



A questionnaire-based study on cranio-cervical-mandibular symptoms in clarinet students

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Abstract

Aim: Pain and overuse syndromes are common problems among musicians. The prevalence of musculoskeletal complaints in professional musicians ranges from 62% to 93%. Excessive muscle tension, rigidity, weakness, and stiffness in various anatomical regions such as the arm, neck, and lower back are common complaints. This study investigates the prevalence and severity of musculoskeletal symptoms, such as the amount and distribution of pain in the cranio-cervical-mandibular complex, the presence of bruxism and temporomandibular noises in conservatory clarinet students.

Methods: A 36-item questionnaire regarding the presence of musculoskeletal symptoms was sent to all clarinet students at Italian conservatories.

Results: From the analysis of the responses of 100 students, the occurrence of pain was not related to experience and was higher during non-musical activities (70%) than during performance (38%) ($P = 0.001$). Female players reported higher levels of pain using a 0–10 numeric rating scale: 4 during performance, 5 during non-musical activities, while males scored 3 in both conditions. A slight positive correlation emerged between pain and years of study ($P = 0.03$). The most painful regions were those of the posterior neck (29–45%) and the masseter muscle (28–31%). Temporomandibular noises were prevalent in female students (female 43%, male 22%, $P = 0.005$) and were often associated with bruxism ($P = 0.015$).

Conclusions: Clarinet students should be informed about the symptoms they may experience, but also about the prevention of these symptoms and the techniques to improve clarinet performance.

Keywords

Musculoskeletal symptoms, facial muscles, neck muscles, clarinet performance, clarinet students



Introduction

The cranio-cervical-mandibular complex (CCMC) is a functional system composed of various structures such as the muscles responsible for mandibular movement, the lingual muscles, the neck muscles, the facial muscles, the temporomandibular joint (TMJ), and the ligaments connecting it to the cervical region [1, 2]. These areas are often subject to the development of musculoskeletal symptoms (MSSs) such as muscle pain, sensation of excessive tension, bruxism, TMJ noises, and limitation and/or deviation of joint movements. Bruxism, TMJ noises, and reduced opening of the oral cavity are among the most common symptoms of temporomandibular disorder (TMD), which can cause pain in the jaw and masticatory muscles. Some researchers have noted that previous studies have shown that craniomandibular disorders, which include TMD, are associated with pain and symptoms outside the orofacial system, such as neck pain and cervical, pelvic, and lower back dysfunction [3–5].

The musculature of the CCMC is of fundamental importance to musicians playing a wind instrument, as it allows them to play and control all aspects of performance art. Indeed, professional musical performance depends on fine motor skills that require full control of the musculoskeletal system. Excessive overuse of these muscles can lead to musculoskeletal injuries and sound changes.

Pain and overuse syndromes are common problems among musicians. Research in performing arts medicine has shown that the incidence of musculoskeletal complaints in professional musicians is between 9% and 68%, with 12-month prevalence between 41% and 93%, and lifetime prevalence between 62% and 93% [6]. Some of these symptoms include excessive muscle tension, rigidity, weakness, and stiffness in various anatomical regions such as the arm, neck, and lower back. These types of symptoms can be more or less disabling for the professional career and may be associated with musculoskeletal disorders. Orofacial pain and pain in the teeth, jaw, and TMJ associated with playing are some of the symptoms of craniomandibular dysfunction [7]. Although pain and MSSs are common among wind instrument players [8], most studies focus on string musicians, while keyboard, percussion, and wind instrumentalists are underrepresented [6, 8–10].

The aim of this questionnaire-based study is to assess the prevalence of MSSs such as pain, TMJ noises, and bruxism in the CCMC in a sample of clarinet students from Italian music conservatories. In particular, we tried to define the most painful regions, whether the pain occurred during performance or during non-musical activities, and the role of practice duration, gender, and experience.

Materials and methods

This is a cross-sectional, questionnaire-based study using the Google Modules of G Suite for Education. The link to the questionnaire was emailed to the clarinet professors of the 73 Italian music conservatories, who then forwarded it to their students. The email also explained the purpose of the research, the importance of MSSs in CCMC, and their impact on sound production.

