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A comparison of the anthropometric measurements, flexibility, and muscle strength of the hands of conservatory piano students and non-musicians

Merve İzci[1], İsmail Can Pelin[1], Tuğçe Şençelikel[2]

[1]*Department of Anatomy, Baskent University, Ankara, Turkey*

[2]*Department of Biostatistics, Ankara Medipol University, Ankara, Turkey*

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For correspondence

Merve İzci

Department of Anatomy, Faculty of Medicine, Başkent University, Çankaya, Ankara, Turkey

E-mail: fzt.merveizci@gmail.com

Abstract

In the present study, the anthropometric characteristics and muscle strength of the hands, and the range of motion of the joints of the hands were evaluated in conservatory music students compared to university students who do not play a musical instrument. The aim of the study was to evaluate the differences in anthropometric characteristics and muscle strength of the hands and flexibility between these two student groups, to compare the correlations between the different physical features by group, to characterize the students who played the piano, and to evaluate the adaptation process. The study included a total of 128 individuals between the ages of 18 and 30 years, including 64 conservatory students who regularly played the piano for a minimum of two years and university students who did not play any musical instruments as a control group. After the demographic data of every participant were recorded, measurements were taken of body height, body weight, hand anthropometric characteristics, hand flexibility and hand muscle strength for each individual. In the context of the anthropometric measurements, no statistically significant differences were found between the groups except for the right hand span being greater in the piano group. No significant differences were found between the groups in terms of hand and finger grip forces (right and left). However, a significant difference was found between the groups in terms of the flexibility measurements. The range of motion measurements were greater for both the right and left hands in the piano group compared to the non-musician group. Measurements of the range of motion of the wrist and finger joints were greater among the piano players compared to the non-musicians, regardless of hand measurements. Thus, hand size may not be a critical factor in a student musician who selects the piano as their musical instrument.

Introduction

The hand serves as a tremendous tool in areas such as playing musical instruments (Jones and Lederman, 2006), which requires some of the most complex motor movements, requiring the musician to rhythmically make consecutive and rapid hand movements. While playing the piano, the positioning and timing of the fingers on the keyboard while reading a musical score are critical. The planning of the movements is controlled by the premotor, motor and primary areas in the cerebral cortex. When the motor regions in the brains of the study participants were examined, less cerebral activation was observed in the premotor and primary motor areas of the musicians' brains (Jäncke et al., 2000).

The use of the hand in playing an instrument is accomplished by a systematic process of complex sensorimotor functions (Furuya et al., 2011). Advanced music performance is achieved through the development and integration of the sensorimotor and neuromuscular systems (Watson, 2006). Effective musical performance develops as a result of the harmony between the structural characteristics of the instrument and the physical characteristics of the individual (Barıs et al., 2006). In order to play an instrument, the musician must have adequate muscle strength, flexibility and endurance (Cimen, 2003).

Musicians need to practice regularly for an extended period to develop their performance skills (Chan and Ackermann, 2014). For proper piano performance, the hands must have agility, coordination and finger flexibility (Richerme, 1996). Repetitive movements and piano practice can significantly increase hand and finger coordination (Fermandes and Barros, 2012), particularly sequential synchronization of the finger movements of both hands at different tempos (Sobierajewicz et al., 2018). With extensive piano training, the coordinated finger transitions required to create changes in tone may be associated with anatomical and functional changes in the hand (Furuya et al., 2011). Therefore, it is assumed individuals must have certain physical characteristics to play the piano. The actions of a pianist's hands occur repeatedly and often unconsciously during a performance. Performers develop movement adaptations that make it easier for them to play without conscious awareness of specific joint biomechanics and muscle contractions (Tubiana, 2005). Excessive or reduced wrist and finger joint motions along with continuous repetitive movements may cause pathological hand joint deformations and musculoskeletal disorders (Larsson et al., 1993).

