

Title:

Pain prevalence in instrumentalist musicians: a systematic review

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ABSTRACT

Objective: To inform on current prevalence of pain amongst different musicians groups, sex and body region.

Methods: Studies were sought from PubMed, Web of Science; Academic Search Complete, Science Direct and Scielo. Databases were searched since 1st January 2000 until December 2012. Two reviewers screened titles and abstracts, and assessed full reports for potentially eligible studies. One reviewer extracted information on musicians' characteristics, study methods and study quality. When possible a meta-analysis of pain prevalence estimates was performed.

Results: A total of 18 studies were included in this systematic review. Studies assessed pain prevalence in general and the prevalence of pain affecting playing capacity for different time periods (point prevalence, one week prevalence, one year prevalence, month prevalence and lifetime prevalence). The prevalence of pain in general, across all groups of musicians and periods of interest over which pain was assessed varied between 29.0% and 90.0%, whereas the prevalence of pain affecting playing capacity varied between 25.8% and 84.4%. There was a tendency for guitar players to have the highest pain prevalence. The most affected body regions were low back (9.8% - 66.7%) and neck (9.8% - 48.5%).

Conclusions: Pain prevalence is high among musicians, independently of the pain definition used. Health and educational policy makers should become aware of the high lifetime pain prevalence affecting performance practices, [so that pain associated mechanisms are investigated and](#) preventive strategies can be implemented and tested.

INTRODUCTION

Music performance is a demanding physical and mental activity ¹; it requires a great deal of skills to process the information contained in the musical score so that it mirrors the musician's own intentions and expectations, including complex interactions between neuromotor control, musicality and expressivity, to fulfill the audiences' expectations ². Recently, much attention has been paid to musculoskeletal problems affecting musicians, as music performance quality correlates, in many different ways, with the instrumentalist's gestures. Music results from "*movement transformed into sound*" ³; thus, the incorrect use of the musculoskeletal system during instrumental practice has a significant negative impact on the overall performance quality and on the development and career of the instrumentalist ⁴. In fact, musculoskeletal pain has been identified as the most prevalent medical problem of the instrumentalist musician ⁵. However, no recent systematic review has been undertaken to inform on pain prevalence rates, considering sex, instrumentalists groups and body region. Contrary to what has happened for other professional groups ⁶, information regarding working-related problems in musicians is difficult to access ⁷, constituting a drawback on efficient prevention and treatment strategies.

The present investigation constitutes a systematic review of research studies that have been undertaken concerning pain prevalence amongst musicians. The goal is to determine current rates of pain prevalence, according to the time period of interest, for different musicians groups, sex and body region.

METHODS

Data Sources and Searches

Studies included in this systematic review were obtained searching within PubMed, Web of Science, Academic Search Complete Science Direct and Scielo. These databases were searched since 1st January 2000. Combinations of the following key words were used, without language restriction: "music," "musician," "instrumentalist," "pain", "disability," "overuse", "musculoskeletal diseases", "work-related musculoskeletal disorders", "overuse syndrome", "playing-related musculoskeletal disorders", "performing arts medicine, "survey" and "prevalence." PubMed was searched using MeSH terms. The reference lists of retrieved articles were screened for reports not identified through electronic searches. The search was conducted in January 2012 and updated on January 2013.

Study Selection

The studies were selected based on the following inclusion criteria: (i) have been published as a full article or an abstract with sufficient detail to extract the main attributes of the study; (ii) be cross-sectional surveys and cohort studies whose primary outcome was the prevalence of pain in musicians; (iii) have measured the prevalence of pain in general or the prevalence of specific pain related condition in instrumentalist musicians with any number of years of experience; and (iv) have specified the period of interest over which pain prevalence was assessed (e.g. at the moment of assessment, last year, and lifetime prevalence). An email was sent to the authors of those studies that meet all inclusion criteria except the latter to request a clarification on the time period over which prevalence was assessed.

Studies were excluded if: (i) more than one article was published based on the same study; in this situation only the most relevant study was included; (ii) they were case series, follow-up studies or studies of a specific technical aspect.