Inclusion criteria

The inclusion criteria for the participants were: to be clarinet students at a conservatory and to have no pre-existing relevant respiratory or musculoskeletal disorders.

The students examined belonged to both advanced (academic first and second level) and basic (propaedeutic) courses. For the years of study at the conservatory, we used a scale from 1 to 8 to describe more precisely the years of the basic courses (propaedeutic from the first to the third year) and the advanced courses: academic first level (3 years), corresponding to the bachelor's degree, and academic second level (2 years), corresponding to the master's degree. On the basis of these data, we divided the students into experts and non-experts, taking into account experts attending first or second level academics.

Questionnaire structure

The questionnaire ([Supplementary material](#)) was structured following reviews of the current scientific literature and interviews with some clarinet teachers and students.

For the review of articles, a query was made on the PubMed search engine using the following keywords: “questionnaire-musculoskeletal-symptoms-musician”. The search produced 88 results, of which only 2 were relevant to the topic and were used as a basis for the development of the questionnaire. The questionnaire we proposed used some of the questions from two questionnaires: “The Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians” [11] and the “Questionnaire on Musculoskeletal Pain in Musicians” [12]. The CCMC regions considered were: temporalis muscle, masseter muscle, buccinator muscle, orbicularis oris muscle, mental muscle, anterior neck, lateral neck, and posterior neck. Drawings of the muscles were included in the questionnaire to help the students understand their location. The questions were about the following symptoms: pain, TMJ noises, and bruxism. Most of the questions were multiple choice, and the questionnaire was kept short to allow completion within 10 minutes and to ensure optimal compliance.

The questionnaire consisted of 36 questions grouped as follows:

1. The first section of the questions related to general information, such as gender and age;
2. The second section concerned the study of the clarinet (e.g., years of study);
3. The third section concerned the presence of pain in the CCMC and its duration and intensity in non-musical activities, such as studying, listening to music, reading, eating, etc.;
4. The fourth section concerned the presence of pain in the CCMC and its duration and intensity during clarinet performance;
5. The fifth section concerned questions about TMJ noises and bruxism.

In the sections in which the presence of pain was assessed, the clarinetist was asked to indicate the anatomical site affected with the support of images. In addition, the participants had to rate the intensity of the pain on a numerical scale from 0 to 10, with 0 corresponding to the absence of the symptom and 10 to the highest possible level.

The questionnaire did not undergo a validation procedure; however, it was translated and culturally adapted through a multi-step process. Initially, a direct translation from the source language into Italian was carried out. In order to guarantee cultural relevance and clarity for the intended demographic, the translated version was subsequently reviewed and refined based on feedback obtained through interviews with both students and teachers. The objective of conducting these interviews was to identify potential linguistic ambiguities, culturally inappropriate expressions, or items that could be misunderstood in the Italian context.

Statistical analysis

This is a pilot study: Sample size estimation was not performed as there was no preliminary data available with which to calculate the effect size for the analysed measures. However, we estimated the number of Italian clarinet students at conservatories by considering that the majority of the 72 conservatoires in Italy have one clarinet class, with the largest having three or four classes of at least ten students. Therefore, we estimate that there are between 720 and 1,500 Italian conservatoire clarinet students in total. Consequently, our sample of 100 completed questionnaires is highly representative of the total population.

The results of the questionnaires were exported to a spreadsheet for subsequent analysis ([Tables S1](#) and [S2](#)). All data were reported as median and 1st–3rd interquartile range. Prevalence analyses were performed using the chi-square test with 2×2 contingency tables using Social Science Statistics software [13]. Comparisons of outcomes between groups were performed with the Mann-Whitney test and correlation analyses with the Spearman rank test using Statview version 5.0 (SAS Institute). The significance level was set at $P < 0.05$. All study procedures adhered to the principles of the Declaration of

Helsinki (2024). All participants provided their informed consent. The study was approved by the Ethics Committee of the University of Genoa (number 2024/74).