Studies have been conducted on the requirements of certain physical characteristics necessary to play an instrument (Barıs et al., 2006). Physical characteristics of the hand, flexibility, muscle-bone relationships, postural features of the body and anatomical structure have been examined (Yagısan, 2002). However, studies on whether playing an instrument changes physical structure and muscle strength over time are limited. Therefore, our study aimed to analyze the anthropometric measurements, muscle strength and flexibility of the hands of conservatory students who regularly played piano compared to individuals who did not play a musical instrument. We believe that the results of this study could be important both in terms of preventing musculoskeletal system injuries as well as potentially guiding individuals to selecting instruments that are matched to their anthropomorphic hand characteristics.

We hypothesized for the present study that there would be differences between the two groups, especially in terms of muscle strength and flexibility. Our expectation was that muscle strength and flexibility would be higher in conservatory music students.

Materials and method

Participants

The study was approved by Baskent University's Institutional Review Board (KA17/318), and Ethical Committee. A total of 128 individuals ranging in age from 18.0 to 30.0 years volunteered for this study. Every participant provided written informed consent. Sixty-four of the 128 individuals were conservatory students who regularly played piano for at least two years. The remaining 64 individuals were university students who did not play a musical instrument (control group). All the participants in the control groups were the students of faculties of medicine and health sciences, and were not working in an additional job. The measurements were performed by a faculty member at the Department of Anatomy, School of Medicine, Baskent University. All measurements were taken by the same researcher at the same time of the day.

Procedures

The musician participants were given a questionnaire to determine how long and how often they have been playing the piano. Those who practiced at least one hour per day, at least one day per week, for at least two years were included in the piano group. Any individual who had previously played any musical instrument were excluded to the control group. Subjects in either groups having had hand and wrist trauma, limited range of motion in the hand joints or who had any surgical procedure on their hands were also excluded from the study.

After the demographic data of all the students were recorded, anthropometric measurements of the hands, as well as body height and body weight measurements, were taken. In addition, the flexibility and muscle strength of each individual's hands were measured. Anthropometric hand measurements included hand length, hand breadth, wrist breadth, span length and the length of each finger (I-V). Hand breadth and finger lengths were taken using a digital caliper, and wrist breadths were taken using a sliding caliper. For hand length and span length, a Martin type anthropometer was used (Oliver and Vallois, 1969). All the measurements were taken by the same individual at the same time of the day and recorded in millimeters with 0.01-millimeter sensitivity. Hand index was calculated as hand breadth/hand length × 100. The hand index hand measurements were classified in three groups: "narrow" (index of ≤ 42.99); "medium" (index of 43.00-47.99), and "wide" (index of ≥ 48.00). These measurements were coded in SPSS as a categorical variable (Oliver and Vallois, 1969).

Flexibility was evaluated by measuring the ranges of motion in the hand and finger joints using a goniometer (Otman and Köse, 2016). Measurements were made of the range of motion for wrist flexion and extension (Fig. 1), wrist ulnar and radial deviation, and abduction for each finger (Fig. 2).

For hand grip strength and for finger grip strength, a Jamar hand dynamometer and a Jamar pinch meter were used, respectively. Measurements were taken in the standard position recommended by the American Association of Hand Therapists, while the subject was sitting with his/her arms in adduction and with forearms and hands were in a neutral position (Shechtman et al., 2005). Hand grip strength was taken twice with the forearm in both flexion and extension, and recorded in kilograms (Fig. 3). Finger grip strength was measured three times as pinch grip, lateral grip and triple grip, and recorded in pounds. All the measurements were taken separately for both the right and left hands. Measurements for muscle strength were repeated three times at one-minute intervals and the average value was used.

