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Orofacial pain experience among symphony orchestra musicians in Finland is associated with reported stress, sleep bruxism, and disrupted sleep - independent of the instrument group

Running title: Orofacial pain in musicians

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Abstract

Background: To evaluate whether orofacial pain experience was related to the type of musical instrument, and to learn more about the roles of sleep and sleep-related issues in the pain among professional musicians.

Objectives: A standard questionnaire was sent to all Finnish symphony orchestras (n=19), with altogether 1005 professional musicians and other personnel.

Methods: The questionnaire covered descriptive data, instrument group, items on perceived quality of sleep, possible sleep bruxism, stress experience, and orofacial pain experience during the past 30 days.

Results: In the present study, which included the musicians only, the response rate was 58.7 % (n=488). All orchestras participated in the study, and there was no significant difference in the response rate between the orchestras. The mean age in men (52.3%) was 47.7 (SD 10.3) and in women (47.7%) 43.4 (SD 9.8) years ($p<0.001$). Overall, current pain in the orofacial area was found in 28.9%, frequent bruxism by 12.1%, and frequent stress by 20.8%. According to Somers' *d*, there were statistically significant but moderate correlations between overall pain reports in the orofacial area and disrupted sleep ($d=0.127$, $p=0.001$), sleep bruxism ($d=0.241$, $p<0.001$), and stress experiences ($d=0.193$, $p<0.001$). Logistic regression revealed, independent of the instrument group (string, wood wind, brass wind, percussion), that current orofacial pain experience was significantly associated with disrupted sleep ($p=0.001$), frequent sleep bruxism ($p<0.001$), and frequent stress ($p=0.002$) experiences.

Conclusions: Among symphony orchestra musicians, orofacial pain experience seems to be related to perceptions of stress, sleep bruxism, and disrupted sleep rather than the instrument group.

Key words:

Orofacial pain, musician, sleep disorder, stress, sleep bruxism

Introduction

Professional musicians playing in symphony orchestras may be at risk for various work-related factors detrimental to health: ambient noise, irregular working hours, tight schedules, and high discipline (i.e., low control, high demand), for example. These factors may cause excessive stress and/or sleep problems, and physical impairment. [1,2]

Not only the work environment but also the type of instrument may relate to problems, which may affect work performance and further increase stress experience and worries. Especially, wind and violin/viola players may be suspected to be more prone to orofacial pain problems than, say, percussionists; due to the playing techniques, wind players may overload their masticatory and facial muscles, and violin/viola playing may add strain in both masticatory and neck muscles. It should also be borne in mind that professional musicians most probably have started playing at an early age. However, studies on temporomandibular disorders (TMD) among musicians have remained ambiguous: some studies have reported no instrument related associations with subjective TMD, whilst studies that have included clinical examinations have shown some.[3]

Perceived stress and poor sleep go reportedly hand in hand.[4,5] Evidence exists that these perceptions are associated with self-reported bruxism[6]. In addition, self-reported bruxism has been associated with orofacial pain experience.[7] Considered as a gold standard, since the publication of Lavigne et al. two decades ago,[8] sleep bruxism has been diagnosed by means of polysomnography (PSG) including audio/video recordings in sleep laboratories, or by data gathered with ambulatory devices at home environment. Unfortunately, with respect to all the findings regarding masticatory muscle activity and concomitant physical events in the body, the PSG-based gold standard diagnostic cut-off point has shown poor clinical relevance regarding the relationship between bruxism and TMD.[9]

An international group of experts defined bruxism as a repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible.[10] Additionally, for operationalization of the definition, a diagnostic grading system of 'possible', 'probable' and 'definite' sleep or awake bruxism was suggested, the grade depending on the method how to assess bruxism. According to the consensus, however, self-reported bruxism can only provide an estimate of 'possible bruxism'. The consensus paper was updated in 2018 to distinguish sleep and awake bruxism: masticatory muscle activity during sleep (characterized as rhythmic or non-rhythmic) was not considered as a sleep disorder or a movement disorder in otherwise healthy individuals.[11] Similarly, masticatory muscle activity during wakefulness (characterized as repetitive or sustained tooth contact and/or by bracing or thrusting the mandible) is not a movement disorder.[11] In addition, the feasibility of self-reports to study bruxism behaviors in large scale studies was addressed.[11]

Up to date, the impact of playing an instrument on perceived orofacial pain has remained unclear. As a part of a large-scale sleep study among professional musicians in Finland, the aim of the present study was to evaluate whether the type of instrument was associated with orofacial pain experience among professional symphony orchestra musicians in Finland. Sleep-related issues, stress experience, and 'possible sleep bruxism' were controlled for.

