ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 10 | October - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

KINAESTHETIC SENSE AND FINE MOTOR DEXTERITY IN KEYBOARD PLAYERS.

Physiotherapy

Krinal Shah* Physiotherapy Research Intern, K.J. Somaiya College Of Physiotherapy, Sion, Mumbai, India. *Corresponding Author

Dr. Anjali Puntambekar (PT) Associate Professor, Department Of Musculoskeletal Physiotherapy, K.J. Somaiya College Of Physiotherapy, Sion, Mumbai, India.

ABSTRACT

Background: Fine motor skills are controlled movements caused by coordination of the central nervous system, the muscle fibrils and intrinsic muscles of the hand. Studies exhibit that repetitive movements, overuse, fatigue and the posture attained have an effect on the motor skills of the keyboardists. The biomechanics of keyboard playing and its related factors attribute to cause deficit in motor skills and proprioception. This study was carried out to assess the kinaesthetic sense and fine motor dexterity.

Methodology: 15 subjects each from the keyboard playing group and non-keyboard playing group were selected by purposive sampling on the basis of inclusion criteria for the study to perform the Purdue pegboard test and the Kinaesthetic Awareness test to assess their fine motor skills.

Conclusion: Kinaesthetic sense and fine motor dexterity was significantly affected in keyboard players.

KEYWORDS

Kinaesthetic Sense, Fine Motor Dexterity, Purdue Pegboard Test, Kinaesthetic Awareness Test by Lynch et al, Overuse.

INTRODUCTION:

Overuse injury has been associated with the musical world since years and more than half of them are keyboardists [5]. Overuse syndrome is a common problem in musicians causing pain, tenderness and loss of function in the muscles and ligaments of the upper limb [16]. There is a prevalence of 39%-90% musculoskeletal complaints in adult musicians [16]. These prevalent problems may involve overuse of muscles resulting from repetitive movements, often in combination with prolonged weight bearing in an awkward position, biomechanical inefficiency of posture and motor skills, the extremely long hours of practice, and insufficient regard for characteristics and structural differences in individual keyboards [3].

Fine motor skills are controlled movements caused by coordination of the central nervous system, the muscle fibrils and intrinsic muscles of the hand [8].

In piano playing and performance, the most important skills in order for a player to complete the task of performance are the motor skills. A musician plays approximately 1300-1500 hours annually in an awkward position [11]. Much of the music that has been composed for various keyboard instruments in different periods of history has a much heavier mechanical action of the hammers.

But the majority of players are ignorant of the serious physical injuries caused. In order to provide the players with preventive programs for playing-related musculoskeletal disorders (PRMD's), the develop ment of an interdisciplinary approach is essential. Therefore, this study aims at assessment and awareness among the keyboardists to reduce the incidence of PRMD's in the population thus helping promote efficient treatment interventions and motivating keyboardists to practice healthy habits [5].

MATERIALS AND METHODOLOGY:

Approval of the study was taken from the institutional ethics committee. All the subjects were provided with consent form in the most understandable language. The subjects were categorized according to individuals with experience of more than 3 years regularly of keyboard playing upto 1-2 hours and 5 times weekly and individuals not playing any musical instruments. Participants with a history of fractures, soft tissue injury, nerve injuries, congenital deformities, or on anti-epileptics, anti-depressives as well as desk job computer operators were excluded from this study.

- The outcome measures of the research study are as follows-

1) **Kinaesthetic Awareness Test By Lynch Et Al-** The test is explained to the patients and the positions are made to practice. The evaluation is done in an ergonomically quiet room. The subject's vision is occluded by placing hand in a box on the table, while the physiotherapist has a full view of the patient's hand kept at an angle of 20 degrees. The physiotherapist demonstrates a set of eight hand positions (Fig.1), and the patient is instructed to produce similar images of these positions with the tested hand, which is hidden inside the masking box. The time taken to replicate each test position is timed in seconds rounded to two decimal places, and the accuracy of replication grading is done using the criteria described by Lynch et al (1992) where:

The reliability of the test is 0.57- 0.82[2].

0 = failure to move the hand from the resting position.

1 = no resemblance to the test position.