Statistical analysis

In the calculations for the required sample size, the pilot study data of 42 (22 pianists, 20 controls) individuals applied by the researcher were used, and "Two-Way Analysis of Variance with Repetitions on a Single Factor" was applied to each anthropometric measurement to provide prediction. In the pilot study, the main effects and the "Partial Eta square" values of the interaction term, which were significant at a 95% confidence level for each anthropometric measurement, were examined and it was decided that the most appropriate effect width for the study was Cohen's medium effect width, Partial $\eta^2 = 0.06$. In this context, in the test of inter-group variability, for "Two-Way Analysis of Variance with Repetitions on a Single Factor," Cohen's medium effect width Partial $\eta^2 = 0.06$, the minimum sample size that will provide 80% test power at 95% confidence level is a total of 128 (64 control, 64 pianists).

In the study, descriptive statistics, mean ± standard deviation or median (minimum-maximum) were used for numerical variables depending on assumptions. Frequency (n) and percentage (%) were given for the categorical variables. Measurements taken from the right and left hand were evaluated separately. Whether there was a significant difference between the group of piano players and control group with respect to every examined measurement was analyzed using the "Student's *t*-test" if parametric test assumptions were met, and "Mann-Whitney U tests" were used if the assumptions were not met. Associations between different independent measurements were analyzed using the Pearson correlation coefficient or the Spearman correlation coefficient depending on the assumptions. Each group was evaluated for within group differences. Differences in terms of right and left side measurements were analyzed using the "Paired sample *t*-test" if parametric test assumptions were met. The Wilcoxon test was used if the assumptions for parametric tests were not met. Probability of Type I error was determined to be 0.05 and two tailed in every analysis, all of which were conducted using IBM SPSS v25.