Data Extraction and Synthesis

Titles and abstracts were screened by AGS and FL, who independently identified potentially eligible studies, applying the inclusive criteria above described. Those studies that were eligible were separately assessed and obtained. The percentage of agreement between both investigators was calculated. Discrepancies in judgment were solved by consensus. AGS extracted relevant information from each included study, using customized forms specifying: author, country of study, study population, mode of data collection, final sample size and response rate, sample characteristics, pain definition, time period of interest for pain prevalence assessment and results. Prevalence of pain was characterised separately for: period of interest, sex, group of musicians and body site. When at least three similar studies were available, as regard to study sample and period of interest over which pain prevalence was assessed, a meta-analysis was performed. Statistical analysis was performed using *MetaXL* (a tool for meta-analysis in Microsoft Excel: <http://www.epigear.com>). Heterogeneity of the studies was assessed applying the Cochran Q test. For homogeneous studies, a fixed-effect model was used to compute common prevalence, whereas a random-effect model was used for heterogeneous studies.

Methodological quality assessment

The methodological quality of the included studies was assessed using a set of criteria previously used in a systematic review of studies on pain prevalence in Parkinson disease⁸. This tool includes 10 items and the quality of score ranges from 0 to 19

points, with a cutoff level for methodological acceptability set at 14 points, i.e. 75% of the maximum total points achieved ⁹.

RESULTS

Over 1500 references were identified in the initial search of the electronic databases. After excluding duplicates, a total of 932 references were screened for relevance by title and/or abstract. Of these, 886 were identified as not relevant because they did not meet the inclusion criteria. The remaining 46 studies were retrieved for further review. Of these, 16 were excluded because they did not meet one of the three first inclusion criteria and 30 were included for further review. The percentage of agreement during the selection for inclusion process was of 72%: both reviewers attributed the same classification (include or exclude from the systematic review) for 33 out of 46 studies. Discrepancies were solved by consensus, giving rise to the following results. Of the 30 studies meeting the first three inclusion criteria, three situations emerged: (i) 12 studies met all inclusion criteria and were not duplicates, so they were immediately included for the following phase of the study; (ii) four studies were considered duplicates because they referred to the same sample; and (iii) 14 studies did not report the time frame used for prevalence assessment. For the second situation, three studies were excluded ¹⁰⁻¹² and only one was included ¹³. For the third case, all first (or solo) authors were contacted via email in order to provide information on pain prevalence assessment time. Only one author replied clarifying the time period of interest for pain prevalence assessment; however, because four other studies were based on data collected using the same questionnaire as the one used by the author that replied, five studies were included ¹⁴⁻¹⁸. Thus, from the 14 studies failing to provide information on the pain prevalence assessment time, only 5 could pass the following phase of the study. Figure 1 presents a flowchart representation of the search and selection processes of articles included in the present systematic review, presenting why only a total of 18 studies were considered at the end ^{4,13-28}.

(please insert Figure 1 about here)

Overall study characteristics

The majority of the selected studies (n = 17; 94.44%) were questionnaire-based; only one study was phone-interview based ²⁶.

The target population included: symphony orchestra musicians (n = 6; 33.33%) (4,19-22,29); music students in schools and conservatoires (n=4; 22.22%) ^{13,23-25}; one targeted the general population and then selected those who were instrumentalists ²⁶;

and specific musicians' groups (n=7; 38.88%)^{14–18,27,28}. Of these seven studies, five report on data gathered applying the University of North Texas Musicians Health Survey^{14–18,27,28}.

The definition of pain varied among studies; thus, for the purposes of this investigation, the authors used a dichotomized definition that could include either (i) *pain affecting playing capacity*, if specified in the pain definition that pain affected playing capacity or (ii) *pain in general*, if playing capacity was not specified in the pain definition.

The periods of interest over which pain occurrence was investigated were: (i) point prevalence; (ii) week; (iii) month; (iv) one year; (v) five years; and (vi) lifetime prevalence. There were however studies that assessed prevalence for more than one time period (n=7; 38.88%)^{4,13,19,21–23,29}. A summary of the studies characteristics is presented in Table 1.

