

BASIC SCIENCE ARTICLE



The structure of occupational diseases in first-third-year piano students

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BACKGROUND: The aim is to analyze the structure of occupational diseases in first-third year piano students studying.

METHODS: A total sample of 300 individuals participating in the research process underwent a complete medical examination at the end of each academic year.

RESULTS: Among piano students, number of those distributed to special medical groups for health reasons grew from 14 to 38% ($p \leq 0.02$). The incidence of diseases of the muscular system increased from 58 to 71% ($p \leq 0.05$), with the sharpest rise during the transition from the second to the third year of study. Similar tendencies were obtained for the incidence of hand-related diseases—their overall frequency advanced from 17 to 23% ($p \leq 0.05$). The surge of morbidity in the transition from the second to the third year of study can be attributed to the increased educational load experienced by students during this period, as they begin to practice music intensively after theoretical classes. Corresponding measures directed at preventing occupational diseases, bettering physical education, expanding the rest intervals between piano lessons are to be taken.

CONCLUSIONS: The research results indicate that the main occupational diseases of piano students are those related to hands and muscular system.

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IMPACT:

- The obtained data suggest that the range of diseases is likely to progress throughout the musical training.
- The main diseases of piano students are those related to hands and muscular system.
- The sharpest rise was during the transition from the 2nd to the 3rd year of study.

INTRODUCTION

Occupational diseases are common to every profession, including musicians. Among musicians who sing in choirs and opera, upper respiratory diseases predominate, while among instrumentalists—dyskinesia and other diseases (myositis, bursitis, epicondylitis, ganglionitis, tendovaginitis, peri-arthritis, ligamentitis). The incidence of these diseases can be up to 30%.¹ The presence of lower limb varicose veins is typical for musicians playing standing in an orchestra. The diseases also have their own age structure—they most often occur among young musicians, up to 30 years old (in 75% of cases). Occupational diseases are sometimes more frequent among musicians compared to the general population—dyskinesia can occur in 30% of cases, which is twice as often as cardiovascular diseases.²

The type of overexertion syndrome is determined by the nature of the dominant movements in the professional activity. It can vary from carpal tunnel syndrome and different forms of arthritis (polyarthritis, peri-arthritis) to myositis and tendovaginitis.³ Diseases observed in musicians usually relate to problems with hands. Today, the overexertion incidence among musicians remains quite high, and, according to some data, it can range from 76 to 85%, which means it is characteristic of almost every

person involved in music as an occupation.¹ Overexertion syndrome is of particular relevance among students of music schools and universities as, during the acquisition of musical skills, the student must spend from 5 to 7 h in rehearsals, and the period of such a tight schedule can range from 5 to 11 years.⁴ In view of this, the frequency of occurrence of overexertion syndrome among students of musical specialties is even higher than among professional musicians and can reach 90%.^{1,5} As concerns the therapy in these cases, as a rule, its measures are reduced to the use of anti-inflammatory drugs and the abolition of music lessons.⁶ However, in the event of improper therapy or ignoring the signs of the growing disease dynamics, a musician can be faced with the possibility of complete loss of professional skills and subsequent decline in the quality of life.⁶

As indicated by data collected from 7.5 thousand musicians, the causes of occupational diseases in musicians are predominantly represented by a large number of monotonous repetitions of specific movements and the physiologically uncomfortable posture taken when playing.⁴ The most unfavorable postures are inherent to violinists and cellists—they complain about overexertion syndrome in 73% and 69% of cases, respectively.⁷ Even though, from the point of view of ergonomics, musicians use

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instruments that are similar in their characteristics (wind, percussion, keyboard, and strings) and take about the same postures, the intensity and frequency of overexertion vary across performers. Therefore, a great deal of research has focused on finding specific determinants that could forejudge its incidence. One of them is the performance technique determining a load on different groups of muscles and tendons. According to a group of Turkish specialists evaluating ergonomic risk among musicians of different specialties—violinists, pianists, and flutists—the majority of players (over 90%) are exposed to the high ergonomic risk.⁸ Researchers indicate a direct relationship between the ergonomically unfavorable posture, the musician's performance technique, and the frequency of manifestation of overexertion syndrome. Similar results were also obtained by Portuguese experts for a single group of pianists in 2020.⁹