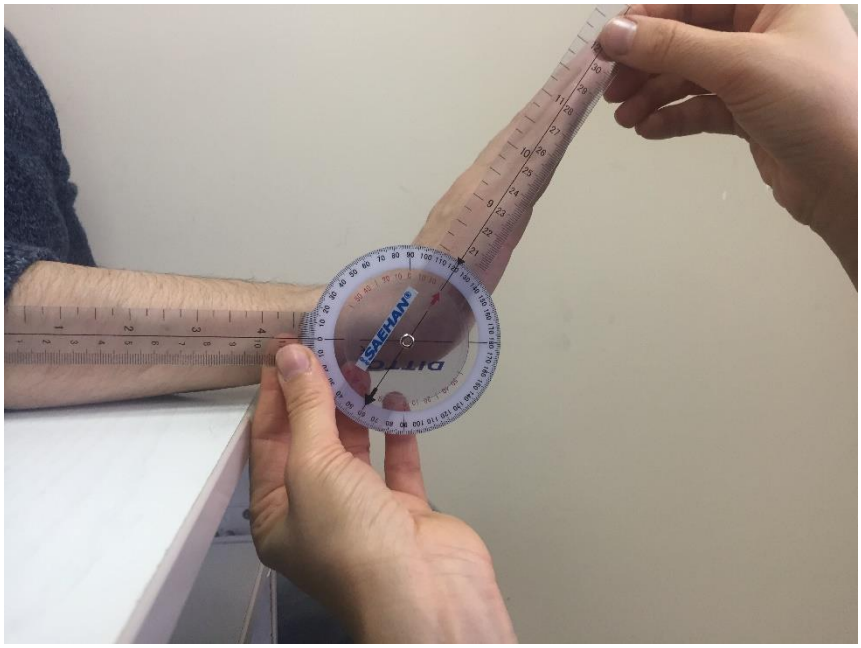

Figure 1. Measurement of wrist extension angle

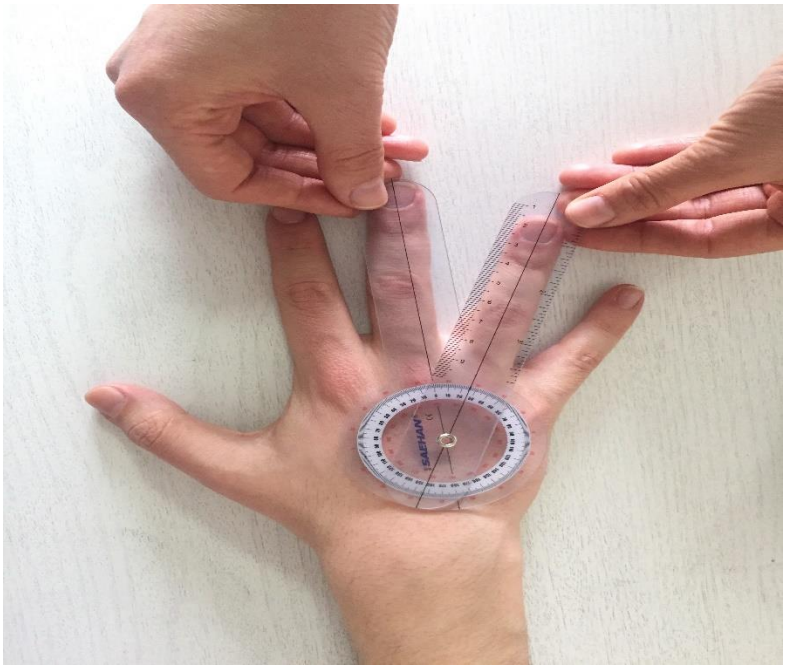

Figure 2. Measurement of the abduction angle of fingers II-IV

Figure 3. Measurement of hand grip strength (in forearm flexion position)

Results

Of the 128 individuals participating in the study, 64 were playing piano regularly and the other 64 participants were Baskent University students who did not play any musical instruments. The demographic characteristics of the participants are summarized in Table 1.

Table 1: Demographic characteristics of the sample

	Piano group (n = 64)	Control group (n = 64)
Sex[a]		
Male	29	31
Female	35	33
Age[b] (years)	21 (18-30)	19 (18-25)
Height[b] (mm)	1680 (1518-1867)	1699 (1553-1923)

a: frequency, b: median (minimum-maximum)

Students in the piano group played at least one and at most six instruments. How long they have been playing the piano varied between 2 and 22 years. The students played piano at least once a day and at most seven days a week. They also played at least one hour and at most six hours per day. A categorical examination of the hand index for the right and left hands showed that the hands of every student in either group had narrow hands (hand index < 42.99).

Comparison of anthropometric measurements between the groups

When hand anthropometric measurements were compared between the piano group and the control group, with the exception of hand span, no statistically significant differences were found for right hand anthropometric measurements with respect to every parameter analyzed. The mean right hand span in the piano group was higher than that of the the control group ($P = 0.049$). Between the two groups, there were no statistically significant differences in anthropometric measurements of the left hand (Table 2).

Comparison of flexibility measurements between the groups

Statistically significant differences were found between the groups for all joint angle measurements for both the right and left hands ($P < 0.001$). In the piano group, for both the right and left hands, all flexion measurements were found to be higher than those of the control group (Table 3).

Table 2: Comparison of hand anthropometric measurements (mm) in the piano and control groups

Anthropometric measurements	Piano group (n = 64)	Control group (n = 64)	*p*
Right hand			
Wrist width	49.94 ± 4,35	50.08 ± 4.30	0.854[a]
Hand width	80.70 (71.18-93.34)	81.30 (71.69-96.45)	0.294[b]
Hand length	182.90 ± 11.78	182.78 ± 12.23	0.953[a]
Hand index	27.32 ± 1.81	27.41 ± 1.62	0.765[a]
Finger I (thumb) length	64.65 ± 5.77	65.24 ± 5.32	0.554[a]
Finger II length	72.59 ± 4.78	72.40 ± 5.48	0.830[a]
Finger III length	77.80 ± 5.08	78.71 ± 6.11	0.357[a]
Finger IV length	72.12 ± 4.73	72.59 ± 5.98	0.618[a]
Finger V length	58.88 ± 4.89	60.05 ± 5.27	0.193[a]
Hand span	213.74 ± 15.60	206.93 ± 16.13	**0.049**[a]
Left hand			
Wrist width	50.00 (44.00-58.00)	50.00 (41.00-59.00)	0.562[b]
Hand width	80.48 (68.08-92.59)	81.19 (71.38-94.20)	0.525[b]
Hand length	182.69 ± 11.49	182.59 ± 11.81	0.964[a]
Hand index	27.17 ± 1.49	27.39 ± 1.54	0.413[a]
Finger I (thumb) length	64.24 ± 5.69	65.05 ± 5.25	0.406[a]
Finger II length	72.49 ± 4.90	72.07 ± 5.37	0.651[a]
Finger III length	78.14 ± 5.21	78.69 ± 5.85	0.580[a]
Finger IV length	71.95 ± 5.24	72.39 ± 5.76	0.651[a]
Finger V length	59.13 ± 4.96	59.69 ± 5.07	0.527[a]
Hand span	215.52 ± 14.99	209.18 ± 16.66	0.067[a]

