

Pain in the spine and upper limbs among double bass players

Dolegliwości bólowe kręgosłupa i kończyn górnych u kontrabasistów

Jakub Szczechowicz^{1,2}, Marta Kania

¹ *Akademia Wychowania Fizycznego w Krakowie, Katedra Fizjoterapii
University of Physical Education, Department of Physiotherapy, Cracow, Poland*

² *Specjalistyczny Ośrodek Rehabilitacji Ręki w Krakowie
Specialist Hand Rehabilitation Center in Cracow, Poland*

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Summary

Paper objective: The objective of this paper was to analyze pain experienced by double bass players within the upper limb and spine region.

Materials and methods: Two groups of musicians with different professional experience in playing the instrument were compared and the anatomical structures undergoing the greatest loads were considered. A group of 50 musicians aged 17 to 31 years was included in the study. In order to obtain data on the frequency, location and nature of pain, a self-prepared questionnaire in electronic form was used. The survey was designed on the basis of available questionnaires used to study the diseases of instrumentalist musicians (Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms and Evaluation of Performing Artist). The respondents answered questions not only about pain, but also factors that can significantly affect their course. The analysis of lifestyle or level of awareness in the area of occupational hazards and prophylaxis was included in 30 open-ended and closed-ended questions.

Findings: The results indicate a high percentage of double bass players suffering from pain. Lumbosacral section, shoulder girdle, wrist and hand pain were the most common types of pain among the double bass respondents. The professional experience in playing the instrument had a negative impact on the severity of pain symptoms, which were often accompanied by other symptoms such as pain radiation, loss of concentration, or difficulties in making precise movements.

Conclusions: It can be concluded that the work of musician is associated with certain occupational risks and affects the health of musicians.

Keywords: health problems of musicians, spine, upper limbs

Introduction

Introductory information regarding the subject of the paper

The first scientist who noticed the overload and health problems of musicians was the Italian doctor Bernardino Ramazzini. In 1713 he published a review of diseases occurring, among others, in this professional group. However, the medical and scientific world became interested in the health of the musicians only in the 1980s. This was due to the growing number of publications, conferences and organizations focusing on the health of artists and performers on stage. Currently, both the level of knowledge

on this subject and the functioning of specialized health care units is still in the development and creation phase, similar to those we deal with in sports medicine [1].

Playing an instrument at a professional level requires high psychomotor skills. Regular, daily workouts, numerous rehearsals and concerts put a heavy load on the entire neuromuscular system. Musculoskeletal disorders are one of the main medical problems of musicians. In turn, appearing ailments significantly affect the artist's physical and mental state, as well as their social and financial status [1]. Kaufman-Cohen and Ratzon claim that most professional musicians will suffer from musculoskeletal disorders during their lives, and some of them will stop playing the instrument as a result of these diseases [2].

To achieve professional success in the music business, artists must work hard physically and mentally. The specificity of this

* Adres do korespondencji/Address for correspondence:
jakub.szczechowicz@awf.krakow.pl

profession is very similar to the working conditions of athletes. Abnormal body exploitation, competition and high levels of stress are common risk factors for both occupational groups [3]. Sports medicine has made significant progress in monitoring athletes, whose performances attract many fans, sponsors, and thus require their quick recovery. The hazards resulting from practicing specific disciplines as well as protocols of conduct in the early post-traumatic phase were identified. Despite many similarities (e.g. shoulder problems, we can see among swimmers, violinists and violists), the differences in the quality of services provided in the area of education and treatment of musicians and athletes are significant [3]. Musicians rarely contact specialized health professionals during their professional lives. During the practice process, they do not receive specialist knowledge of work ergonomics or prophylaxis principles that can minimize the potential risk of injury. Most of them do not participate in training or workshops on using the body as a work tool that could support their development and career [3]. There are no specialists who regularly monitor the health of musicians whose professional careers last longer than in the case of athletes.

According to the Trade Union of Polish Orchestra Musicians, as of today the subject of musicians' health and occupational diseases has been omitted by the Polish legislative bodies. Risk factors associated with the exercise of this profession have not been determined, and procedures and patterns of conduct have not been formulated, which in practice significantly impairs diagnostic and therapeutic work. Still artists' problems are referred to as *non-specific occupational prevalence*, which Mirosław Janiszewski wrote in 1992 in his book entitled *Ergonomia zawodu muzyka* (Ergonomics of the musician profession) [4]. The fact is that playing at the highest level requires very good psychophysical fitness from the artist. On the other hand, it is known that time and professional experience negatively affect the „performative apparatus” of the musician, reducing its artistic form. Moreover, the Union emphasizes that there are no mechanisms and specialized public medical centers that could delay this process. Usually, musicians who want to stay on the labor market for as long as possible must seek help on their own and cannot count on proper care from the National Health Fund (NFZ). The scale of the problem is very serious and requires attention from various state and social authorities [5].