(please insert Table 1 about here)

Prevalence of pain

(i) Point prevalence

Two studies assessed pain point prevalence^{4,19} and both were conducted with symphony orchestra musicians. Sample sizes were 103 and 241, respectively, and prevalence of pain was 61%⁴ and 68%¹⁹, with a mean prevalence of 64.5%. Only one study presented prevalence rates according to sex (males = 58.7%; females = 80.8%), showing a significantly higher prevalence rate for women¹⁹.

(ii) One week prevalence

One study assessed one week pain prevalence²⁹ in seven symphony orchestras (n=342) and reported a pain prevalence of 74.3%.

(iii) One month prevalence

Two studies^{13,21} assessed month prevalence; one targeting adolescents¹³ and the other targeting adults²¹. For the first study, results indicated a month prevalence of about 56% in a sample of 731 adolescents: girls had 1.56 higher probability of reporting pain than boys. The second study reported a month prevalence of 71% in a sample of 243 symphony orchestra musicians.

(iv) One year prevalence

Five studies assessed 1 year pain prevalence: three studied musicians in symphony orchestras (total n=688)^{4,21,29}; one targeted the general population and then selected those who were instrumentalists (n=209)²⁶; and another targeted guitarists (n=261)

(28). Pain prevalence ranged from 29%²⁶ to 88.6%²⁹. Only one study²⁹ was interested on pain prevalence by sex; no significant differences between men and women could be found.

Within this group of studies, those studying a similar group of musicians and assessing pain prevalence over a similar period of interest were considered for a meta-analysis^{4,19,21,29}: all were carried out with symphony orchestras, 3 assessed one year pain prevalence and the other point prevalence. This group of studies presents significant heterogeneity and the meta-analysis indicates that pain prevalence for 1 month to 1 year is 75% (95% CI=57%-91%) (Figure 2).

(please insert Figure 2 about here)

(v) Lifetime prevalence

Seven studies reported lifetime prevalence^{14-18,27} across [very wide age groups \(including adults, young adults and adolescents\)](#) and for diverse type of musicians, including: bassoon players²⁷; percussionists¹⁸; guitar players¹⁶; keyboard players¹⁴; and brass players¹⁵. [Additionally, one study¹³ included high school students only \(participants' mean age = 12.7+2.0 years\)](#). Spence¹⁷ did not report on overall pain prevalence, only site specific prevalence. Pain prevalence varied between 59.2%¹⁴ and 81%¹⁶ for [those studies including wide age groups and was of 67.0% in the study including only high school students](#). Separating respondents by sex, Pak and Chesky¹⁴ found a statistically significant different mean lifetime prevalence between men (50.7%) and women (66.3%).

Prevalence of pain affecting playing capacity

(i) Point prevalence

Only one study²² assessed point prevalence of pain affecting playing capacity, in a sample of 377 symphony orchestra musicians. The results suggested a prevalence rate of 50%.

(ii) One month pain prevalence

Two studies^{13,25} assessed month prevalence of pain affecting playing capacity of piano students²⁵ and of high school and music college students¹³. Prevalence rates were 38.5% and 30%, respectively.

(iii) One to five year pain prevalence

Three studies assessed one year prevalence of pain affecting playing capacity^{4,21,29} whereas one assessed five-year prevalence of pain affecting playing capacity²⁴.

Estimates varied between 41% and 73% for the one year pain prevalence and were 77% for the five-year pain prevalence.

(iv) Lifetime prevalence

Four studies assessed lifetime prevalence of pain affecting playing capacity, three of which in symphony orchestras ^{19,20,22} with a mean prevalence of 84.2%. The other study ²³ used a sample of undergraduate piano students and reported a prevalence of 25.8%.