a: Student's t-test; mean ± standard deviation, b: Mann-Whitney U test; median (minimum-maximum)

Table 3: Hand flexibility measurements between groups (degrees)

Flexibility measurements	Piano group (n = 64)	Control group (n = 64)	*p*
Right hand			
Wrist flexion	96.00 (83-107)	90.00 (78-98)	< **0.001**[b]
Wrist extension	89.00 (63-98)	78.00 (57-92)	< **0.001**[b]
Radial deviation	33.00 (20-55)	26.00 (13-45)	< **0.001**[b]
Ulnar deviation	58.97 ± 6.735	49.36 ± 7.981	< **0.001**[a]
Thumb abduction	92.17 ± 10.099	74.36 ± 12.670	< **0.001**[a]
The angle between thumb and index finger	91.00 (68-110)	76.00 (52-103)	< **0.001**[b]
Index finger abduction	51.00 (35-71)	41.50 (22-78)	< **0.001**[b]
Finger IV abduction	41.33 ± 6.544	34.91 ± 6.192	< **0.001**[a]
Finger V abduction	52.67 ± 8.136	43.70 ± 8.554	< **0.001**[a]
Left hand			
Wrist flexion	96.00 (86-111)	90.00 (72-96)	< **0.001**[b]
Wrist extension	87.00 (69-97)	77.00 (60-91)	< **0.001**[b]
Radial deviation	32.00 (18-53)	25.00 (12-43)	< **0.001**[b]
Ulnar deviation	57.00 (39-70)	48.00 (22-63)	< **0.001**[b]
Thumb abduction	92.00 (62-120)	73.50 (51-102)	< **0.001**[b]
The angle between thumb and index finger	94.00 (70-113)	77.50 (53-110)	< **0.001**[b]
Index finger abduction	50.50 (37-70)	41.50 (23-81)	< **0.001**[b]
Finger IV abduction	42.23 ± 6.872	33.87 ± 6.906	< **0.001**[a]
Finger V abduction	54.08 ± 8.445	44.91 ± 7.239	< **0.001**[a]

a: Student's t-test; mean ± standard deviation, b: Mann-Whitney U test; median (minimum-maximum)

Comparison of right and left hand flexibility measurements in the piano and control groups

When right- and left-hand joint ranges of motion were compared in the piano group, statistically significant differences were found for the ulnar deviation angle ($P = 0.003$) and the angle between the thumb and index finger ($P = 0.006$). The ulnar deviation angle was significantly greater in the right hand than it was in the left hand. On the other hand, the angle between the thumb and index finger was found to be significantly greater in the left hand than in the right hand. Values analogous to the measurements in the piano group were similar in the control group with respect to flexion measurements. In the control group, the right hand ulnar deviation angle was greater than the left hand ulnar deviation angle, while the angle between the thumb and index finger was greater on the left hand than the right hand (Table 4).