Materials and methods

A standard questionnaire was sent to all Finnish symphony orchestras (n=19) with altogether 1005 musicians and other personnel. The objective was to collect data to understand sleep and sleep-related issues among professional musicians.

The questionnaire covered descriptive data, among others, items on perceived quality of sleep, sleep related problems and symptoms[12], stress experience[13], and orofacial pain[14].

For the present study, which comprised of musicians only, a special emphasis was on orofacial pain experience. The following items were used:

- Age and sex
- Instrument group (string, woodwind, brass, percussion)
- Orofacial pain: “During the past 30 days, how long did any pain last in your jaw or temple area on either side?” (no pain, pain is present occasionally, pain is continuous)
- Sleep bruxism: “Sleep bruxism is involuntary periodical tooth grinding or tooth clenching. Do you have such symptoms?” (never, only a little, occasionally, almost every night, every night)
- Stress experience: “Stress means the situation when a person feels tense, restless, nervous or anxious, or is unable to sleep because his/her mind is troubled. Do you feel that kind of stress these days?” (not at all, seldom, to some extent, rather much, very much)
- Difficulties in initiating sleep: “How long does it usually take before you fall asleep?” (less than 10 minutes, 10-30 minutes, over 30 minutes)
- Disrupted sleep: “How many times do you usually wake up during the night?” (0-1 times, 2-3 times, 4 times or more)
- Non-restorative sleep: “How often do you feel refreshed after awakening?” (never or once a week, 2-4 times a week, 5 or more times a week)
- Tiredness: “How often do you feel tired or non-energetic during daytime?” (never or once a week, 2-4 times a week, 5 or more times a week)

Statistical methods

For descriptive data, one-way ANOVA was used to compare the mean age within the instrument groups, and the Chi Square test to study the associations between the groups and categorical variables. In addition, Somers's *d* was run to assess the associations between orofacial pain experience and disrupted sleep, sleep bruxism, and stress. Logistic regression model was fitted to analyze the probability of current orofacial pain (any pain = 1, no pain = 0). The independent variables included in the model were categorized as follows: frequent sleep bruxism (almost every night or every night = 1, else = 0), frequent stress (rather much or very much = 1, else = 0), difficulties initiating sleep (30 minutes or more = 1, else =0), disrupted sleep (4 times or more = 1, else = 0), non-restorative sleep (never or once a week = 1, else =0), tiredness (5 or more times a week =1, else = 0), each instrument group against a dummy variable (group x = 1, all other groups = 0, etc.). Five respondents were excluded from the analyses due to the difficulty to categorize the specific instrument. Stepwise backward logistic models were tested to select variables for the final analyses, in which the method enter was used, i.e., all independent variables were entered in a single step in the model. Odds ratios and the corresponding 95 % confidence intervals were calculated. The model was adjusted by age and sex. IBM SPSS® statistical software (version 25.0; SPSS®, Inc., Chicago, IL, USA) was used for the analyses.

Results

The response rate was 58.7 % (n=488). There was no significant difference in the response rate between the orchestras. Of the respondents, 52.3 % were men. The mean age in men was 47.7 (SD 10.3) and in women 43.4 (SD 9.8) years ($p<0.001$), without significant difference between the studied instrument groups (viz., string, woodwind, brass, percussion).

Women were more often string instrumentalists (60.3%), whereas men were more often brass (81.4%) and percussion players (90.9%) ($p<0.001$). Overall, current pain in the orofacial area was reported by 28.9%, frequent bruxism by 12.1%, and frequent stress by 20.8%. Difficulties initiating sleep, disrupted sleep, non-restorative

sleep, and tiredness were reported by 13.6%, 6.0%, 21.7%, and 8.9%, respectively. Descriptive data on the study population according to the instrument group are shown in table 1.