The specificity of playing double bass and the loads on the movement system as the result thereof

The work of an instrumentalist musician requires movement activities with complex kinematics. The artist's musculoskeletal system is subjected to various loads resulting from both static and dynamic work of the musculoskeletal system. The musician's performative apparatus is a kind of variable biokinematic chain. Depending on the situation and need, the chain of the upper limb may consist of the hand and forearm, or extend to the part of the arm [6]. Professional activities of a musician

are characterized by a high frequency of biomechanical changes. Adopting the correct body posture, i.e. correct static work, largely determines how the musician will play. It is important that the position during playing the instrument is unforced and natural. Relaxation of the muscles of the neck, shoulder girdle and spine allows the double bass player to make precise movements with both the right and left upper limbs. What's more, the height of the double bass is important, which should be adjusted to the height of the musician's body. This minimizes neck muscle tension and reduces the risk of left upper limb ischemia. The specificity of playing double bass carries a high risk of loading the torso stabilizing system. Aggravating factors may include standing position, which is recommended from the beginning of learning to play this instrument, as well as the size and weight of the instrument itself. To hold the instrument and maintain a correct body posture, double bass players need a stable point of support. Two extreme approaches are best known among many double bass schools. The playing musician stands a little apart and extends his right leg forward, which causes the body's center of gravity to be moved forward and the entire body weight based on the left leg. The second, oppositional approach proposes extending the left leg forward with a small spread. Similarly, the left leg becomes a support leg and the body weight rests on it, the center of gravity of the body moves forward. The standing position generates gentle tilts of the torso forward, which is followed by increased work of the torso stabilizers and back muscle hypertonus. Numerous hours spent during rehearsals or concerts in this position increase the load in the cervical and lumbar spine. Research carried out by the Department of Movement Organ Correction and Occupational Rehabilitation of Musicians of the Music Academy in Łódź confirms that the double bass together with the piano, violin and viola is one of the instruments that cause very heavy loads in these regions [6,7]. The double bass belongs to a group of instruments which, by their construction, force the body to position itself asymmetrically, which affects the incidence of bad posture among double bass players [8,9], and thus overloading the entire performative apparatus [8].

It is extremely important to arrange and relax the left upper limb, which determines the technical efficiency, correct intonation and vibration of the extracted sounds. The forearm and shoulder should form a right angle with the neck of the instrument. This position is determined by the raised elbow joint and abduction of the shoulder joint. For double bass players, violists and flautists, the angle of abduction in the shoulder joint is the biggest. The strings on the neck are moved primarily by three fingers of the left hand: index, middle and small (the ring finger is used to support the small finger and only in some cases it becomes independent). To obtain a correct and clear tone, the musician must press the string with one finger, but at the same time support this movement with adjacent fingers. This playing technique can explain the results of research on static fatigue of flexor muscles and finger extensors. The data show

that the increase in fatigue rates for these muscles is greatest in the group of double bass players, violists and pianists. The very construction and tension of the strings put great resistance onto the muscles responsible for the movement of the fingers. Significant loads are also noted when the thumb is working, regardless of the schools that propose several solutions for its positioning [6, 7].

The quality of work of the upper limb is determined by the condition of the stabilization system, which is the shoulder. During playing the instrument, the positioning during abduction carries a heavy load and indicates the clear predominance of static muscle work. The interaction of antagonists as well as the involvement of many muscle groups negatively affects the condition of the muscles. It maintains the disproportion between oxygen demand and inhibited blood supply to muscles. Such a condition may lead to permanent functional dysfunctions of the performative apparatus and translate into the quality and effectiveness of playing the instrument [10]. In musical performance, the right shoulder complex performs dynamic work. The shoulder muscles are the generators of every bow stroke. The other elements of the right upper limb form a lever that transmits this force. The ability and possibility to maintain a relaxed arm and forearm, not stiffening the elbow and work with an active wrist are the conditions for conducting a technical playing of the instrument with the bow. It is true that the weight of the bow is greater than in the case of e.g. the violin, but the holding system and technically correct playing the instrument mean that the main loads are transferred to the latissimus dorsi, which belongs to a group of muscles that do not succumb to fatigue quickly [6, 7].

Playing the double bass carries some risk and can permanently affect the health of the musician. The research shows that the area most susceptible to overload and pain is the shoulder complex of the left upper limb and torso stabilizers [7].

The purpose of the study was to analyze the pain in the spine and upper limbs, which most often accompany instrumental musicians playing the double bass.

The following research questions were asked:

1. What are the most common types of pain among double bass players?
2. Does the professional experience in playing the instrument increase the occurrence of pain among double bass players?
3. Do double bass players know the principles of work ergonomics and adhere to them to prevent pain?

Materials and study method

The study involved 50 respondents aged 17 to 31, playing the double bass, who are students of the State Secondary Music Schools of the Second Level and professionally active musicians. Over 2/3 of respondents were men (average age 23 years). The respondents were divided into two groups depending on the experience in playing the instrument. Most of the respondents practiced over 3–4 days a week, and playing the instrument took them on average 2–4 hours a day (Table 1).

In order to obtain data on back and upper limb pain among double bass players, depending on the experience in playing the instrument, a self-prepared questionnaire was used. The study was designed and conducted in electronic form using the Google Form. The survey was developed on the basis of analysis questionnaires of pain occurring among musicians and previously used by other researchers. The authors modified two questionnaires (Standardized Nordic Questionnaires for the Analysis of Musculoskeletal Symptoms and Evaluation of Performing Artist) and adapted it to the needs of the study [11,12]. The survey consisted of 30 questions, both closed-end and open-end. It contained a record specifying the respondents in terms of sex, age, experience of playing the instrument and the level of education, or employment status. Questions regarding the frequency, nature and type of pain are presented in the tables. They referred to particular regions of the body, which according to scientific literature are most often loaded in the group of double bass players, i.e. the cervical spine, thoracic spine, lumbar spine, shoulder girdle/arm, elbow/forearm and wrist/hand. The next questions concerned the lifestyle, interests and level of awareness about the occupational risk of musicians.