Table 4: Right and left hand flexibility measurements (degrees) in the groups

Flexibility measurements	Right hand	Left hand	P
Piano group			
Wrist flexion	96.17 ± 4.538	96.48 ± 5.42	0.502[a]
Wrist extension	89.00 (63-98)	87.00 (69-97)	0.442[b]
Radial deviation	33.00 (20-55)	32.00 (18-53)	0.641[b]
Ulnar deviation	58.97 ± 6.735	56.52 ± 6.928	**0.003**[a]
Thumb abduction	92.50 (68-116)	92.00 (62-120)	0.959[b]
The angle between thumb and index finger	91.11 ± 8.805	94.02 ± 9.54	**0.006**[a]
Index finger abduction	50.08 ± 5.886	51.33 ± 6.128	0.150[a]
Finger IV abduction	41.33 ± 6.544	42.23 ± 6.872	0.195[a]
Finger V abduction	52.67 ± 8.136	54.08 ± 8.445	0.064[a]
Control Group			
Wrist flexion	88.95 ± 3.856	88.88 ± 4.897	0.896[a]
Wrist extension	76.86 ± 7.715	76.92 ± 7.018	0.942[a]
Radial deviation	26.00 (13-45)	25.00 (12-43)	0.441[b]
Ulnar deviation	49.36 ± 7.981	47.52 ± 6.561	**0.007**[a]
Thumb abduction	73.00 (49-107)	73.50 (51-102)	0.650[b]
The angle between thumb and index finger	75.81 ± 12.150	78.02 ± 13.336	**0.027**[a]
Index finger abduction	41.91 ± 9.074	4.50 ± 9.106	0.556[a]
Finger IV abduction	34.91 ± 6.192	33.88 ± 6.906	0.072[a]
Finger V abduction	43.70 ± 8.554	44.91 ± 7.239	0.056[a]

a: Paired sample t test; mean ± standard deviation, b: Wilcoxon test; median (minimum-maximum)

Comparison of grip strength measurements between the groups

No statistically significant differences were found between the piano and control groups with regard to either right or left wrist and finger grip strength measurements ($P > 0.05$) (Table 5).

Table 5: Right hand (kg) and finger (pounds) grip strength measurements between groups

Strength measurements	Piano group (n = 64)	Control group (n = 64)	*p*
Right hand	34.00 (20-60)	34.00 (22-65)	0.797[b]
Wrist grip strength (forearm in flexion) (kg)			
Wrist grip strength (forearm in extension) (kg)	32.10 (16-67)	34.00 (20-65)	0.949[b]
Tip pinch grip strength (pounds)	14.00 (7-23)	12.00 (6-23)	0.437[b]
Lateral pinch grip strength (pounds)	17.26 ± 4.313	17.33 ± 4.694	0.933[a]
Three point pinch strength (pounds)	15.90 (8-31)	14.00 (7-29)	0.371[b]
Left hand			
Wrist grip strength (forearm in flexion) (kg)	30.00 (16-63)	31.50 (19-61)	0.628[b]
Wrist grip strength (forearm in extension) (kg)	30.00 (14-64)	32.00 (15-59)	0.979[b]
Tip pinch grip strength (pounds)	13.35 (7-23)	12.00 (6-34)	0.101[b]
Lateral pinch grip strength (pounds)	16.45 (8-29)	16.00 (8-27)	0.778[b]
Three point pinch strength (pounds)	15.10 (7-24)	13.50 (8-32)	0.628[b]

a: Student's t test; mean ± standard deviation, b: Mann-Whitney U test; median (minimum-maximum)

Correlations between anthropometric measurements and flexibility measurements

In the piano group, negative weak, but significant, correlations were found between hand breadth and wrist flexion angles for both hands (P_{right} = 0.004; r = −0.359) (P_{left} = 0.002; r = −0.373). In the control group, on the other hand, statistically significant, negative, weak correlations were found between left hand breadth and left wrist flexion angle (P = 0.014; r = −0.305). However, no correlations were found in this direction on the right side. Apart from the relationship between these two variables, none of the pairwise relationships mentioned above were found to be statistically significant (P > 0.05).