According to Somers' *d*, there were statistically significant but moderate correlations between pain in the orofacial area (no pain, pain is present occasionally, pain is continuous) and disrupted sleep (*d*=0.127, p=0.001), sleep bruxism (*d*=0.241, p<0.001), and stress experiences (*d*=0,193, p<0.001). This indicates that increased severity of disrupted sleep, sleep bruxism, and stress are associated with the frequency of orofacial pain experience.

Logistic regression revealed, independent of the instrument group and adjusted by age and sex, that current orofacial pain experience was significantly associated with disrupted sleep (p=0.001), frequent sleep bruxism (p<0.001), and frequent stress (p=0.002). Odds ratios and their 95% confidence intervals are shown in table 2.

Discussion

The purpose of our study was to evaluate whether orofacial pain experience was related to the type of musical instrument, and to learn more about the roles of sleep and sleep-related issues in the pain among professional musicians. The main findings were that current orofacial pain experience was significantly associated with perceptions of disrupted sleep, frequent sleep bruxism and stress. This in line with an earlier study.[7] It's worth of notion, however, that the occurrence of disrupted sleep was markedly lower compared to previous findings in Finland and in other adult populations.[12, 15]

The overall response rate (58.7%) of the present study was considered fair. The sample size (n=488), enabled us to perform the multivariate analyses.

To assess current pain status, we measured orofacial pain experience within the past month using the validated three-point single question included in the Diagnostic Criteria for TMD Axis I TMD screening protocol (question 1).[14] Chronic pain was not evaluated. This may be considered as a weakness of the study, bearing in mind that professional musicians probably have played since childhood/adolescence, which

may have exposed them to excessive stress and even affected facial structures, for instance.[16] Unfortunately, as the present study is a part of a large-scale sleep study among professional musicians, it was not possible to set an in-depth focus on TMD.

It has been generally hypothesized that especially musicians playing a wind instrument could overload the masticatory system due to the muscle work in the masticatory and facial to control the playing. Also, string instrumentalist (violin and viola) use the same muscles together with neck/shoulder muscles to keep the instrument in position in relation to jaw and shoulder. However, a recent evidence-based review on TMD among musicians revealed that no clear-cut associations between TMD and wind instrument players exist.[3] Neither did the authors find reported differences between wind and other musicians. In the present study, none of the studied instrument groups was associated with current orofacial pain experience.

Stress was measured using a validated method,[13] which in fact includes the aspects of anxiety and disturbed sleep. This measure of self-report of perceived stress, as well as state anxiety by the Symptom Check List 90, [17] have also previously been reported to associate with the frequency of self-reported sleep bruxism in media workers with or without irregular shift work.[18] In the same data set, frequent sleep bruxism and disrupted sleep were found to be significantly associated with perceived current orofacial pain.[6]

Bruxism is jaw muscle activities of different etiology and clinical relevance, viz., tooth grinding, clenching and masticatory muscle activities without tooth contact. It has two circadian manifestations: it may occur during sleep or awake. Tooth grinding is rarely or never present in healthy individuals during wakefulness. Bruxism may be a sign of underlying disorders, can represent a risk factor for clinical consequences, or may be just a behavior without any pathological relevance. This construct of bruxism has been the basis of a recently published updated consensus paper [11] that revisited the definition and diagnostic grading proposed in 2013 by a bruxism expert panel.[10] During the past two decades it has become more or less evident that PSG-based diagnostic methods for sleep bruxism have poor relevance regarding its clinical consequences. Also, self-reports and PSG findings do not match when compared. In the present study, according to earlier findings in Finland, [7] self-reported sleep

bruxism (i.e. possible sleep bruxism) and current orofacial pain experience were significantly associated. However, the limitation of the present study may be considered that awake bruxism was not included.