Statistical analysis was performed using IBM SPSS 22 program, the English language version, for the Windows platform. Compatibility of distributions of variable results was performed using the Shaphiro Wilk test ($n < 100$). Descriptive statistics were carried out, percentages of response data and the number of respondents were calculated for qualitative variables. For quantitative variables – percentage distributions, depending on the distribution; means or medians; standard deviations and interquartile range. Checking the correlation between variables was calculated using Pearson's linear correlation, statistical hypotheses using the Wilcoxon rank-sum test. For qualitative variables, testing was done using the Chi² (X^2) test, compliance of expected and given answers. The alpha level was set at 0.05.

Table 1.
Characteristics of the group under study

| Variable | N=50 |
|---|-------------------|
| Gender [F/M%] | 30/70 |
| Age [years] | 23 (± 4.08) |
| Professional status [%] | |
| Pupil | 18 |
| Student | 52 |
| Working musician | 30 |
| Researcher | - |
| Number of years of playing the double bass [%] | |
| 4-9 | 46 |
| 10-15 | 54 |
| How many days a week do you play instrument (i.e. practice, rehearsals, performances, recordings)? [%] | 6.7 |
| Every day | 2 |
| 1-2 days | 14 |
| 3-4 days | 46 |
| 5-6 days | 38 |
| How many hours a day on average do you play double bass? [hours] [%] | |
| <2 | 12 |
| 2-4 | 60 |
| 5-7 | 28 |
| >7 | - |

Results

Pain that prevented normal levels of playing the instrument during the last 12 months was experienced in the cervical section (58%) most often on both sides of the spine, in the thoracic section (30%) most often on both sides of the spine, in the lumbosacral section (70%) most often on both sides of the spine, in the shoulder girdle/arm (30%) most often on both sides, in the elbow/forearm (38%) most often on the left side and in the wrist/hand (64%) most often in both limbs (Tab. 2)

On average, during the year about 29% of the respondents did not participate in any competition, exam or other musical event due to pain in the spine or upper limb. The most common region that was affected by pain and disturbed participation in a musical event was the shoulder girdle and arm (Table 3).

On average, during the year about 33% of the respondents were unable to complete their regular classes. The most common area of pain that disturbed the performance of daily activities was the lumbosacral section, preventing these activities among more than half of the respondents (Table 4).

On average, during the last week about 30% of the respondents were unable to play at their normal level due to the severity of pain. The area that most often disturbed normal musical activity was the shoulder girdle (Table 5).

The respondents most often pointed to pain occurring outside the time spent on playing (1/3 of respondents). In second place was the time devoted to practice and rehearsals (Table 6).

The most common symptoms accompanying the pain were its radiation (96%), difficulty in making precise movements (92%), loss of concentration and weakening of muscle strength (80%) (Table 7).

As many as 64% of respondents were not diagnosed with any condition belonging to the most popular ones among musicians. The most common diagnosis turned out to be pains in the cervical section, as well as inflammation of the tendons (Table 8).

About 2/3 of respondents declared that regarding their pain, no treatment was implemented, 8% underwent surgery, and 20% participated in physiotherapeutic procedures (Table 9).

Subjectively, about 2/3 of respondents assessed their health as good. Only 2% of respondents considered their health condition to be poor, 12% said they felt very well (Table 10).

Almost half of the respondents (42%) performed a warm-up before playing the instrument. Most often, the respondents declared a warm-up of the upper limb joints (59%), followed by stretching (36%), and the least often a general warm-up (23%). The frequency of warming up was variable. Most often, respondents replied that they almost always carried out such exercises (50%). Only 9% conscientiously did a warm-up before

Table 2.

The level of pain in individual regions of the body

| Variable | N=50 |
|--|------|
| Do you have any pain? [%] | |
| Yes | 86 |
| No | 14 |
| Have you experienced any pain/discomfort that has prevented you from playing at a normal level over the past 12 months? Yes [%] | |
| Cervical section | |
| No | 40 |
| Yes on both sides | 26 |
| Yes on the left | 8 |
| Yes on the right | 8 |
| N/A | 14 |
| Thoracic section | |
| No | 70 |
| Yes on both sides | 8 |
| Yes on the left | 4 |
| Yes on the right | 4 |
| N/A | 14 |
| Lumbosacral section | |
| No | 28 |
| Yes on both sides | 46 |
| Yes on the left | 2 |
| Yes on the right | 6 |
| N/A | 14 |
| Shoulder girdle/arm | |
| No | 36 |
| Yes on both sides | 20 |
| Yes on the left | 20 |
| Yes on the right | 10 |
| N/A | 14 |
| Elbow/forearm | |
| No | 62 |
| Yes on both sides | 8 |
| Yes on the left | 16 |
| Yes on the right | - |
| N/A | 14 |
| Wrist/hand | |
| No | 36 |
| Yes on both sides | 14 |
| Yes on the left | 26 |
| Yes on the right | 8 |
| N/A | 14 |

Table 3.