Results

Data collection took place between September and December 2024. A total of 103 questionnaires were completed, of which 3 were excluded because some questions were not completed correctly, so we examined the answers of 100 subjects. We report and discuss here only the most relevant items that received consistent and reliable responses.

The distribution of the population consisted of 56 female and 44 male musicians with a median age of 21 years (range 13–39 years, IQR 19–24). There were 65 expert musicians and 35 non-expert musicians.

Pain prevalence

The majority of students reporting pain in the CCMC, both during non-musical activities and during performance, were experts and females, although the incidence of pain was not significantly different between males and females (non-musical activities, chi-square test $P = 0.095$; during performance, chi-square test $P = 0.3$) or between experts and non-experts (non-musical activities, chi-square test $P = 0.8$; during performance, chi-square test $P = 0.6$) (Table 1). The overall prevalence of pain was higher during non-musical activities (70%) than during performance (38%) (chi-square test $P = 0.001$, Table 2).

Table 1. Pain prevalence during non-musical activities and performance according to gender and experience

Pain prevalence		Pain	No pain	<i>P</i> value
Pain during non-musical activities	Males	27	17	0.095
	Females	43	13	
Pain during clarinet performance	Males	14	30	0.3
	Females	24	32	
Pain during non-musical activities	Experts	46	19	0.8
	Non-experts	24	11	
Pain during clarinet performance	Experts	26	39	0.6
	Non-experts	12	23	

Table 2. Overall pain prevalence during non-musical activities and performance

Pain prevalence and activities	Pain present during performance	Pain absent during performance	<i>P</i> value
Pain present during non-musical activities	34	36	0.001
Pain absent during non-musical activities	4	26	

Pain intensity

Considering the numerical rating scale (NRS) pain scores, women reported higher levels of pain than men both during performance [women: 4 (2–6), men: 3 (1.75–5), Mann-Whitney test $P = 0.03$] and during non-musical activities [women: 5 (3–6.25), men: 3 (0–5), Mann-Whitney test $P = 0.006$]. Pain levels during non-musical activities were similar between experts and non-experts [experts: 4 (2–6), non-experts: 4 (2–5), Mann-Whitney test $P = 0.1$], but a slight positive correlation was found between pain and years of study (Spearman rank test $Rho = 0.23$, $P = 0.03$), which was not due to the effect of age, as no significant correlation was found between pain and age (Spearman rank test $Rho = 0.19$, $P = 0.08$).

Pain distribution

As regards the CCMC muscles affected by pain during both non-musical activities and performance, based on the body site where the pain was perceived, we observed that most complaints were referred to the masseter muscle and posterior neck region, with specific involvement of buccinator and orbicularis oris during the clarinet performance (Table 3).

Table 3. Muscles affected by pain during non-musical activities and performance

CCMC muscles	Number (%) of students (non-musical activities)	Number (%) of students (performance)
Temporalis	10	2
Masseter	28	31
Buccinator	5	19
Orbicularis oris	8	17
Mentalis	2	6
Anterior neck	6	5
Lateral neck	19	14
Posterior neck	45	29

CCMC: cranio-cervical-mandibular complex

Temporomandibular noises and bruxism

Temporomandibular noises were reported more frequently by female ($n = 43$) than male ($n = 22$) students (chi-square test $P = 0.005$), while bruxism was reported by 30 female and 18 male students (chi-square test $P = 0.2$) (Table 4). These two complaints were significantly associated (chi-square test $P = 0.015$, Table 5).

Table 4. Temporomandibular noises and bruxism prevalence according to gender

Temporomandibular noises and bruxism		Present	Absent	P value
Temporomandibular noises prevalence	Males	22	22	0.005
	Females	43	13	
Bruxism prevalence	Males	18	26	0.2
	Females	30	26	

Table 5. Association between temporomandibular noises and bruxism

Association between bruxism and temporomandibular noises	Noises	No-noises	P value
Bruxism	37	11	0.015
No-bruxism	28	24	

Discussion

The main findings of this questionnaire-based study are that clarinet students complain of CCMC pain mostly during non-musical activities and that female musicians are affected by higher severity of symptoms.