Correlations between wrist joint ranges of motion

When the ranges of motions of wrist joints were evaluated for the piano group, a significant, but weak correlation was observed between wrist flexion and extension for the right hand (P = 0.019; r = 0.293). For the left hand of the piano group, a significant, positive and weak correlation was found between radial deviation and the flexion of both wrists (P = 0.011; r = 0.316) and extension (P = 0.041; r = 0.256). On the other hand, for the control group, only a positive moderately significant correlation was found between the left wrist extension angle and the ulnar deviation angle (P < 0.001; r = 0.427).

Correlations between duration of playing piano and flexibility, muscle force and the anthropometric measurements of the hand

Time playing the piano for conservatory students was between 2 and 22 years. No significant correlations were found between how long students have been playing piano and the range of motion of wrist and finger joints, hand and finger grip strength, and the anthropometric measurements (P > 0.05).

Discussion

Studies on anthropometric measurements of the hand are important for the use of instruments (Kong and Kim, 2015). Anthropometry in musicians is important particularly for evaluating the structures that are necessary for playing a specific instrument. Playing the piano requires hand and instrument compatibility. A number of changes are inevitable during the course of adaptation

to an instrument, especially in terms of flexibility (Markison, 1998). In cases of failure in ensuring adequate adaptive changes, pathological issues may occur.

In this study flexibility was found to be higher in conservatory music students. However, no difference was found between the two groups regarding anthropometric measurements and muscular strength.

Analyses of musical performance can provide individual solutions for technical problems. However, it does not provide much information about any biomechanical characteristics and limitations. The biomechanics of the hand should be analyzed to evaluate the freedom of motion and limitations of the hand. Biomechanical infrastructure for playing an instrument comprises three elements: the size and shape of body parts, the resilience of relevant joints, and the muscular force that has an impact on these joints. These three basic elements should be evaluated concurrently in order to determine the potential of the hand (Wagner, 2012). These biomechanical elements are usually analyzed not only with regard to playing a musical instrument but also for the purpose of evaluating physical capacity in other activities such as sport, dancing, visual arts, etc. (Kabakcı et al., 2018).

In the study by Sims et al. on musicians who played different instruments, a comparisons were made of grip strength, pinch grip strength and hand joint mobility between musicians and those who did not play any musical instruments. It was observed that the right-hand grip strength of the female musicians and the right- and left-hand grip strength of the male musicians were lower than those of the non-musicians. No statistically significant differences were observed between the non-musician group and the musician group with regard to hand joint mobility (Sims, et al., 2015). In this study, hand grip strength, pinch grip strength, lateral grip strength and triple grip strength were evaluated in the conservatory students who played piano and in the control group. Contrary to the findings of Sims et al., in our study, no significant differences were found between the groups on all of the strength parameters. When wrist and finger joint ranges of motion were examined to evaluate hand flexibility, joint range of motion was found to be higher in the piano group for all flexibility parameters. It is possible that the differences between our findings and the findings of the study by Sims et al could be due to the fact that the latter study included musicians playing different types of instruments, whereas our current study was conducted with individuals playing only piano.

In the study by Yoshimura et al., the angles between the fingers of piano students were measured. All the measurements were significantly higher for the left hand (Yoshimura et al., 2006). In our study, no significant differences were observed between the right and left hands except for the ulnar deviation angle and the angle between the thumb and index finger. The ulnar deviation angle was significantly larger for the right hand. It emphasizes the capability of the pianists to deviate their right hand towards the lateral side while playing the piano. Moreover, the angle between the thumb and index finger was larger for the left hands in the piano group.

The present study has revealed that all measured hand and finger joint ranges of motion were significantly higher in the piano group when compared with the with the non-musician control group. No significant correlations were found between how long the participants have been playing the piano and flexibility. As this study involved conservatory students who had at least two years of piano playing experience and were playing the piano regularly, it is possible these students have reached the necessary and possibly optimal level of flexibility for healthy performance. In order to clearly reveal the reason for such high flexibility, a longitudinal study would need to be conducted following individuals playing from the beginner level.