Similarly to what has happened with the studies on prevalence of pain not affecting playing capacity, the ones conducted on a similar group of musicians and assessing pain prevalence over a similar period of time were grouped for a meta-analysis. Four studies ^{4,21,22,29} were used to estimate pain prevalence affecting playing capacity for a one-year period or less. This group of studies presents significant heterogeneity and the meta-analysis indicates that pain prevalence is 54% (95% CI= 39%-69%) (Figure 3). Additionally, three studies were included in another meta-analysis regarding lifetime pain prevalence affecting playing capacity ^{19,20,22}. This group of studies can be considered homogenous and the meta-analysis indicates a prevalence of 85% (95% CI = 82%-87%) (Figure 4).

(please insert Figure 3 about here)

(please insert Figure 4 about here)

Pain prevalence by sex

Only six studies assessed whether pain prevalence varied according to sex. Of these, four found that women reported significantly more pain than men ^{13,14,19,29}, whereas two found no difference between men and women ^{23,25}.

Pain prevalence by musician group

Of the total 18 studies included in this systematic review, nine reported pain prevalence for a specific group of musicians ^{14-16,18,23-25,27,28}; and five presented pain prevalence for each of the musician group included in the total sample ^{13,19,20,22,26}. The remaining four studies were not included in this sub-analysis because they either did not report pain prevalence for a given musician group, or instead of reporting percentage they rather reported odds ratio instead ^{4,17,21,29}. The following section will describe the results obtained for each musician group.

(i) Brass instrumentalists

Pain prevalence for brass musicians varied between a minimum of 25% and a maximum of 86.2% across five studies^{15,19,20,22,26i}. However, most studies had a small number of brass musicians (between 8 to 58). Only the study of Chesky et al.¹⁵ used a larger sample (n=739); the results indicated a lifetime pain prevalence of 61.0%.

(ii) Bassoon instrumentalists

Only one study reported pain prevalence for bassoon players²⁷; from a total of 166 instrumentalists surveyed, a lifetime pain prevalence of 78% was found.

(iii) Guitarists

From the four studies reporting pain prevalence for guitar players, two used larger sample sizes (n=520 and n= 261, respectively). The results suggested 61.3% and 81.0% pain prevalence for one year and for lifetime pain prevalence, respectively^{16,28}. The other two studies concerned smaller sample sizes (n=63 and n=57, respectively); the results indicated a 30% and a 71% pain prevalence for one year and lifetime, respectively^{13,26}.

(iv) Keyboard instrumentalists and pianists

Two studies reported pain prevalence for keyboard players and four for piano players. The two studies on keyboard players reported a lifetime pain prevalence of 59.2% in a sample of 455 instrumentalists and a one year pain prevalence of 33.0% in a sample of 91 instrumentalists^{14,26}. The four studies concerning specifically piano players showed estimates, for a lifetime pain prevalence of 25.8% and 52.0%; for five years prevalence, 77.0%; and for a month prevalence, 38.4%^{13,23-25}.

(v) Percussion instrumentalists

Six studies reported pain prevalence for percussionists^{13,18-20,22,26}. However, 5 of these 6 studies presented a small sample size: between 3 and 22 percussionists. For these, reported prevalence estimates varied between 50.0% and 100.0%. The study of Sandell et al.¹⁸, involving a larger sample size (n=279), presented a lifetime pain prevalence of 77.4%.

(vi) String instrumentalists

Five studies reported pain prevalence for string players^{13,19,20,22,26}. Two studies had sample sizes of 6 and 47 participants, indicating a pain prevalence between 33.0% and

61.7%, respectively ^{20,26}. The other three studies with sample sizes between 157 and 237 reported pain prevalence between 68.8% and 76.8% ^{13,19,20,22,26}.

(vii) Woodwind instrumentalists

There were five studies reporting pain prevalence for woodwind players ^{13,19,20,22,26}. Four studies presented sample sizes between 23 and 67 participants, for which estimates of pain prevalence varied between 17% ²⁶ and 88.1% ²². The fifth study reported a lifetime prevalence of 58.0% in a sample of 212 woodwind players ¹³.