The methods of preventing occupational diseases of musicians are addressed in detail by a team of scholars from the Netherlands who attempted to establish the concept of an ergonomically safe performing technique for violinists.^{10–12} They report that a higher shoulder rest relates to a higher violin fixation force and, correspondingly, to a higher load on the shoulder and neck muscles, which causes premature fatigue and rapid development of overexertion syndrome. On top of this, there is evidence that the extreme (maximum and minimum) motor amplitudes of muscles and gripping force used by musicians when playing contribute to their overstrain.¹³ Provided that overstrain is more typical for musicians with weak muscles, it is declared that the risk of developing overexertion syndrome is associated greatly with the performance technique. The experts claim that, on average, this technique is imperfect both from musical and ergonomic perspectives for almost 95% of musicians.¹⁴ On the other hand, a perfect performance technique does not necessarily mean full avoidance of the overexertion possibility. Scholars note that even in this case, musicians may have weak muscles and deviations in the range of motion in the joints when playing. In this respect, researchers from Brazil confirm that among pianists who devote more than 20 h of practice in 7 days, train for more than 60 min without a rest, and do not play sports, there are significantly more injuries to muscle groups of the hand, shoulder, and forearm.¹⁵

Most of the studies on the matter refer to musicians who have already mastered their profession,^{16–19} whereas much less research is devoted to music students.²⁰ In parallel, according to experts from Australia, overexertion syndrome occurs with a significantly higher frequency precisely among music students.¹⁹ The reason for this lies primarily in the fact that students do not know or use methods of preventing occupational diseases. Of particular relevance here is that in 70% of cases, overexertion syndrome occurs in musicians aged under 25.²⁰ The highest disease incidence (about 60% of cases) is typical for student age, namely for 18–23 years olds.²¹ Considering this, it seems crucial to conduct research specifically among musicians of this cohort.

The present paper aims to conduct a comprehensive study of diseases of undergraduate musicians majoring in piano performance. This group of musicians was chosen as a model because there is not enough research on their occupational diseases.^{19,20} The authors admit that, apart from the diseases associated with the peculiarities of the ergonomics of the posture during the play and the performance technique affecting hands and spine, other diseases may also have a significant impact on the musician's health. The ultimate goal of this work lies in carrying out a comparative analysis of the range of diseases of first-third year piano students studying at the Central Conservatory of Music (People's Republic of China).

Its fulfillment presupposes the following tasks to be solved:

- Determine the main diseases characteristic of the students of each of the study years.
- Carry out a comparative analysis of the dynamics of changes

in the range of diseases between different years of study.

- Identify a possible connection between the profession of a piano player and diseases' incidence.

MATERIAL AND METHODS

Sample

The study was conducted in 2016–2019 at the North Minzu University, Guangxi Arts University, ShenYang Conservatory Of music, NingXia University. It enrolled a total of 300 students, 100 of whom were freshmen (Group 1), 100 were sophomores (Group 2), and 100 were juniors (Group 3). All students were trained as professional piano performers. Among the participants, 95% were young men; therefore, sex differences were not determined. The specifics of the predominance of young men can be explained by the fact that they constitute the main number of students in the courses. The average age within the Group 1 was 18.6 ± 0.4 years, within the Group 2— 19.7 ± 0.2 years, and within the Group 3— 20.8 ± 0.1 years. Students were selected according to their specialization. All students were under the same learning conditions, which took place in classrooms with the same conditions.

Research design

The main idea of this research implied an integrated approach to the investigation of diseases of students specializing in piano playing. It analyzed not only occupational diseases of the musculoskeletal system typical of musicians but also others, for example, diseases of the gastrointestinal tract (GIT), which can also considerably worsen the life quality. Another important point to note is that oral and written agreements were concluded with all enrolled musicians, in which their consent to participate in the study was declared clearly. These agreements provided for the anonymity and confidentiality of the information received and the omission of all the participants' names. From this it follows that the current research was carried out in conformity with the generally accepted ethical and moral standards.

The included participants were required to comply with the following criteria:

- Sign a participation agreement and give oral consent.
- Absence of serious cardiovascular diseases.
- Absence of mental diseases.
- Absence of speech impairments.
- Absence of epileptic seizures in the diagnosis.
- Absence of bad habits (drug addiction, alcoholism).

All students who failed to meet at least one of the above points were not included in the study process.

