Research article

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# Understanding upper body playing-related musculoskeletal disorders among piano and non-piano players using a photogrammetry

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**Abstract**

*Objective.* Playing-related musculoskeletal disorders (PRMSD) are a common problem for the pianist. The poor upper body ergonomics influences the natural positioning of the neck and shoulders, which involves forward head posture (FHP) and rounded shoulder posture (RSP). This misaligned position could produce a sensation of pain over the upper body, which affects the piano player and computer users with similar ergonomic posture. Recently, photogrammetry methods are commonly applied in a clinical setting to assess posture. The goal of this research is to compare the upper body playing-related musculoskeletal disorders between the piano and the non-piano players by applying photogrammetry.

*Materials and Methods.* This causal-comparative study includes 70 participants with 35 piano and 35 non-piano players. The participant's FHP was assessed using a digitized photo to record the Craniovertebral angle (CVA) with the support of Kinovea software. Besides, digital Vernier Calliper used to assess the scapular index on the RSP and Neck disability indices (NDI) used to measure neck pain and functional disability of the participants.

*Results.* The findings showed piano players have a higher NDI, lower CVA, and RSP when compared with the non-piano players at a statistically significant level of p-value <0.05.

*Conclusion.* The obtained results conclude piano players are highly prone to the risk of developing PRMSD in the upper body. ***Clin Ter 2021; 172 (2):163-167. doi: 10.7417/CT.2021.2305***

**Key words**: *Piano Players, Non-piano Players, Playing-related Musculoskeletal Disorders, Forward Head Posture, Rounded Shoulder Posture, Neck Disability Index*

## Introduction

Playing-related Musculoskeletal Disorders (PRMSD) are commonly found among the musician (1). The lengthy hours of practice time contribute to asymmetrical movements and postures during play and even induce additional development of pain and musculoskeletal dysfunctions(1). PRMSD is a common problem amongst the piano players with insidious neck and shoulder pain caused by bad neck postures and movements (2). The numerous factors that lead to these phenomena of PRMSD include poor upper body posture. In general, the poor upper body posture with pain and discomfort primary to cause forward head posture (FHP) (3,4), and rounded shoulder posture (RSP) that might affect the ability to play piano in a long run (5). Piano players who strived for perfection require hours of endurance on their practice. Consequently, the pain or tension would gradually develop and cause unsought injuries if practicing with improper posture, typically in the neck and shoulder region (5).

The forward head posture (FHP) and the shoulder protraction is also known as the rounded shoulder posture (RSP) (6), these could interfere with the load on supporting bone and muscle activity, which increase the pain for the piano players during play (7). These poor postures are likely to trigger undesirable stress on the cervical spine and scapular during play(2). PRMSD are caused by intrinsic and extrinsic factors, in which the intrinsic factors include age, gender, strength, physical size, physical & mental condition, and personality. Whereas the extrinsic factors include the type of repertoire which is the genre, type of piano, teachers, and the environmental settings psychotically. Besides, there is another factor that causing PRMSD which is the interacting factors that include the posture, playing technique, or music instruction (1). Among the piano players, the findings showed 38.1% to 91% experience PRMSD that directly associated with practice nature and poor sitting posture that inducing pain is one of the risk factors (7).

Progressively, FHP tense up the neck muscles, and soon provoke tension elsewhere in the body as well and 67 % of healthy university students reported with FHP (8). As we know the muscles of the neck and shoulders have to function in an adhesive unit to produce movements. The poor habit of movements while playing the piano will produce pain due to the inefficient use of the body muscles (1,7). The presence of neck and shoulder pain are always ignored by the piano players because they spend a lot of time and effort on concentrating the hand and finger movements (9).

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The studies showed craniovertebral angle (CVA) is widely applied in FHP, smaller the angle of the CVA, the more significant of the presence of FHP when comparing with the healthy subjects(10–12). Additionally, prolonged practice time and shortening of pectoralis minor muscles (13) could cause RSP that protracts the acromion forward from the normal line of gravity(14). The shortening of pectoralis minor length measured usually by using the scapular index (13).

The majority of adults with work-related musculoskeletal disorders experience neck pain, which is associated with computer usage (8). Usually, the neck and shoulder pain are unsegregated with some unquestionable poor neck postures(15). There is a correspondence of the ergonomic posture between the piano players and the computer keyboard users as well, concerning the task of the biomechanics. This could extend to the same poor upper body postures as mentioned (7). The purpose of this present study is to compare the upper body playing-related musculoskeletal disorders among the piano and the non-piano players.