2 = incomplete replication of the position.

3 = complete and accurate replication [2].

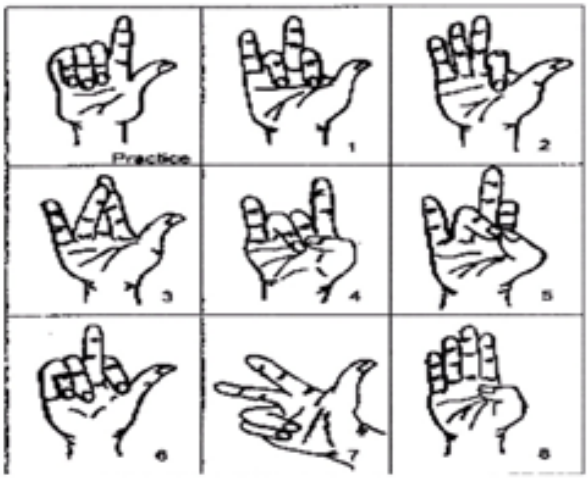

Fig 1

2) **Purdue Pegboard Test-** The Purdue Pegboard consists of a test board, pins, collars, washers, and score sheets. Subjects are instructed to put one pin at a time with the top hole first vertically, as quickly as possible in a fixed time. The final scoring is the number of pins inserted. The test compiles five separate scores:

1) right hand (30 s), 2) left hand (30 s), 3) both hands (30 s), 4) right + left + both hands, and 5) assembly (60 s). The R + L + both score (i.e., a combined score) is used to represent the overall dexterity function [1]. The reliability of the test is 0.62- 0.90 [1] .

RESULTS:
A Pilot Study was conducted on 10 subjects: 5 keyboard players and 5 non- keyboard players. The Sample size was calculated according to the Mean & S. D. obtained. Comparison of values of Hand Dexterity and Kinaesthetic sense test for the keyboard and non-keyboard groups was analysed using GRAPHPAD INSTAT. Unpaired T test was used for comparing the values obtained in both the groups as the data passed normality. The tests were performed at 5% significance level.

The participant population consisted of 15 keyboard and 15 non-keyboard players with average age of 19-22 years out of which females and males in keyboard playing group were 9 and 6 respectively and 8 and 7 respectively in non-keyboard playing group. The values for fine motor dexterity and kinaesthetic sense are summarized in the table below.

Outcome Measures			**Test**	**P Value**	**Interpretation**
1)Fine Motor Dexterity	Mean	Standard Deviation			
Keyboard Players	54.4	7.287955	Unpaired T Test	>0.0001	Significant
Non- Keyboard Players	75.25	6.953588			
2)Kinaesthetic Sense					
Keyboard Players	148.04	22.16599	Unpaired T Test	>0.0001	Significant
Non- Keyboard Players	84.44	14.53112			

A significant decrease was observed in fine motor dexterity and kinaesthetic sense in the keyboard group as compared to the non-keyboard group.

LIMITATIONS:
Longitudinal studies should be conducted to determine
- The changes in kinaesthetic sense and fine motor dexterity considering all age groups, gender and years of experience.
- The effect of factors such as the physical and mental background of a keyboardist contributing in the affection of motor skills.

DISCUSSION:
This study aimed at assessing the kinaesthetic sense and fine motor dexterity among the keyboard players when compared to the non-musical instrument playing group. Overall the keyboard players performed slow in the Purdue pegboard test when compared to the non-keyboard playing group as well as took longer time for the kinaesthetic sense test by Lynch et al to copy a position when compared to the non-musician group. A number of risk factors may contribute towards this occurrence of lack of motor skills and associated PRMDs: lack of awareness of PRMDs, lack of muscle fitness and tolerance for the assigned repertoires, duration and changes in practice habits, poor playing postures and movements, lack of awareness about biomechanical efficiency of keyboard instrument, and previous trauma. While conducting this study, the keyboardists were observed carefully and were interacted with. Observations showed awkward playing postures, lack of muscle strength and inefficient attack of the finger on the key, and most importantly lack of awareness about the associated PRMD's. Persistent pain in the muscles and other soft tissue structures while playing musical instrument are called playing related musculoskeletal disorders (PRMD's).