Research methods

Once a year, all study participants underwent a full medical examination with the participation of medical specialists of various fields: neurologists, otolaryngologists, cardiologists, orthopedists, surgeons, dentists, phlebologists, and vascular surgeons. Each student was examined individually. Based on their diagnoses and conclusions, medical reports on the state of health of each respondent were drawn up. By way of contrast, similar data obtained for the same period but for students of other musical specialties (majoring in vocal art, as well as wind, percussion, plucked, and string instruments) were used. For comparison convenience and adequacy, the number of students of other specialties was also equal to 100 people in each of three groups. In such a manner, a clear picture of changes in morbidity rates among piano players (as the main analyzed group) and individuals engaged in other specialties (as the group for being compared) for all 3 years of study were obtained. Among the range of diseases, the following were considered. Diseases of the musculoskeletal system included such diseases of hands and muscles as dyskinesia, neuromyositis, neuralgia, muscle spasms, Raynaud's disease, and scoliosis. At the same time, the diseases of muscles, arms, and spine were differentiated by groups. The group of diseases of the respiratory system included tracheitis, fungal infections, and traumatic dental problems. Cardiovascular diseases (tachycardia, bradycardia, arrhythmia) were also outlined as an independent group. Students belonging to special medical groups for health reasons were taken into account separately.

Statistical analysis

All research data were processed using Microsoft Excel 2016 spreadsheet editor. Statistical analysis was performed by means of Statistica v. 7.0. The significance coefficients were calculated between three groups of piano students, as well as between students majoring in piano performance and other music-related specialties. Student's *t* test for independent samples was applied to determine the significance of these differences (significant at $p \leq 0.05$). Differing significance levels were mentioned separately. In order to unify the comparison, the incidence rates were given as a percentage in the text of the article, whereas the diagrams used direct values (the number of students). Some of the students had several diseases at once, which was also taken into account in the diagrams.

Ethics approval

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The research was approved by the local ethics committees of North Minzu University. Informed consent was signed by participants.

RESULTS

In the course of the study, significant differences were obtained between students of various study years distributed to special medical groups for health reasons. Thus, if for first-year piano students this indicator was 14%, for the second year it constituted 23% ($p \leq 0.05$ with the first-year respondents), and for the third-year respondents it equaled as much as 38% ($p \leq 0.02$ with the first-year respondents). Correspondingly, one can confidently assume about the ever-worsening health of piano students. For undergraduates majoring in other specialties, significantly lower values were obtained. On average, it was 9% for the individuals in the first year of study ($p \leq 0.05$ with first-year piano students), 17% for the second year ($p \leq 0.05$ with the second-year piano students), and 31% for the third year ($p \leq 0.05$ with the third-year piano students).

Accordingly, among piano students, much more individuals are enrolled in special medical groups for health reasons. The causes for this become apparent with a more detailed analysis of the structure of diseases among the undergraduates of different specialties and study years. Thus, among first-years, diseases of the spine prevailed—their frequency ranged from 86 to 93% (Fig. 1). Students of piano specialty had average indicators for this group of diseases, constituting about 89% ($p \geq 0.05$ with other specialties). Muscle-related diseases were the next largest group in this aspect. Their incidence ranged from 4 to 58%, i.e., a greater variation among different specialties in comparison with diseases of the spine. The diagnosed muscle diseases included neuralgia, muscle contracture, and spasms. From this perspective, students of the piano specialty were at the most significant risk as their indicators were the highest (58%, $p \leq 0.05$ with other specialties, except for individuals playing string instruments, for whom this value did not differ statistically and constituted 54%). Stomatitis was another common disease established in the examined respondents. Regardless of specialty, it had a relatively low spread, from 60 to 64%. Quite common among first-years were diseases associated with the respiratory system (from 5 to 31%) and GIT (from 17 to 45%). In this respect, piano players got sick on

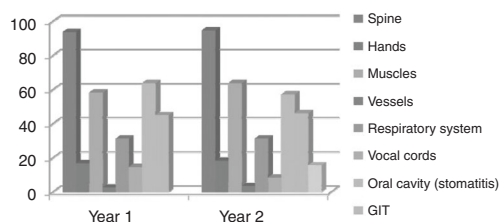


Fig. 1 Incidence of diseases among first- and second-year music students.

average as often as the rest—in 32% and 19% of cases, respectively ($p \geq 0.05$). The specificity of piano students can be seen when analyzing the frequency of diseases of hands (neuromyositis, Raynaud's disease, carpal tunnel syndrome, and dyskinesia). The overall incidence rate for their occurrence ranged from 2 to 17% among all specialties, and only among piano players constituted 17% already in the first year of study ($p \leq 0.05$ with other specialties). In the second year, the situation was somehow worse—almost all students had problems with the spine. For piano players, this indicator equaled 92% ($p \leq 0.05$ with their first-year results), while for individuals majoring in other specialties, it varied from 88 to 95% ($p \leq 0.05$). Hand diseases remained practically at the same incidence rate values (from 2 to 18%) with piano students in the leading positions ($p \leq 0.05$ with other specialties). A similar increase was noted for the incidence of muscular system-related diseases among sophomores (from 7 to 64%, $p \leq 0.05$ with the indicators of the first year). However, here, piano players retained leadership as well (64%, $p \leq 0.05$ with other specialties).