Limited participation in musician's professional life vs. pain among double bass players

| Variable | N=50 |
|---|------|
| Has there been a situation in the last 12 months in which due to ailments you did not take part in the competition, exam or other musical event? Yes [%] | |
| Cervical section | |
| No | 82 |
| Yes on both sides | 4 |
| Yes on the left | - |
| Yes on the right | - |
| N/A | 14 |
| Thoracic section | |
| No | 74 |
| Yes on both sides | 2 |
| Yes on the left | - |
| Yes on the right | - |
| N/A | 14 |
| Lumbosacral section | |
| No | 80 |
| Yes on both sides | 6 |
| Yes on the left | - |
| Yes on the right | - |
| N/A | 14 |
| Shoulder girdle/arm | |
| No | 60 |
| Yes on both sides | 2 |
| Yes on the left | 8 |
| Yes on the right | 6 |
| N/A | 14 |
| Elbow/forearm | |
| No | 66 |
| Yes on both sides | 6 |
| Yes on the left | 4 |
| Yes on the right | - |
| N/A | 14 |
| Wrist/hand | |
| No | 76 |
| Yes on both sides | 6 |
| Yes on the left | 4 |
| Yes on the right | - |
| N/A | 14 |

Table 4.

Limited performance of activities vs. pain

| Variable | N=50 |
|---|------|
| Has there been a situation in the last 12 months in which due to these ailments you have not been able to perform your regular activities? Yes [%] | |
| Cervical section | |
| No | 74 |
| Yes on both sides | 8 |
| Yes on the left | 4 |
| Yes on the right | - |
| N/A | 14 |
| Thoracic section | |
| No | 80 |
| Yes on both sides | 2 |
| Yes on the left | - |
| Yes on the right | 4 |
| N/A | 14 |
| Lumbosacral section | |
| No | 47 |
| Yes on both sides | 24 |
| Yes on the left | 2 |
| Yes on the right | 6 |
| N/A | 14 |
| Shoulder girdle/arm | |
| No | 58 |
| Yes on both sides | 8 |
| Yes on the left | 10 |
| Yes on the right | 10 |
| N/A | 14 |
| Elbow/forearm | |
| No | 78 |
| Yes on both sides | 2 |
| Yes on the left | 6 |
| Yes on the right | - |
| N/A | 14 |
| Wrist/hand | |
| No | 64 |
| Yes on both sides | 8 |
| Yes on the left | 14 |
| Yes on the right | - |
| N/A | 14 |

Table 5.

The level of pain in individual regions of the body

| Variable | N=50 |
|--|------|
| Have you experienced any pain/discomfort that has prevented you from playing at your normal level over the past week? Yes [%] | |
| Cervical section | |
| No | 74 |
| Yes on both sides | 8 |
| Yes on the left | 4 |
| Yes on the right | - |
| N/A | 14 |
| Thoracic section | |
| No | 84 |
| Yes on both sides | 2 |
| Yes on the left | - |
| Yes on the right | - |
| N/A | 14 |
| Lumbosacral section | |
| No | 62 |
| Yes on both sides | 22 |
| Yes on the left | - |
| Yes on the right | - |
| N/A | 14 |
| Shoulder girdle/arm | |
| No | 64 |
| Yes on both sides | 22 |
| Yes on the left | - |
| Yes on the right | - |
| N/A | 14 |
| Elbow/forearm | |
| No | 70 |
| Yes on both sides | 8 |
| Yes on the left | 2 |
| Yes on the right | 6 |
| N/A | 14 |
| Wrist/hand | |
| No | 66 |
| Yes on both sides | 20 |
| Yes on the left | 2 |
| Yes on the right | - |
| N/A | 16 |

Table 6.

The intensity of pain depending on the conditions of playing the instrument

| Variable | N=50 |
|--|------|
| In what moments do you think the pain occurs and/or intensifies most often? Yes [%] | |
| Practice | 20 |
| Rehearsals | 22 |
| Concerts | 12 |
| out of playing time | 32 |
| N/A | 14 |

each professional activity, 14% of the respondents said that they rarely did a warm-up. Over 46% of people spent 20–30 minutes on this activity.

Half of the respondents were doing a warm-up for no more than 10 minutes. Almost all respondents took breaks during instrument practice (98%). Most of the respondents spent between 5 and 30 minutes (88%) on breaks during practice.

Relaxation techniques after physical effort related to playing the instrument were used by 2/3 of respondents. The most common ways of relaxation were sleep and stimulants (22% each) as well as hobby 27%. Electronic entertainment and physical activity were quite popular forms of relaxation (15–18% of respondents). Meditation/yoga and hanging out with friends were the least frequently chosen form of relaxation by the respondents (12%).

Less than 1/5 of respondents, during their education, had classes related to the ergonomics of playing the instrument. Approximately 40% of the respondents participated in optional workshops on ergonomics and occupational hygiene. During their musical activity, around 2/3 of the respondents drew attention to the principles of ergonomics. 26% did not know if they applied the principles of ergonomics of playing the instrument, and 8% admitted that they did not pay attention to them.

The most common non-professional sport activity undertaken by the respondents was running (40%), 24% of the musicians attended the gym or fitness classes. About 20% chose stretching, swimming or cycling. 14% of respondents did not perform any non-musical physical activities. (Table 11).

Significantly more respondents (15%) from the group with 10–15 years of experience in playing the instrument reported pain, compared to the persons with 4–9 years of experience (Table 12).