Pain prevalence by body region

Five studies provided data for pain prevalence by body region ^{16–18,22,23}. Data for pain prevalence for body region is presented for the following body regions: head/face, neck, upper/middle back, lower back, shoulder/arm, elbow/forearm, wrist, hand/fingers and lower limb. Across studies, lifetime pain prevalence varied between: (i) 0.0% and 31.5% - head/face; 9.8% and 48.5% - neck; 9.8% and 24.6 - upper/middle back; 9.8% and 66.7% - lower back; 7.3% and 41.8% - shoulder/arm; 6.9% and 36.6% - elbow/forearm; 8.3 and 38.6 – wrist; 6.9 and 48.7 - hand/fingers; and 10.3% and 25.0% - lower limb. Pain prevalence for each body region and for different time periods is presented in Table 3.

(please insert Table 3 about here)

Methodological quality

The overall methodological quality of all 18 studies included in this systematic review is listed in Table 4. Only eight (44.4%) studies scored 14 points or more (4,13,16,20–22,25,29). The remaining studies scored less mainly due to lack of sample representativeness; this was the case of eight studies scoring zero for this methodological parameter (14,15,17–19,26–28). [If only the eight studies that scored ≥ 14 points were considered in the analysis, estimates of pain point prevalence would be 50% for pain affecting playing capacity and 61.0% for pain in general ⁴; one week pain prevalence would be 74.3% ²⁹; One month pain prevalence would be 56.0% \(high school students\) ¹³ and 71.0% \(adults\) ²¹ while prevalence of pain affecting playing capacity would be 30.0% \(high school students¹³\) and 38.4% \(teenagers and young adults\) ²⁵; One year prevalence of pain affecting playing capacity would range between 41.0% and 73.0% and pain in general between 86.0% and 90.0% ^{21, 29}; Lifetime prevalence of pain affecting playing capacity would vary between 81.3% and 84.0 and prevalence of pain in general between 67.0 and 81.0% ^{16,20,22}.](#)

DISCUSSION

The goal of the present investigation was to inform on current rates of pain prevalence amongst different musicians groups, sex, and body region, according to time period of interest. An elevated number of published research-studies were systematically reviewed, by applying inclusion and exclusion criteria that could lead to works answering the initial research question. From the analysis of such investigations it became evident that it is difficult to establish a specific range of pain prevalence amongst musicians: [for example, lifetime pain prevalence in musicians can vary as much as 25.8% to 87.0%](#), when considering all study samples. A possible explanation for such wide range may be related to the fact that a great variability of methodological approaches was used, as well as different definitions of pain, different age groups and a rather weak sample representativeness. Thus, it was quite difficult to establish a pain prevalence rate that could distinguish between pain in general and pain affecting playing capacity. Nevertheless, a meta-analysis was possible to be carried out, considering only those studies presenting a similar musician's group sample and period of interest for pain prevalence assessment. The estimate of pain prevalence for one year (or less) suggested that about 75% of musicians suffer from pain, whereas only 54% (95% CI=39%-69%) have pain affecting playing capacity. The latter percentage is even higher when considering lifetime pain affecting playing capacity: about 85% (95% CI=82%-87%). This result is on the higher limit of a rate prevalence interval found in a previous systematic review, which included studies on pain related musculoskeletal disorders. The authors found a rate prevalence between 17% and 87%, when disregarding definition of pain and period of interest ⁶.

Generally speaking, one might say that a high estimate of pain and, in particular, of pain affecting playing capacity, was found. Pain is also a prevalent symptom in the general population ³⁰. The results of a large-scale survey including fifteen European countries and Israel, comprising a total of 46.394 respondents, found a prevalence rate of chronic pain of about 19%. Breivik et al. ³⁰ reported that 61% of respondents in their survey were less able (or even unable) to work outside home at the time of the survey. Although the definition of pain involved in this study was very different from the one used in the studies included in this systematic review, pain prevalence in the general population seems lower than pain prevalence in musicians. It is therefore urgent to [investigate when and under what circumstances the pain occurs in order to learn how to prevent and treat it. Simultaneously, there is also an urgent need to implement preventive strategies and assess their impact on the percentage of musicians affected and on the severity and implications of their complaints.](#) The implementation of useful

preventive strategies is of paramount importance within schools, conservatoires, universities and orchestras.