Sleep is the very basis for optimal cognitive functioning, viz., data handling, learning, consolidation of memory, to name a few. Sleep is also the essential conductor of metabolism and recovery. [19] Unfortunately, sleep disorders have become increasingly prevalent affecting health, well-being, and working ability,[20] causing a burden in economic and societal levels. Reportedly, shift-workers and especially those working irregular shifts, have been demonstrated to have higher prevalence of sleep problems compared to those with regular day work. [21]

Although some sleep disorders are strongly related to a sedentary lifestyle, there also can be several underlying mechanisms for certain sleep disorders e.g. anatomic abnormalities, personality characteristics, or genetic factors. The master biological clock, which locates in the bilaterally paired suprachiasmatic nucleus in the anterior hypothalamus, controls the timing of sleep and wake in humans and regulates the circadian behavioral, physiologic, and biologic rhythms,[22] with inter-individual differences concerning the wake-sleep rhythm and the preferred timing to perform various activities. However, there are two extremes (in addition to the neutral type) in the so called chronotype profiles: morning type (individuals who wake up early and go to sleep early) and evening type (individuals who wake up late and go to sleep late). It is noteworthy that these profiles may be in imbalance with social activities and work duties. Thus, in addition to other stress factors regarding work performance and environment, irregular working hours may also endanger good sleep among professional musicians often working at late hours and on public holidays.

It may be concluded, that among symphony orchestra musicians the perceptions of disrupted sleep, stress, and sleep bruxism seem to play a more important role with reports of orofacial pain rather than the instrument group. To ensure optimal health and the high demand quality of work performance, the effects of workload, sleep quality, and the need for sleep counseling should be further studied.

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Table 1. Descriptive data on the study population according to the group of instrument.

N=483	Instrument group				
	String	Woodwind	Brass	Percussion	
n=	283	92	86	22	p-value
Mean (SD):					
Age	45.6 (10.2)	45.9 (10.4)	46.4 (9.9)	42.3 (11.3)	0.407
Percentages for:					
Sex					<0.001
male	39.7	54.8	81.4	90.9	
female	60.3	45.2	18.6	9.1	
Orofacial pain					0.580
no pain	71.8	67.7	77.9	72.7	
occasional	26.5	29.0	22.1	27.7	
continuous	1.7	3.2	0.0	0.0	
Sleep bruxism					0.561
never	42.7	35.5	40.7	52.4	
seldom	23.1	22.6	20.9	23.8	
occasionally	24.1	24.7	25.6	9.5	
almost every night	8.0	11.8	7.0	14.3	
every night	2.1	5.4	5.8	0.0	
Stress experience					0.934
not at all	6.7	4.3	7.0	4.5	
seldom	35.4	38.7	36.0	40.9	
to some extent	36.8	39.8	34.9	27.3	
rather much	15.1	11.8	11.6	18.2	
very much	6.0	5.4	10.5	9.1	
DIS (sleep latency, minutes)					0.618
less than 10	43.2	41.9	40.7	22.7	

ten to 30	43.5	44.1	47.7	54.5	
over 30	13.3	14.0	11.6	22.7	
DS (awakenings per night)					0.475
less than two	53.3	43.0	49.4	59.1	
two to three	40.1	50.5	45.9	40.9	
four times or more	6.6	6.5	4.7	0.0	
NRS (mornings per week)					0.922
less than two	22.3	23.7	17.4	22.7	
two to four	54.4	55.9	60.5	50.0	
five or more	23.3	20.4	22.1	27.3	
Tiredness (days per week)					0.043
less than two	38.2	41.9	47.6	28.6	
two to four	53.4	50.5	45.2	42.9	
five or more	8.5	7.5	7.1	28.6	

One-way ANOVA for the group means, Chi square test for the categorical variables.

DIS: difficulties initiating sleep, DS: disrupted sleep, NRS: non-restorative sleep.

Table 2. The probability of any pain in jaw, template, ear or in front of the ear on one side or the other during the past 30 days.

n=483	OR	95 % CI	p-value
Difficulties initiating sleep	0.9	0.5-1.8	0.908
Disrupted sleep	4.1	1.7-9.6	0.001
Non-restorative sleep	1.4	0.7-2.4	0.252
Frequent sleep bruxism	3.8	2.0-7.0	<0.001
Frequent stress	2.4	1.3-4.1	0.002
Instrument group:			
string	0.9	1.3-5.4	0.861
woodwind	1.1	0.2-6.9	0.958
brass	0.7	0.1-4.9	0.742
percussion	1.2	0.1-9.6	0.899

Logistic regression. Adjusted by age and sex.