Significantly higher intensity of accompanying symptoms in the form of pain radiation was experienced by the respondents with 10–15 years of experience in playing the instrument. Loss of concentration was higher in the group of respondents with the experience of 4–9 years (Table 13).

Table 7.

Intensity of symptoms accompanying the pain

| Variable | N=50 |
|---|------|
| Which of the following symptoms most often accompany the pain? Please rate each of them on a scale of 0-5, where 0 means no symptoms, and 5 the most severe ones Yes [%] | |
| Numbness | |
| 0 | 54 |
| 1 | 18 |
| 2 | 18 |
| 3 | 10 |
| 4 | 10 |
| 5 | 2 |
| N/A | 14 |
| Pain radiation | |
| 0 | 4 |
| 1 | 10 |
| 2 | 10 |
| 3 | 24 |
| 4 | 30 |
| 5 | 20 |
| N/A | 14 |
| Muscle weakening | |
| 0 | 20 |
| 1 | 14 |
| 2 | - |
| 3 | - |
| 4 | 14 |
| 5 | - |
| N/A | 14 |
| Restriction of joint mobility | |
| 0 | 42 |
| 1 | 16 |
| 2 | 12 |
| 3 | 8 |
| 4 | 6 |
| 5 | 2 |
| N/A | 14 |
| Loss of concentration | |
| 0 | 18 |
| 1 | 8 |
| 2 | 14 |
| 3 | 20 |
| 4 | 8 |
| 5 | 18 |
| N/A | 14 |
| Difficulty in making precise movements | |
| 0 | 8 |
| 1 | 20 |
| 2 | 4 |
| 3 | 18 |
| 4 | 22 |
| 5 | 8 |
| N/A | 14 |

Table 8.

Most often diagnosed ailments

| Have any of the following conditions been diagnosed with you? Yes [%] | |
|--|----|
| muscle pain with pressure soreness | 6 |
| tendinitis | 10 |
| fibromyalgia | - |
| carpal tunnel syndrome | 4 |
| cubital tunnel syndrome | - |
| thoracic outlet syndrome | - |
| ailments from the cervical section | 14 |
| none of the above | 64 |

Table 9.

Treatment undertaken

| Variable | N=50 |
|---|-------------|
| Has treatment been undertaken? Yes [%] | |
| rehabilitation | 20 |
| surgery | 8 |
| chiropractor | 6 |
| no treatment has been undertaken | 66 |

Table 10.

Subjective assessment of one's own health

| Variable | N=50 |
|---|-------------|
| How do you assess your health? Yes [%] | |
| Very good | 12 |
| Good | 64 |
| Average | 22 |
| Poor | 2 |
| Bad | - |

Table 11.

Prophylaxis of pain

| Variable | N=50 |
|--|-------------|
| Do you do any sport activities to keep your body in good shape and prevent possible pain? Yes [%] | |
| Stretching | 20 |
| Running | 40 |
| Swimming | 22 |
| Gym/fitness | 24 |
| Cycling | 22 |
| Team sports | 12 |
| Horse riding | 6 |
| I don't exercise | 14 |

Table 12.

Intensity of pain symptoms vs. professional experience in playing the instrument

| Variable (experience in playing the instrument [years]) | 4-9 | 10-15 | p |
|--|------------|--------------|--------------|
| | N=23 | N=27 | |
| Occurrence of pain | | | |
| Yes | 78.3 | 92.6 | 0.021 |

The number of working musicians reporting good health was significantly lower compared to the group of pupils and students. Significantly more respondents from the group of working musicians manifested moderate health compared to those from groups of pupils and students (Table 14).

Significantly more respondents reported pain from the group who did not know or were not familiar whether they applied the principles of ergonomics (Table 15).

The respondents who did not apply or did not know whether they applied the principles of ergonomics, showed a higher intensity of pain-related symptoms, such as loss of concentration

Table 13.

Intensity of symptoms accompanying the pain vs. professional experience in playing the instrument

| Variable (experience in playing the instrument [years]) | 4-9 | 10-15 | p |
|---|------------|--------------|--------------|
| | N=23 | N=27 | |
| Which of the following symptoms most often accompany the pain? Please rate each of them on a scale of 0-5, where 0 means no symptoms, and 5 the most severe ones Yes [%] | | | |
| Numbness | | | |
| Mean | 2.3 (2.1) | 2.3 (1.9) | 0.87 |
| Pain radiation | | | |
| Mean | 2.9 (1.3) | 3.38 (1.4) | 0.04 |
| Muscle weakening | | | |
| Mean | 2.86 (1.1) | 2.58 (1.2) | 0.067 |
| Restriction of joint mobility | | | |
| Mean | 2.25 (1.5) | 2.2 (1.1) | 0.52 |
| Loss of concentration | | | |
| Mean | 3.4 (1.6) | 3.05 (1.3) | 0.046 |
| Difficulty in making precise movements | | | |
| Mean | 2.76 (1.4) | 2.95 (0.76) | 0.09 |

Table 14.

Work status vs. health status

| Variable | Pupil N=9 | Student N=26 | Working Musician N=15 | p |
|------------------------------|--------------|-----------------|-----------------------------|-------------|
| Health status Yes [%] | - | - | - | - |
| Very good | 11 | 11.5 | 6.5 | - |
| OK | 66 | 81 | 46.6 | 0.02 |
| Average | 33 | 11.5 | 40 | 0.01 |
| Poor | - | 3.8 | - | - |
| Bad | - | - | - | = |

Table 15.