Most studies in the literature have investigated the presence of MSSs in heterogeneous groups of musicians, mainly professionals; few of these have considered wind instrument players and their symptoms in the CCMC. Since, to our knowledge, no questionnaire-based studies on symptoms in the CCMC in clarinet students have been published, we developed an ad hoc questionnaire for clarinet students studying at Italian conservatories.

Pain prevalence and intensity

No significant differences were found between experts and non-experts regarding the presence of pain in the CCMC during both non-musical activities and performance. This could suggest that regardless of the years of study at the conservatory, the student may potentially develop pain in the CCMC. However, this contrasts with data from a previous study which observed that the more years of study, the greater the risk of developing musculoskeletal disorders [14]. It should be emphasised that we obtained a borderline significance ($P = 0.08$) in the correlation between pain and age, which warrants further research on this topic.

In terms of NRS pain scores, women reported higher levels of pain than men during both performance and non-musical activities, a finding that may be explained by a higher perception of pain in women [15], but also by the fact that women are structurally smaller than men and may be prone to experiencing greater fatigue in the long term. It is known that catecholamines, and particularly norepinephrine, released by descending pathways modulate pain perception. As in other stressful situations, catecholamine levels increase during a musical performance, when attention is also engaged and diverted away from bodily discomfort [16]. It is possible that musicians experience more pain during non-musical activities because catecholamines are high during performance, and attention is focused on aspects of performance rather than on the possible presence of pain.

Pain distribution and temporomandibular symptoms

With regard to the high prevalence of pain during non-musical activities in the lateral and posterior neck regions, it is assumed that the student maintains non-physiological postures for long periods of time during the day due to the predominantly postural function of the muscles located in these regions. Regarding the presence of pain during performance in the lateral and posterior neck regions, it is thought that the maintenance of non-physiological postures during long study sessions may lead to this symptom in this area. In particular, posterior neck pain could be mainly related to the prolonged contraction of the upper part of the trapezius muscle, which is involved in supporting the weight of the arm and therefore the instrument.

Regarding the presence of masseter pain, it is hypothesised that those who complain of bruxism may activate the masseter muscles more frequently, resulting in pain or a feeling of excessive tension. Some previous studies have found a possible association between increased masseter muscle activity and bruxism [17], and it is possible that the students surveyed may or may not be experiencing stress related to competitiveness, exams, and expectations from teachers and family. Such situations can lead to the development of TMD symptoms, including bruxism, which is one of the responses to stress. Stress is defined as one of the factors in the development and exacerbation of temporomandibular symptoms, especially in young people in late adolescence and early adulthood [17]. The presence of masseter pain during performance could be due to the involvement of the masseter muscles in stabilising the mouthpiece [18]. This could mean, in line with the findings of Franz et al. [18], that clarinet students may be more prone to developing facial muscular symptoms. The regions corresponding to the buccinator and orbicularis oris muscles are some of the most painful during performance, as they are actively involved in blowing and emitting sound, and it is also thought that long periods of uninterrupted study may lead to difficulty controlling the mouthpiece, muscle fatigue and pain [19].

The results of the review by Santos Da Silva et al. [20] support the data obtained regarding the high frequency of temporomandibular symptoms in musicians. In fact, out of 100 participants, 48% reported suffering from bruxism and 65% reported the presence of TMJ noises, and it was observed that those suffering from bruxism also had TMJ noises.

A significant difference was found in the presence of TMJ noises between the male and female groups. This result showed that women had more TMJ noises than men, and this finding is supported by previous studies [21–23]. No significant differences were found in the presence of bruxism between males and females, in contrast to previous scientific evidence that found a higher frequency of bruxism in females compared to males [21–23].

Further research should raise awareness of the possibility of a musician experiencing MSSs, take into account other symptoms such as muscle weakness and stiffness, and understand the impact of these symptoms on performance. Differentiating the type of symptoms according to age and gender may help address rehabilitative treatments and investigate whether MSSs are associated with the presence of changes in the musician's posture, due to playing or caused by other factors.