## Materials and Methods

A causal-comparative study design that targeting to explore the upper body posture examination among the piano players (group A) & non-piano players (group B). Through a purposive sampling method a total of 70 subjects were recruited, 35 piano players and 35 non-piano players. The player's age ranging from 18-25 years old and at least grade 5 by pianist was selected in group A. Photogrammetry method is a science of making measurements from the taken photographs known as the photographic posture analysis method (PPAM). A Sony camera placed and mounted on a tripod at a distance of one meter away from the subject in a sitting position in the lateral view. The camera positioned well to allow all the anatomical markers were detectable in a photo (10,16). Digitized photographs were measured to assess the CVA to determine the FHP by using the open-access software as mentioned(10). While measuring CVA, the marker points (11) were placed in the C7 spinous process, and the tragus (Fig.1 & 2).

The scapular index was measured by Digital Vernier Callipers (Code 1108-150) to assess the RSP (17). The sternal notch (SN), coracoid process (CP), the adjacent thoracic vertebral spine (TS), and posterolateral angle of the acromion (PLA) were marked initially (Figure 3 &4). Then, calculate the equation according to this method, [(SN to CP/ PLA to TS) x 100] to find the severity (6,17). Also, the neck disability index (NDI) was used to measure neck pain and functional disability (18,19).

The descriptive analysis of the demographic data between both groups was analyzed. The independent *t*-test was performed to compare the CVA, RSP, and NDI between both the groups. A *p*-value of $<0.05$ was considered significant.

## Results

A total of 70 subjects (35 piano players and 35 non-piano players) were recruited in the study. The age of subjects ranged between 18 and 25 years with a mean of 21.54± 1.75 years.

Table.1 showed the comparison of all variables between the two groups, the mean percentage of the RSP in the piano


Fig. 1 CVA measurement using Kinovea software for Piano Player


Fig. 2 CVA measurement using Kinovea software for Non-piano Players

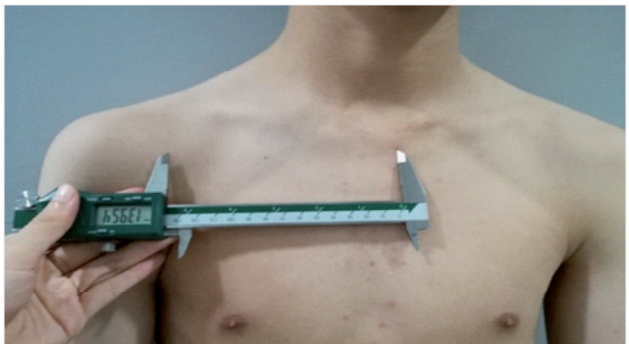

Fig. 3. Digital Vernier Callipers (Code 1108-150) used to record scapular index anteriorly from the coracoid process (CP) to sternal notch (SN)

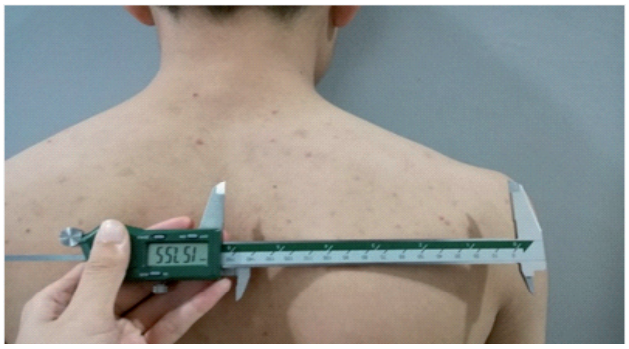

Fig. 4. Digital Vernier Callipers (Code 1108-150) used to record scapular index posteriorly from the posterolateral angle of the acromion (PLA) to Thoracic vertebral spine (TS)

players is higher than the non-piano players, there was a significant difference in the score ($t$ (68) = 4.28, $p$= <.001), for RSP in piano players (86.03± 4.89) and non-piano players (90.49 ± 3.72). The obtained result of the scapular index shows the severity of RSP. The higher the mean value, the lesser the tightness of the pectoralis minor muscles, the lesser the severity of the RSP. The result determined that the piano players have higher RSP compared to the non-piano players.

In CVA, the mean value of the CVA in the piano players is lower than the non-piano players, where the mean of CVA in piano players (35.80° ± 7.26) while in non-piano players (40.02° ± 9.40). Besides, the equal variances assumed the result of $t$ (68) = 2.10, $p$=0.04 which is < 0.05 when compared with both groups. The CVA indicates the severity of the FHP. The higher the mean value of CVA, the lesser the FHP. The acquired result shows the piano players have lower CVA compared to the non-piano players.

In NDI, the mean percentage of the NDI among the piano players (15.37± 8.75) is higher than the non-piano players (11.37± 7.51). Besides, the equal variances assumed the result of, $t$ (68) = 2.05, $p$=0.04 which is < 0.05 when compared with both groups. The acquired result shows that the piano players have higher NDI compared to the non-piano players.