The type of instrument played may well impact on pain prevalence. Thus, it seemed relevant to separate pain prevalence according to musicians' groups. However, due to the high variability in the estimates of pain prevalence within each musician's group, robust conclusions could not be withdrawal. In particular, the small sample size and heterogeneity of these groups prevented a meta-analysis to be carried out. However, considering only those studies that included samples with ≥ 100 participants per musicians group and estimates for lifetime prevalence, guitar players seem to present the highest prevalence of all: 81.0%, estimated in a sample of five hundred and twenty participants.

Questioning whether sex may influence pain prevalence, the findings of this systematic review suggest that pain prevalence is higher for female musicians. This corroborates previous findings on the general population for specific painful conditions such as neck pain or low back pain, where prevalence estimates were also found to be greater for females³⁰⁻³².

Estimates of pain prevalence for specific body regions showed a wide variability. However, when considering lifetime pain prevalence in specific body regions, results suggest higher prevalence rates for low back (9.8% - 66.7%), neck (9.8% - 48.5%), fingers (6.9% - 48.7%) and shoulder (7.3% - 41.8%). With this respect, musicians seem not to be very different from the general population. For the latter, low back pain was also found to be the most prevalent painful condition, with estimates for lifetime prevalence ranging from 11% to 84%³³. A systematic review on neck pain prevalence reported lifetime prevalence to vary from 14.2% to 71%, with a mean of 48.5%³¹. Despite the fact that the very wide prevalence intervals and methodological differences difficult the comparison, these findings raise several questions that future work might attempt to answer: i) Does playing an instrument increase the risk of having pain only at specific body regions; ii) Which body regions are these? and also iii) Despite similar figures for pain prevalence in some body regions, do pain characteristics (e.g. intensity, duration, associated disability, prognostic) differ in musicians when compared to the general population?

The results of the present investigation should be interpreted with caution. On the one hand, the great heterogeneity of methodological approaches and the small sample

sizes used in the studies included in the systematic review may well have impacted on the accuracy of the results. For example, pain definition and pain prevalence period greatly varied amongst studies. In addition, age and years of instrument playing were not considered, as most of the studies included did not present pain prevalence distributed according to age or to years of playing experience. However, both factors are likely to influence pain prevalence. On the other hand, the analytical decisions of summarising the results, might also have had an impact on the prevalence rates found. For example, when pain prevalence was presented for the left and right sides of the body, only the highest value was included. This may have contributed to an underestimation of pain prevalence. Finally, another limitation concerned the fact that, for some studies, pain prevalence was retrieved from graphics, for musician group and/or for body region, a procedure prone to error.

In order to have more reliable estimates of pain prevalence in musicians, studies must clearly define pain and the period of interest over which pain prevalence is being assessed. Moreover, it will be important to use validated questionnaires if one wants to assess pain and its impacts, and use larger samples that may represent the whole targeted population. Additionally, presenting prevalence estimates by age range, years of experience, type of musician and instrument played, will give deeper insights on how these variables impact on pain prevalence amongst musicians.

Conclusion

Pain is highly prevalent in instrumentalist musicians, with lifetime prevalence of pain affecting playing capacity as high as 85%. This highlights the urgent need to study the factors that contribute to pain and to integrate in the musicians' curricula information on movement, posture and preventive strategies for the physical and mental demands of playing a music instrument. Additionally, these findings suggest that a closer work between musicians and health professionals is required.

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CONCLUSIONS

The prevalence of pain amongst musicians is high, when compared with the general population, for pain affecting playing capacity, with estimates up to 86%.

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FIGURE CAPTIONS

Figure 1. Flowchart summarising all steps taken during the article search and their results in terms of numbers of articles found and included in the systematic review.

Figure 2. Forest plot displaying rate of pain prevalence over a period of interest of one year (or less).

Figure 3. Forest plot displaying pain prevalence affecting playing capacity, over a period of interest of one year (or less).

Figure 4. Forest plot displaying lifetime pain prevalence, affecting playing capacity.