Considering the switch to the third year of study, one may clearly recognize that some diseases' incidence raised drastically (Fig. 2).

As follows from Fig. 2, the incidence of spinal diseases (particularly scoliosis) increased from 91 to 96% ($p \leq 0.05$ with the second study year and $p \leq 0.01$ with the first), whereas the frequency of muscle problems enhanced from 12 to 71% ($p \leq 0.05$ with the second year of study) with piano players ahead (71%, $p \leq 0.05$ with other specialties). A notable drop in the incidence of stomatitis (up to 25%) may be associated with more conscious adherence to hygiene rules. As for dyskinesias, the pianists still hold top positions across all the examined third-year respondents (23%, $p \leq 0.01$ with the second study year, and $p \leq 0.001$ with the first). Apart from dyskinesias, neuromyositis (9%, $p \leq 0.05$ with other specialties), Raynaud's disease (6%, $p \leq 0.05$ with other specialties), muscle neuralgia (64%, $p \leq 0.05$ with other specialties), and muscle spasm (74%, $p \leq 0.05$ with other specialties) also remain widespread among the 3-year piano players.

Figure 3 shows how sharply the frequency of diseases of the muscles, spine, and respiratory and cardiovascular systems increased over three examined years.

As can be seen from the data above, when only eight groups of diseases were identified in the first-year students, already ten of them were noted in juniors. Consequently, in addition to the raised incidence rate, there is a substantial increase in the diseases' range. Among all other musical specialties, piano students represent the most vulnerable group in terms of hands and muscular system diseases. Apparently, the prevention of precisely these medical problems must be given primary attention when teaching students to play the piano.

DISCUSSION

The results obtained clearly demonstrated that among music students the predominant group are muscular and skeletal diseases, the frequency of which can be up to 90%. Among them

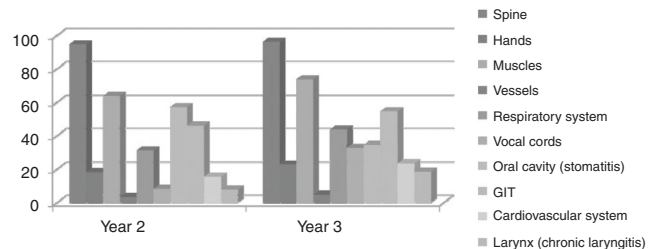


Fig. 2 Incidence of diseases among second- and third-year music students.

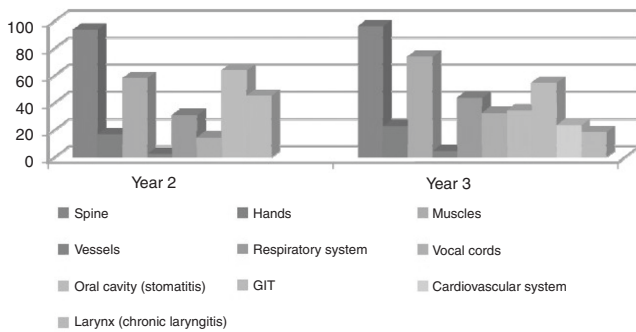


Fig. 3 Incidence of diseases among first- and third-year music students.

occupational diseases have a special place, the frequency of which is up to 20–30%, i.e., can account for up to one third of cases. It follows that much attention should be paid to the prevention of occupational diseases among musicians, because their incidence is quite high. These findings are consistent with those of pianists, among whom the incidence of posture disorders can be as high as 90%.^{8,9} Muscle injuries associated with overstrain as a result of active and prolonged piano playing are prevalent even among professional pianists, so the obtained data are consistent with the already known.¹⁵