Knowledge of ergonomics vs. occurrence of pain

| Variable | Yes N=34 | No* N=16 | p |
|---------------------------|-------------|-------------|------|
| Occurrence of pain | | | |
| Yes | 82.4 | 93.8 | 0.04 |

* „no” and „I don’t know” answers were taken together to increase data reliability

and difficulty in making precise movements, compared to the respondents who knew the principles of ergonomics (Table 16).

Musicians diagnosed with one of the popular occupational diseases suffered from pain (Table 17).

Discussion

Compared to athletes, the career of an instrumentalist musician lasts much longer. For example, a pianist Arthur Rubinstein made his debut at the age of three, and ended his solo career at the age of 90. Violinists such as Arthur Grumiaux and Yehudi Menuhin played their first public concert at the age of five [13]. It is worth paying attention to physical effort and the number of hours that instrumentalists spend on practicing. According to research by Jourbel (after Lledó) [13], string musicians devote a minimum of 20 hours a week to practice and give about 28 concerts a year. The own study has shown that about 1/3 of the respondents spend over 5 hours a day playing the instrument, on average 3–4 days a week. In total, this results in about 15–20 hours of practice per week. 38% of respondents reported that they play 5–6 days a week.

The results of the systematic review showed that as many as 85% of musicians have experienced pain in their lives [14]. Moreover, other studies have confirmed that the musicians are not aware of the fact that fatigue and chronic pain can lead to impairment of psychomotor coordination and thus permanently

Table 16.

Knowledge of ergonomic principles vs. the intensity of symptoms accompanying the pain

| Variable | Yes N=23 | No* N=27 | p |
|---|-------------|-------------|--------------|
| Which of the following symptoms most often accompany the pain? Please rate each of them on a scale of 0-5, where 0 means no symptoms, and 5 the most severe ones | | | |
| Numbness | | | |
| Mean | 2.25 (1.1) | 2.44 (2.1) | 0.64 |
| Pain radiation | | | |
| Mean | 3.34 (1.8) | 3.07 (1.6) | 0.052 |
| Muscle weakening | | | |
| Mean | 2.8 (0.6) | 2.58 (1.9) | 0.09 |
| Restriction of joint mobility | | | |
| Mean | 2.26 (1.4) | 2.14 (1.5) | 0.66 |
| Loss of concentration | | | |
| Mean | 3.13 (1.1) | 3.33 (1.8) | 0.047 |
| Difficulty in making precise movements | | | |
| Mean | 2.76 (1.9) | 3.07 (1.4) | 0.037 |

* „no” and „I don’t know” answers were taken together to increase data reliability

Table 17.

Comorbidities vs. occurrence of pain

| Medical condition | Pain is occurring | Pain is not occurring | p |
|------------------------------------|-------------------|-----------------------|---|
| muscle pain with pressure soreness | 100 | | |
| tendinitis | 100 | | - |
| fibromyalgia | 100 | | - |
| carpal tunnel syndrome | 100 | | - |
| cubital tunnel syndrome | - | | - |
| thoracic outlet syndrome | - | | - |
| ailments from the cervical spine | 100 | | - |

affect their careers [15]. Unfortunately, most musicians, especially young ones, consider pain as an integral part of their work, showing high tolerance for pain [16]. Some of them subconsciously believe that only when they feel pain, they get involved enough to achieve professional success [15]. In contrast to neuromuscular and musculoskeletal disorders, chronic pain has not

been given due consideration by music medicine. Occupational diseases with chronic pain being the most significant are a serious problem and can lead to career breaks. The study conducted on a group of German musicians employed in orchestras, radios, theaters and television aimed at determining the main causes of chronic pain, as well as the degree of disability caused by pain in the professional group concerned. 66% of 740 respondents confirmed the occurrence of pain and 63% described it as chronic [17].

Another systematic review of studies presents a summary of all publications up to 2011 looking for relationships between pain and the anatomical region of pain occurrence. Kok et al. (after Leaver) [18] confirm that for string musicians, the body regions most at risk of pain are the cervical (56%), lumbar (51%), shoulder (51%), as well as wrist and hand (33% of respondents). The Kaufman-Cohen and Micheo publication (also cited by Leaver) presents similar results – 39% of the respondents struggle with the problem in the cervical section, 49% in the lumbar spine, and as much as 55% report pains within the shoulder complex [18]. The results of the own study showed that in the group under study the most common types of pain were lumbosacral (70%), shoulder girdle (64%) as well as wrist and hand (64%). Interestingly, in the last 12 months only 29% of respondents did not participate in musical events due to pain. Such a low indicator in relation to the scale of the problem can be explained by high pain tolerance, environmental pressure and psychological factors that do not allow musicians to give up concert tours or performances. In addition to pain, the musicians complained about other symptoms that accompany them during rehearsals, concerts, and also outside of playing time. Respondents most often mentioned radiation and difficulty to make precise movements, which significantly affected the quality of musical interpretation. The third symptom was the loss of concentration, which makes the musician's work even harder. Loss of muscle strength, limitation of mobility in the joint and numbness are equally common symptoms that the respondents complained about, but indicated as slightly less onerous.