## Discussion

From the findings, the piano players are prone to develop into poor upper body postures like the FHP and RSP, not excepting the non-piano players. Further, the severity of FHP and RSP among piano players higher when compared to the non-piano players. Similarly, the study among university students reported FHP among 63.96% of participants was correlated with RSP (3). Another study among medical students had reported that the presence of the FHP and RSP could lead to the upper cross syndrome, which associated with the flexion of the lower cervical region and extension of the upper cervical region cause FHP, while the RSP is associated with alteration of the scapular position(20). In general, the upper cross syndrome alters the normal musculoskeletal structural stability, muscular activities or body kinematic which results in loss of function, numbness, pain, and other neuromuscular symptoms in the upper body, these changes would eventually accelerate the presence of muscular tension and impact the stress over the shoulders and neck region. As in the neck pain, it could affect the localized

*Table 1. Means, standard deviation and Independent t-test results of participants between the groups*

| | **Piano players** | **Non-piano players** | | | |
|---|---|---|---|---|---|
| Variables | Mean (SD) | Mean (SD) | t | df | p-value |
| RSP | 86.03 (4.89) | 90.49 (3.72) | 4.29 | 68 | <.001 |
| CVA | 35.80°(7.26) | 40.02° (9.40) | 2.10 | 68 | 0.04 |
| NDI | 15.37 (8.75) | 11.37 (7.51) | 2.05 | 68 | 0.04 |

Note: Rounded shoulder posture (RSP), Craniovertebral angle (CVA), Neck disability indices (NDI), Standard deviation (SD)

and surrounding areas, leading to the shoulder pain and weakness of the arm lastly is reducing the range of motion and develop into postural deformity (18,21).

Based on the findings from this study the method of photogrammetry is a reliable tool to assess postures. It is time and cost-efficient, non-invasive, and disclosure to any radiation for the subjects. Besides, it is an ideal tool for assessing the sitting postures in large epidemiological studies(16). A study Puig-Diví et al., (2017) showed that the Kinovea software is a valid and reliable tool able to measure accurately at distances up to 5m from the object and at an angle range of 90°- 45° (22). As the existing tools have many disadvantages beginning from the size, price, availability, ending with the reliability and the ability of a physiotherapist to deal with it, so Kinovea software program becomes a valid and reliable measurement tool that measures the joint range of motion (23).

The severity of the FHP depends on the degree of the CVA in the upper body posture, which is classified into 3 groups, including the groups of non-FHP (53.2 - 56.8°), slight FHP (46.9 -49.1°) and moderate-severe FHP (40.7 - 43.2°). The current study finding shows the CVA observed less than 50° among the piano (35.80° ± 7.26) and non-piano (40.02° ± 9.40) players; this indicates the participants are having FHP concerning the normal range (4,12). Likewise, the lower mean value in the CVA, greater the FHP. The greater the FHP, the greater possibility of getting the neck disability(10,12). Previous studies reported that FHP of the piano players were 21 – 51° and the non-piano players were 16 – 51°, whereas only the 5.7% non-piano players (55 – 59°) not experienced with FHP (24,25). This finding strongly supports piano players are more prone to FHP.

The present study reports that the majority of the piano players (46%) have at least 10 years of playing experience. However, 49% of the piano players claimed that they did warming up before playing the piano, while 51% of the piano players claimed don't do the warm-up. The previous study points the importance of warming up before playing the piano is an essential component to prevent injuries by increase the muscle extensibility and reduce the muscle tension, thus increase the blood circulation (9). Besides, the break between the practices of the piano is very important as well. From the findings, the majority of the piano players (72%) claimed that they would take breaks in between. Taking rests and breaks wisely can effectively control the risk of getting PRMSD (25). The awareness of the finger movements among the piano players is higher when compared to body posture and body movements. The awareness of the finger movements among the piano players is the highest while comparing with their body posture and body movements. This showed that the piano players would put more attention on the finger movements instead of focusing on other parts of the body. Similarly, the findings reported in previous research showed that the piano players would be concentrating more on the hand and finger movements (1,7). However, this can create a risk to the neck and shoulder injury as well as it tends to create tension on it because the neck and shoulders are the adhesive units to connect to the hands to produce movements on the piano keyboard. A prolonged hour of playing with this ignorance of the neck and shoulder posture will adaptively develop into poor postural playing habits (9), which leads to PRMSD in youth. When comparing, elderly population is highly prone to PRMSD that might cause bone degeneration(26).

This study result has limitations to generalize upper body posture dysfunctions between both genders. Since the majority of participants were female their psychological influence (27) might affect the upper body posture.

Based on the results obtained, this study concludes piano players are highly prone to the risk of developing postural changes in the upper body comparing with non-piano players. However, both the piano and non-piano players need to be more attentive in preventing the FHP to free from playing-related musculoskeletal disorders. Finally, this study suggests future investigations to advance the understanding of the importance of FHP with poor upper body posture in a larger number of participants with playing-related musculoskeletal disorders.

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*Conflict of Interest*

The authors declare no conflicts of interest

*Ethical approval*

Ethical approval was obtained from INTI International University ethical committee, and that the procedures followed during the study were under the Helsinki Declaration of 1975.

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