Rehabilitative perspectives

In the speech-language therapy context, developing body awareness is essential before beginning any rehabilitative work. Helping wind musicians recognize and localize pain allows for more targeted and effective intervention. Through guided attention and relaxation exercises, the speech-language pathologist (SLP) can support the identification of muscle sensations (tension, pain, stiffness), promoting greater self-management and awareness. This approach enhances pain control, increases the effectiveness of techniques such as massage, and helps prevent the worsening of muscle tension.

SLPs should also provide guidance on protecting CCMC: avoiding smoking, alcohol, unhealthy environments, and stress, maintaining proper hydration and vocal hygiene, and prioritizing rest.

Myofascial massage, self-massage, and progressive muscle relaxation techniques help reduce pain and stimulate blood circulation. These can be complemented by gentle stretching and training in diaphragmatic breathing, which is key to minimizing compensatory muscle activation and improving sound quality.

Finally, Neuromuscular Taping, when applied by a qualified professional, may support lymphatic drainage, improve circulation, and reduce inflammation, contributing to the overall well-being and performance of wind musicians.

Study limitations

We acknowledge several limitations of this study: Firstly, it is a questionnaire-based study, completed by the students without supervision, and may contain errors due to misinterpretation of some questions. In addition, the pain assessment in the questionnaire was based on the NRS alone, without other specific rating scales. We assumed that all participating students played the Bb clarinet, but we cannot exclude the possibility that at least some of them use a different type of clarinet with a different shape and weight. The questionnaire, although partly derived from existing validated questionnaires, did not undergo ad hoc validation. Furthermore, we do not know how many clarinet students there are in Italian conservatories and therefore what the actual percentage of those who participated in the study is. It is also possible that those with CCMC pain were more likely to participate, leading to a selection bias and an overestimation of the prevalence of CCMC pain among clarinet students. Finally, we did not use specific rating scales for stress, anxiety, and depression; these aspects might be interesting to explore in further studies.

Conclusions

We believe that the results obtained highlight the need to inform clarinet students of the symptoms they may suffer and help them to recognise this type of symptom, but also to make them aware of ways of preventing them and techniques to improve the quality of life of clarinet performance. Health rehabilitation professionals, such as SLPs, should be directly involved to treat micro-trauma of the musculoskeletal system, improve breathing and all aspects of sound production. Finally, we believe that future research in this area should take into account the possible presence of stress, especially in young populations of musicians, by involving mental health professionals in this type of research.

Abbreviations

CCMC: cranio-cervical-mandibular complex

MSSs: musculoskeletal symptoms

NRS: numeric rating scale

SLP: speech-language pathologist

TMD: temporomandibular disorder

TMJ: temporomandibular joint

Supplementary materials

The supplementary material for this article is available at: https://www.explorationpub.com/uploads/Article/file/1004114_sup_1.pdf. The supplementary tables for this article are available at: https://www.explorationpub.com/uploads/Article/file/1004114_sup_2.xlsx.

Declarations

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Author contributions

LB: Conceptualization, Data curation, Investigation, Visualization, Writing—original draft. EG: Conceptualization, Methodology, Supervision. TC: Conceptualization, Supervision, Validation, Writing—review & editing. MB: Methodology, Supervision, Writing—review & editing. LV: Methodology, Validation, Writing—review & editing. CT: Supervision, Writing—review & editing. LM: Formal analysis, Visualization, Writing—original draft. All authors read and approved the submitted version.

Conflicts of interest

Lucio Marinelli, who is the Editorial Board Member of Exploration of Neuroprotective Therapy, had no involvement in the decision-making or the review process of this manuscript. The other authors declare no conflicts of interest.

Ethical approval

The study was approved by the Ethics Committee of the University of Genoa (number 2024/74).

Consent to participate

Informed consent to participate in the study was obtained from all participants.

Consent to publication

The data do not involve subject privacy, and therefore consent to publication is not required.

Availability of data and materials

The full dataset is available as Supplementary materials.

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