The obtained findings confirm that piano students of the first-third year of study are increasingly exposed to diseases of hands and muscular system.²² This is what sets them apart from most of other musicians. The distinct specificity of piano students lies in the very performance technique and the relative inactivity of other body parts.^{23–25} Among the possible reasons for the initially low and increasingly deteriorating health indicators is the poor fitness level.¹⁸ In another research work on the topic conducted by American specialists in 2019, physically healthy musicians playing the violin were taken as a control group and compared with young people of a sedentary lifestyle. The research object was represented by physical strength and the parameters of hands muscles' motility. As a result, it was found that the external muscles of the shoulder part of the violinists' hands (deltoid, triceps, and biceps) had the same strength as in the control group, while the internal muscles were much weaker. This can be explained by the fact that the internal muscles of the shoulder girdle do not work when playing the violin, at least as hard as the external ones. On the other side, motor tests conducted among the experimental group respondents ended with much better results. Accordingly, one can confidently infer that the optimal solution for the perfect violin bowing technique is to maintain good motor skills and have muscles of medium strength.

Research similar to the current was carried out by specialists from the United Kingdom who studied the state of respiratory, musculoskeletal, and cardiovascular systems among 483 music students.¹⁶ Based on the examination of their physical strength (how respondents coped with the plank, press-ups, sit and reach, and pull-ups), they found that, compared to the control group, power indicators of students of musical specialties are likely to be lower by 22%. Besides, they unveiled that both pianists and students playing string instruments demonstrated hypermobility. The state of the respiratory system was within the normal limits only in students playing wind instruments. In contrast, the state of the cardiovascular system caused the most significant concern—for almost all musicians, it was significantly lower than the norm. In view of this, it is necessary to revise physical training classes for musicians to ensure better development of their professional qualities in the future.^{26–28} The present work is in line with these findings as it showed high and annually increasing incidence of

diseases of respiratory, cardiovascular, and musculoskeletal systems in music students.

Among diseases associated with the muscular system or hands, no cardinal differences in clinical implications are reported for musicians or professionals in other fields.²⁹ According to the classification of musicians' overexertion syndrome, published by experts from the United States, there are five degrees of clinical signs' manifestation.³⁰ The first degree presupposes pain only when playing, and not throughout the entire limb, but locally. In the meantime, the fifth degree implies constant uncomfortable pain with lost sensitivity and limited mobility throughout the entire arm. In our work, this problem has not been investigated; however, according to the complaints of intensively studying piano students, it can be assumed that their pain corresponds to the first degree of clinical manifestations of overexertion syndrome. The increasing frequency of diseases of the muscular system and hands in piano players during the training period suggests that pain sensations will also escalate in degree and intensity.

Future research in this field should be aimed at studying the distribution of the degrees of clinical manifestations of overstrain syndrome in piano players as well as the dynamics of diseases related to the muscular system and hands throughout the whole conservatory study period. The main study limitation is a fairly narrow age group (18–20 years old). This is due to the chosen period of study, when students move from theoretical training to intensive practical training.

CONCLUSIONS

The obtained data suggest that the range of diseases is likely to progress throughout the musical training. This is especially evident in the transition from the second to the third year of study, which is due to the increased workload on students during this period, when they move from theory to active practical exercises, which can take several hours. According to the examination results, their number and incidence increased from eight to ten from the first to the third year of study. A similar rise was noted for the number of students distributed to special medical groups. If at the first year there were 14% of such individuals among piano players, by the third year their number almost tripled (38%). Thus, the general state of physical health of piano students, as well as students of other musical specialties, deteriorates as they proceed in the educational process. During the analyzed period, the incidence of piano students' muscular system diseases progressed from 58% in the first to 64% in the second and 71% in the third study years. Such a sharp jump can be explained by the greater intensity of piano practicing. While during the first year the incidence of hand diseases in piano players constituted 17%, in second- and third-year respondents, it occurred much more often (18% and 23%, respectively). This situation is most likely to be provoked by the fact that the muscular and skeletal systems play key roles when playing the piano. Another important implication is that among future professional pianists, as well as the bulk of students majoring in other specialties, a considerable increase in the incidence of problems with the spine was noted (up to 96%). Hence, the main professional diseases that reliably distinguish piano students from other musicians relate to the troubles with hands and the muscular system.

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AUTHOR CONTRIBUTIONS

Substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data—H.Z.; Drafting the paper or revising it critically for important intellectual content—H.Z.; Final approval of the version to be published—H.Z.

COMPETING INTERESTS

The author declares no competing interests.

INFORMED CONSENT

Informed consent was signed by participants.

ADDITIONAL INFORMATION

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