The authors of some publications find differences in the occurrence of pain in specific areas of the body depending on the type of instrument which the musician works with. String instruments, due to their structure and specificity, require the artist to position his/her arms, elbow and wrists high. Such working conditions are the cause of pains in these joints [18]. Studies assessing the frequency of pain occurrence among professional orchestral musicians depending on the category of instrument found that 89% of respondents experienced pain associated with playing the instrument. It was noted that pain distribution and frequency fluctuated between individual instrument groups. Cervical pain was the most severe for all instruments. Over 43% of respondents stated that pain occurred in as many as 5 areas [19]. Most studies compare instruments by dividing them into groups such as string, wind, keyboard and other instruments.

The group of string instruments to which the double bass belongs is very heterogeneous. The standing body position during the playing of double bass players is completely different than the body position of the violinists or the sitting position of violists. The distribution of forces is different due to the repertoire of movements, which is usually much slower, heavier and more often repeated. This condition affects the inaccuracy of results and it is difficult to make a distinction between subgroups of string instruments, and thus extract specific data about double bass musicians [1].

Some publications have found that women are more prone to musculoskeletal disorders and pain than men. Moreover, this is in line with the literature on musculoskeletal problems among the general population: female sex is a known risk factor for the development of diseases of this system [1]. Double bass is one of the instruments most often chosen by men. In the group under study, women constituted only 30%. This smaller representation of women in the group under study made it impossible to confirm or deny this hypothesis.

Technically and intonationally correct playing the instrument is possible only thanks to a combination of biomechanical, psychological and physiological factors, such as the ability to precisely control the instrument. Problems with the technique of playing the instrument may result from the lack of awareness of what effort the organ of movement of musicians is subjected to. Such state of affairs reduces the quality of musical interpretation, and also becomes a risk factor for musculoskeletal disorders. If someone does not get the attention of the interested parties in time, it may cause organic and irreversible disorders. And here comes the problem of negligence on the part of cultural and educational institutions or public administration bodies. Studies show that musicians, and in particular instrumentalists, have significant deficiencies at the education stage in receiving information on serious physical injuries caused by errors [13]. Bodnar came to similar conclusions in her studies [20], who pointed out that pain usually affects the group of string instrumentalists. However, the severity of symptoms is directly proportional to the professional experience in playing the instrument and depends on the individual technique. Statistical analysis of the own study showed a reduced number of respondents who subjectively experienced pain in the group of persons with 4–9 years of experience, compared to those with 10–15 years of experience. Such results confirm the thesis put forward not only by Bodnar, but also by Lledó et al. [13], who classify the age and experience in playing the instrument as one of the main causes of occupational ailments among musicians. It is important to carry out preventive actions in the first years of education, build awareness of music school students and be sensitive to quick reaction and problem solving in the early stages [20]. The fact is that the prophylaxis is the most effective method of combating occupational overload. Numerous studies have proved that therapy of musicians' diseases is long-term, often

ineffective, but above all very burdensome for the artists themselves [21]. To avoid musculoskeletal overloads, you must first find and recognize unhealthy, harmful behavior and attitudes in the music environment. It is necessary to change the perception of pain, which is not an indispensable companion of playing the instrument, but the first warning sign. A few basic rules should be followed during work to protect the musculoskeletal system against excessive overload due to bad posture. The head, chest and pelvis should always be positioned in the longitudinal axis of the body, because it allows for natural spinal positioning, called the neutral position. Static load in a position deviating from the neutral position is always much higher and leads to non-ergonomic work of muscular and joint structures. Consequently, we can notice changes in joint surfaces, an increase in muscle tone and pain [22].

A rest break during work is important in any profession associated with long repetitive activities. It helps to protect the musculoskeletal system against diseases resulting from cumulative loads. Musician's work belongs to such a group of professions. Medical guidelines suggest a minimum of 5 minutes break every hour to prevent physical stress and give the body time to replenish energy resources. Regular breaks allow musicians to reduce the constant tension of soft structures and the load on joints needed to maintain correct posture and technical movement. It is important for musicians to be aware that when they are able to influence the organization of their independent practice, they must remember about breaks. Unfortunately, it is often impossible at rehearsals and concerts.

The work of a musician is compared to that of an athlete. However, there is a significant difference in the approach of the interested parties and their environment. One aspect has been examined in this paper. It is obvious for every athlete that before the physical effort related to training or competition one should prepare the body for work. Activation of many muscle fibers prevents injuries of the musculotendon structures, which usually occur when a small amount of them is active [23]. The own study indicates that less than half of the respondents do a warm-up before physical activity related to the musician profession, i.e. practice, rehearsals or concerts. Statistical analysis showed that incorporating the warm-up reduces the occurrence of pain. 25% of musicians incorporating warm-up did not feel pain. Compared to the respondents who did not perform any activity, those who did warm-up had twice as few respondents who did not experience such symptoms (13.8%).