This could be attributed to keyboard playing which is associated with three main disorders. Musculoskeletal disorders (62%), neuropathi es due to compression (18%) and motor dysfunction (10%) [12]. The keyboardists during this study showed poor pinch grip during the Purdue pegboard test as well as showed slower execution of the position to be attained during the kinaesthetic sense test. This could be the initiation of these disorders in the musicians. These could be associated with disruption of the so-called motor control complex pathway affecting the of the motor skills.

Motor control is a skill which is learned and developed continuously through one's life. The success of a planned motor response is determined by a number of factors. Development of these cognitive processes is a complex network. This comprises multisensory inputs via afferent feedback from the environment, for example visual, auditory and somatosensory both tactile and kinaesthetic [11]. Humans possess three types of receptors responding to touch and stretch, helping in following body movement and position: 1) Pacinian corpuscle, 2) Neurons surrounding the internal organs, and 3) Meissner's corpuscles, the Merkel's cells (tactile receptors) and muscle spindles [13].

Any skilful activity like playing keyboard is regulated by a highly integrated system that includes motor planning, sensorimotor integration, execution and adaptation, following any damage or change in the biomechanics [20]. This causes a formation of feedback system which receives sensory inputs from interaction with the external environment (the music, the orchestra/other musicians, and the instrument) [15]. The physical adaption in motor control and sensorimotor integration help to adjust a physiological response to environmental changes [15]. This affection of the feedback system caused delayed motor planning, sensorimotor integration and thus late execution and adaptation of the activity; thereby causing the keyboardists to perform slow in the Purdue pegboard and Kinaesthetic sense test and lack of motor skills and kinaesthetic sense leading to fatigue and overuse in keyboardists.

Other biomechanical factors for the poor performance of the keyboardists are large sustained forces, weighted repetitive contractions cause muscle fatigue due to high physical demands [15].

The pathophysiology of keyboard playing is such that the motions of the finger are produced by either the small "weak" intrinsic hand muscles, or by the longer stronger muscles which reach up into the forearm [5]. When using these strong flexors, there is a momentary tension on the underside of the wrist and the strong muscles are used to sound the notes, the intrinsic muscles of the hand are used to hold notes down once they have been depressed [5]. Sufficient structural disruption is thus caused due to application of repetitive stress causing loss of the tissue's adaptive ability and causing injury without complete loss of function. This further causes microdamage to tissue collagen, combined with direct or indirect damage to the microvasculature, and subsequently oxygen deprivation [12]. This could be another factor associated with fatigue and overuse in keyboard players. The inter-joint coordination and “angle of attack” (angle of the vector defined from MCP to fingertip relative to the key) during key press is also an important factor affecting the microvasculature of the hand. Recent studies of muscle demonstrate that plyometric contractions and repetitive loading of tendon can lead to muscle injury and loss of function.

The evidences for musculoskeletal disorders and complaints in professional musicians has increased considerately, however, the prevalence of risk factors and efficiency of the prevention or treatment amongst musicians, are still missing. Improvement in the methodology and analysing relevant risk factors in musicians can help in optimum prevention and intervention of PRMD's [7]. Assessment of risk factors and musculoskeletal discomfort in musicians receive little academic attention and there are academic gaps to be filled to make music activities less harmful to the health of practitioners. Therefore, this present study tends to minimize this academic deficit and understand disorders affecting the musicians and enhance the knowledge of existence of these pathologies. These academic contributions through this study will enable the keyboardists to be aware about the prevention, control and rehabilitation strategies to deal with musical routines and patterns [7]. This study sees fertile field for the promotion of various risk factors associated with keyboard playing and is thus capable of developing useful guidelines in relation to the improvement of the quality of life of the musicians. This study can be a mediator of primordial prevention and intervention in these musicians.

CONCLUSION:
Kinaesthetic sense and fine motor dexterity is significantly affected in keyboard players.

The study analysis would certainly create awareness among the young keyboardists regarding overuse syndromes and playing related music disorders and improving the quality of life of the musicians.