Wristen et al. studied pianists with small hands and compared these pianists' use of pianos with normal sized versus small keyboards. A 10-degree increase in the ulnar deviation angle and a 5-degree increase in the radial deviation angle were found when the pianists with small hands

used a standard sized keyboard (Wristen et al., 2006). This suggests that hand flexibility can increase depending on the size of the piano keyboard.

Wagner compared the hand sizes as well as the wrist and finger joint ranges of motion of pianists with individuals who were not musicians. He reported there was a greater joint range of motion in the pianists (Wagner, 1988). This finding was consistent with our results.

The wrist is an intricate joint. Angular motions occur as a result of a combination of complex structures with non-uniformly shaped carpal bones, reinforced with integral ligamentous structures and synergistic muscular movements of intrinsic and extrinsic muscles (Moojen et al., 2003). The range of motion of the wrist joint are attained from a neutral starting position such that the wrist can actively achieve its greatest flexibility. In our study, every motion was initiated from an anatomically neutral position. However, in the Li et al. study of healthy young men, it is reported that during dynamic movements, the wrist joint would move in only one plane. Moreover, combined movements were observed, such as wrist extensions with radial deviation and wrist flexions with ulnar deviation (Li et al., 2005). When the relationship between all ranges of motion of the finger and wrist joints were measured separately without dynamic hand movements, the piano group demonstrated a positive, weak, but significant correlation between wrist flexion and extension for the right hand. A positive but weak significant correlation was also found between radial deviation and wrist flexion and between radial deviation and wrist extension for the left hand. In the control group, a positive, moderate, significant relationship was found only between wrist extension and the ulnar deviation in the left hand. It is normal to observe a correlation between the radial and ulnar deviation, as well as flexion and extension since all these movements are related to flexibility. However, our findings emphasize the importance of lateral deviation rather than flexion and extension in pianists.

Joint range of motion above normal levels is called joint hypermobility, which is an advantage for some professionals such as ballet dancers. However, it may become a disadvantage for athletes (Larsson et al., 1993). In a study of musicians by Larsson et al, pathological disorders appeared to be correlated with hypermobility in musicians. The results of the study suggested both reduced joint range of motion in frequently recurring movements and excessive joint ranges of motion could each be important factors in musculoskeletal disorders in musicians. Furthermore, the researchers suggested that greater joint range of motion could be an advantage for musicians who play flute, violin or piano. However, this advantage could also be a risk factor for musculoskeletal disorders (Larsson et al., 1993). Our current study found a greater range of motion in the piano group compared to the control group. This suggests that playing the piano requires good hand/wrist flexibility.

In order to evaluate the hand from a holistic perspective in the present study, hands were evaluated from a number of different perspectives. No significant differences were found between the groups with regard to anthropometric measurements and hand and finger grip strength. However, when the ranges of motion of the wrist and finger joints were evaluated, the piano group was found to exhibit greater ranges of motion of the wrist and finger joints than control group.

Wagner et al. emphasized that there was a relationship between certain flexibility parameters and pain in the pianists (Wagner, 2012). Even though the present study did not address cases of pain experienced by pianists due to playing the piano, exact knowledge of the hand characteristics of pianists could provide insight into the underlying reasons for complaints of pain associated with playing the piano.

The results of the present study could set the foundation for further research. A longitudinal study could be conducted with individuals who have just started to play the piano. This type of study may provide important insight into whether the increase in hand flexibility is related to

how long a player has been playing piano, and it may also provide information on risk factors for developing musculoskeletal injuries.

Limitations of the Study

We could not exceed the statistically necessary sample size because it was difficult to find students who played the piano. Enlarging the sample size would no doubt have enabled us to obtain more efficient results in terms of strength and anthropometric measurements.

Conclusions and recommendations

Depending on the results of the study, it can be concluded that anthropometric characteristics are not related to the tendency to play the piano, and thus cannot be used as elimination criteria. The range of motion of the wrist and fingers is greater in conservatory music students than in non-musician students. Exercises that increase flexibility can be recommended for students.

Disclosures

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