These results suggest that male musicians are more likely to develop musicians' cramp than female musicians. Furthermore, the gender difference was greater in the current study compared with that in the previous literature (Table 1). In the current study the male:female ratio was 6:1 (154:29). While large, the direction of the bias is in agreement with a previous study in patients with writers' cramp (another form of focal dystonia); these patients demonstrated a gender bias with a male: female ratio of 2:1.¹⁶ These results suggest that male musicians may be more susceptible to developing musicians' cramp; however, it should be noted this study is limited to musicians who have actively sought assistance with their problems; therefore, the true estimate of the number and gender of musicians with focal dystonia may be different.

While there is no dispute about the greater prevalence in male compared with female patients who have musicians' cramp, the age at onset categorized by gender has conflicting results. In the current study, there was no significant difference in age at onset between males (34 ± 9) and females (34 ± 8). It is acknowledged that there are only five studies investigating focal dystonia in musicians with sufficient numbers, and the differences are likely due to the relatively small sample sizes in previous studies. For example, 58 and 47 cases

of patients with musicians' cramp have been reported previously.^{8,9} In this sample, there were 183 musicians with a clear diagnosis of focal dystonia seen over a seven-year period.

In comparison with other forms of focal dystonia, in a recent review of patients in a collaborative study reported in the journal *Neurology*,¹⁷ ages of onset were significantly different in males and females across different forms of primary dystonia. Of particular interest, male patients with generalized, segmental, and focal dystonias had significantly earlier ages of onset compared with females. For patients with writers' cramp, female patients had earlier onsets than males. This suggests that the ages of onset of symptoms may be different across different forms of focal dystonia and that gender may also play an important role.

CONCLUSIONS

One hundred eighty-three musicians with the primary diagnosis of musicians' cramp were examined over a seven-year period at the IMMM in Hannover, Germany. This outpatient clinic is part of the University for Music and Drama in Hannover and receives many referrals from around central Europe and examines musicians who have problems with coordination. In this sample of patients with musicians' cramp, gender was a factor in the prevalence of the disorder. The instruments that musicians play also affect the symptoms and localization of musicians' cramp. Ages of onset were not different between genders, and in the majority of patients, the symptoms of musicians' cramp appeared gradually; unfortunately, the symptoms appeared when musicians were likely to be at the peak of their professional careers (in their 30s). There was a clear association between instrumental groups and the presentation of certain symptoms; investigations for the instrumental design and teaching technique will benefit musicians and may perhaps influence the prevalence of musicians' cramp. Musicians' cramp is an important area of research to investigate as it has the potential to end a professional music career and has relevance to other focal dystonias such as writers' cramp.

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