REFERENCES
1) J Hand Ther et al. Assessing Dexterity Function, US National Library of Medicine, National Institute of Health, 2011 Jul 28. doi: 10.1016/j.jht.2011.05.001, pages 313-321.
2) Eur Spine J et al. Evaluation of the kinaesthetic sense and function of the hand in early period in operated cervical disc hernia, European Spine journal 2005 Apr 26. doi: 10.1007/s00586-005-0888-4, pages 992-997.
3) Physiology of piano playing, https://bayes.wustl.edu/etj/music/m6p.pdf
4) Zeliha Baskurt et al.Assessment of kinesthetic awareness and fine motor dexterity in

music students with performance-related hand disorders, Jan 2012, Healthmed 6(10):3395-3402.
5) Brenda G. Wristen et al. Overuse injuries & piano technique: A Biochemical Approach, Aug 1998.
6) Laura M Kok, Theodora PM Vliet Vlieland, Marta Fiocco, and Rob GHH Nelissen et al, A comparative study on the prevalence of musculoskeletal complaints among musicians and non-musicians. BMC Musculoskelet Disord. 2013; 14: 9, 2013 Jan 4. doi: 10.11 86 /1471-2474-14-9
7) Irina Foxman. Barbara J Burgel et al, Musician Health and Safety Preventing Playing Related Musculoskeletal Disorders, August 2006, AAOHN Journal 54(7):309-16 DOI: 10.1177/216507990605400703
8) Alice G Brandfonbrener et al, Musculoskeletal problems of instrumental musicians. Jun e 2003, Hand Clinics 19(2):231-9, v-vi DOI: 10.1016/S0749-0712(02)00100-2.
9) Yael Kaufman-Cohen, Navah Z Ratzon et al, Correlation between risk factors and mu sculoskeletal disorders among classical musicians. February 2011Occupational Med icine 61(2):90-5, DOI: 10.1093/occmed/kqq196.
10) Renato Silva et al, Differences in tactile acuity and body schema between musicians and July 2015, Thesis for: MSc Advanced Neuromusculoskeletal Physiotherapy
11) Cheryl D. Metcalf, Thomas A. Irvine, Jennifer L. Sims, Yu L. Wang, Alvin W. Y. Su and David O. Norris et al, Complex hand dexterity: a review of biomechanical methods for measuring musical performance, Rehabilitation and Health Technologies, Faculty of Health Sciences, University of Southampton, UK. 12 May 2014, https://doi.org /10.338 9/fpsyg.2014.00414
12) James A. Ashton-Miller et al, Response of Muscle and Tendon to Injury and Overuse. Biomechanics Research Laboratory, Department of Mechanical Engineering and Applied Mechanics, G.G. Brown 3208, University of Michigan, Ann Arbor.
13) Uwe Proske, Simon C Gandevia et al, Kinesthetic Senses, July 2018 Comprehensive Physiology 8(3):1157-1183 DOI: 10.1002/cphy.c170036.
14) Shinichi Furuya, Martha Flanders, and John F. Soechting et al, Hand kinematics of piano playing, Journal of Neurophysiology, 2011 Dec; 106(6): 2849–2864, doi: 10. 1152/jn.00378.2011.
15) Cheryl D. Metcalf, Thomas A. Irvine, Jennifer L. Sims, Yu L. Wang, Alvin W. Y. Su, and David O. Norris, Complex hand dexterity: a review of biomechanical methods for mea suring musical performance, NCBI 2014; 5: 414, 2014 May 12. doi: 10.3389 /fpsyg. 201 4.00414
16) C. Zaza et al, Playing-related musculoskeletal disorders in musicians: a systematic review of incidence and prevalence, CMAJ April 21, 1998 158 (8) 1019-1025.
17) Evadio Pereira Filho, Junior Raimundo Da Silva et al, Musculoskeletal disorders and risk factors in string musicians, December 2019 Exacta 18(1):16-36 DOI: 10.5585/exactaep.v18n1.8885,
18) H.J.H. Fry, m. Hallett, T. Mastroianni, N. Dang, J. Dambrosia et al, Incoordination in pianists with overuse syndrome, Aug 1, 1998.