Economical work in the context of musicians means that the musician maintains the correct posture and performs complex, precise movements with minimal physical effort. Movement system disorders usually force the artist to change his/her body position to avoid pain. The musician is forced to find a different position using other muscles. This leads to deviations from the normal biomechanical system, and consequently deteriorates its performance permanently [22]. In the light of the conducted

study, attention was paid to the level of awareness of the surveyed musicians. It is assumed that an important element in the prophylaxis and treatment of musculoskeletal disorders is adequate training. Lack of understanding of the causes of the ailments or insufficient number of educational tools may lead to the fact that musicians when seeking medical advice they use unreliable sources, which translates into incorrect diagnostics and inadequate treatment [3]. In the own study, 58% of respondents participated in classes on the principles of ergonomics of musician profession. Disturbing is the fact that only 18% of respondents received such education at the school learning stage, the remaining respondents sought information at additional, optional training and workshops. Two-thirds of double bass players surveyed said that they pay attention to ergonomic principles at work. Such a result may prove that most of them try to take care of their health and the performative apparatus. The collected data show that only 14% do not perform any physical activity to prevent pain. Statistical analysis showed a reduced number of respondents who experienced pain in a group of persons applying the principles of ergonomics compared to those not applying these principles. The respondents who do not apply or do not know whether they apply such principles are more likely to lose concentration and make it difficult to make precise movements.

Musculoskeletal problems apply not only to professional musicians who have been exposed to stressful and non-ergonomic working conditions for years. Conducting surveys in a group of young, just learning musicians revealed the occurrence of musculoskeletal problems, and moreover the need for their treatment. In addition, there was no clear difference between the occurrence of musculoskeletal disorders in the group of students of music academies and musicians employed in orchestras, which confirms the large scale of the problem [22]. At the moment there are not enough programs and questionnaires to analyze the damage caused by playing the instrument. It is necessary to create such tools that will take into account, among others, ergonomic factors, musicians' anatomical characteristics and type of playing technique. They should take into account the dimensions of the instrument, its weight and size. Although specific studies have been conducted into the risk factors for PRMD (playing-related musculoskeletal disorders) [14], the results vary widely. Their credibility is undermined by the fact that most studies are based only on the assessment of subjective symptoms reported by respondents [2]. There are very few publications focused only on double bass players. The authors of this paper would like to draw attention to the need to systematize the diagnostic and therapeutic approach, the need to conduct further studies that shall take into account many factors related to the professional life of musicians. The interest of authorities responsible for educating musicians must be aroused. Legal and administrative institutions should undertake to sort out matters regarding occupational threats of musicians. Thus, order should be introduced and musicians should be given more effective medical care, and

bureaucracy related to health insurance or compensation should be simplified. Double bass players, but also musicians in general, should feel that at each stage of their careers, properly trained and prepared persons provide them with professional assistance. In order for this to happen, it is necessary to determine the causes of pain, find risk factors for occupational diseases, develop a system of training teachers and healthcare professionals so that they can counteract and treat musicians' pain with specific knowledge and skills. To sum up, for the situation of musicians to improve, it is necessary to carry out more extensive studies on a larger group of respondents and in terms of many aspects related to the professional life of artists.

Conclusions

1. Lumbosacral section, shoulder girdle, wrist and hand pain are the most common types of pain among the double bass respondents.
2. Pain intensifies in the group of double bass players with longer experience in playing the instrument (10–15 years) compared to the group with shorter experience in playing the instrument (4–9 years).
3. Working musicians significantly less often assess their health condition as good compared to the group of pupils and students.
4. Most of the double bass players under study apply the principles of ergonomics, despite the fact that only slightly more than half of them participated in compulsory or additional classes on the work ergonomics of a musician.
5. It was noted that musicians doing warm-up before an activity related to musical performance less frequently complained about pain.

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Streszczenie

Cel pracy: Celem niniejszej pracy była analiza dolegliwości bólowych występujących u kontrabasistów w obrębie kończyny górnej i kręgosłupa.

Material i metody: Porównano dwie grupy muzyków z różnym stażem gry na instrumencie i rozpatrzono struktury anatomiczne, które ulegają największym obciążeniom. Badaniem objęto grupę 50 muzyków w wieku od 17. do 31. roku życia. W celu pozyskania danych na temat częstotliwości, lokalizacji i charakteru dolegliwości bólowych zastosowano samodzielnie przygotowany kwestionariusz ankiety w formie elektronicznej. Ankieta została zaprojektowana na podstawie dostępnych kwestionariuszy wykorzystywanych do badań nad schorzeniami muzyków instrumentalistów (Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms oraz Evaluation of Performing Artist). Ankietowani odpowiadali na pytania nie tylko dotyczące dolegliwości bólowych, ale także czynników, które w znaczący sposób mogą wpłynąć na ich przebieg. Analiza stylu życia, czy poziomu świadomości z zakresu zagrożeń zawodowych i profilaktyki została zawarta w 30 pytaniach o charakterze otwartym i zamkniętym.

Wyniki: Wyniki wskazują na wysoki odsetek kontrabasistów cierpiących z powodu dolegliwości bólowych. Najczęściej występującymi dolegliwościami bólowymi u ankietowanych kontrabasistów okazały się bóle odcinka lędźwiowo-krzyżowego, obręczy barkowej oraz nadgarstka i ręki. Staż gry wpływał negatywnie na nasilenie objawów bólowych, którym często towarzyszyły inne symptomy, takie jak promieniowanie bólu, utrata koncentracji czy utrudnione wykonywanie precyzyjnych ruchów.

Wnioski: Można wnioskować, że praca muzyka związana jest pewnym ryzykiem zawodowym i wpływa na stan zdrowia muzyków.

Słowa kluczowe: problemy zdrowotne muzyków, kręgosłup, kończyny górne
