Research Article

Assessing hand grip strength and screening of performance related upper limb injuries experienced by Indian musicians

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Abstract

The objective of this study were to assess Hand Grip Strength and screen for performance related upper limb injuries experienced by Guitar, Sitar, Keyboard, Harmonium, and Tabla players.100 Musicians from age group of 20-60 years participated in this survey. Every musician was given a questionnaire to fill as per their experience about performance related symptoms and problem faced in past or present in upper limb. After this, Hand grip strength (B/L) was measured in sitting position with elbow flexed in 90^0, shoulder adducted, forearm in mid prone position with wrist in neutral position and cuff of Modified Mercurial type Adult Sphygmomanometer inflated to 20 mmHg. Every participant musician was told to press the cuff as hard as possible for 3 times. Rest period of 5 minutes was given in-between every trail. The Mean score among 3 trails was recorded. The result showed, 66 Musicians out of 100 were having performance related symptom or problem experienced in upper limb. The information about musician`s hand grip strength, showed significant difference between the dominant and non-dominant hand grip strength ($p = 0.034$). Musicians participated in survey experienced symptoms like significant pain in musculoskeletal system, abnormal sensations in finger tips, weakness in muscles and loss of sensation in fingers. Assessment of grip strength is an essential evaluation method and it's useful to keep normative data of hand grip strength for musicians and also for physiotherapist.

Keywords: Modified Mercurial type Adult Sphygmomanometer, Hand grip strength, Significant pain.

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INTRODUCTION

Many aspiring peoples of any age are interested in playing any musical instrument, but they don`t know a silent side of various performance related upper limb injury which comes as the side effect of their passion. To play any musical instrument good muscle memory is required. Muscle memory is best achieved by consistent repetition of the intended task, by asking the muscles to perform. Hand is the most important and key body part involved to create sound from any musical instrument. Thus upper limb is more exposed to injuries due to over practice or because of performing professionally for many years and for much of the time. These injuries result when a biological tissue (e.g., muscle, bone, tendon, ligament) is stressed beyond its physiological limit. Also included under the umbrella of overuse injuries are specific diagnoses such as lateral epicondylitis, De Quervain's syndrome or tenosynovitis, carpal tunnel syndrome, thoracic outlet syndrome (TOS), focal hand dystonia, neuritis, and bursitis.[1] Musician's hands are vital to their musical performance. Musicians often have to perform to the limit of their abilities physically, emotionally, and spiritually. They utilize rapid, complex, coordinated movements. Sometimes they are required to play in less than ideal environments and usually they do not have a medical team to support them in the way sports medicine supports athletes.[2] Musician is assessed on and off their instrument and, once a diagnosis has been made, a short and long-term treatment plan can be established. The focus of performing arts medicine is to prevent injury.

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Most musicians acquire their injuries due to performance related issues such as incorrect practice or technique when playing their instrument.[3] Musician must be aware that the length of the healing process is in months rather than weeks. The key to getting better and staying better is to modify the amount of time and the way they are playing their instrument, as this may be predisposing them to the condition.[4] Human hand is a complex instrument that has many aims. Only the hand is capable of making distinctions about external characteristics because it combines strength and accuracy. The hand has a central role in many activities of daily life like eating, writing, typing, etc, the list is endless. Loss of optimal hand function does not merely hamper practical tasks such as personal hygiene it affects other areas of the life. Thus grip strength is frequently evaluated in clinical settings as an indicator of disease activity. It is evaluated as a component of hand function. In addition to being an economical measure that is easy to administer, it is one of the best indicators of the overall strength of the limb. Grip strength is the integrated performances of muscles that can be produced in one muscular contraction. It is widely accepted that grip strength provides an objective index of the functional integrity of the upper extremity.[5] Good hand grip strength and technique is the key element in Guitarists, Sitarists, Harmonium Players career, as it is much required to play their instrument constantly and for many years. Thus it's very important for every musician to keep record of hand grip strength. As it will be helpful to musicians to check whether musical instrument is having any impact on their hand grip strength. Till date many surveys are carried out in western countries on their musicians to study performance related injuries to upper limb or other body part, but such study is not carried out in Indian musicians in India. So my need behind this survey is to do screening of performance related upper limb injuries experienced by Indian musicians and find what are the symptoms or problem they face because of their profession and playing their musical instrument for many years. Many of us know our body weight, height, blood pressure as it is measured by us or by our Doctor, but record of hand grip strength is not been kept or known to us and our Doctor also. By measuring the hand grip strength, we can provide a normative data to the musicians, surgeons and physiotherapists which will help in rehabilitation of such musicians if they have any upper limb injury later on in his/her life. If musicians have pre-injury data of hand grip strength it will be helpful for them to plan their professional commitments if any in the rehabilitation phase.

MATERIALS AND METHODS

Cross sectional survey was done on 100 Indian musicians across Pune city to assess hand grip strength and to screen performance related upper limb symptoms and problems. It was one time study. The research protocol was approved by guide and institution. Ethical clearance was taken from comities. Musicians who aged between 20-60 years, playing the musical instrument for minimum past 2 years and playing daily at least 2 hours a day were included in the survey. Exclusion criteria was set for any musician having Musculoskeletal or neurological injury or surgery of upper limb (approx.1 yr), any pre-existing diagnosed upper limb joint arthritis, any musician playing more than 1 type of instrument, any musician operating computer more than 2 hrs continuously, any musician involved in heavy industrial work. 30 Table players, 11 Sitarists, 23 Harmonium players, 28 Guitarists and 8 keyboard players participated in the survey with written consent. All 100 musicians were given a questionnaire which helped in screening the common performance related upper limb injuries experienced by them. Informed consent was taken from all the participating musicians prior filling the forms. Questionnaire[*] mainly contained a set of question which musicians were to tick as per their experience.

Problems experienced in past and present in upper limb

1. Significant pain
2. Musculoskeletal problems, such as joint pain and swelling
3. Abnormal sensations (e.g. tingling, pins and needles)
4. Numbness or loss of sensations
5. Loss of strength or feeling of weakness
6. Lack of coordination or muscle control
7. Muscle cramps /tightness
8. Impact on professional and personal life.
9. Types of treatment received: Physical therapy, Massage, Medications, Surgery.

(*[*]Mr. Balwant Dixit, Director, center for Performing Arts of India, University of Pittsburgh`s USA, has given permission to carry out such study and use their Questionnaire which was used in 2004 for their survey in USA).*

After filling the questionnaire about the upper limb symptoms and problem, every musician was assessed for hand grip strength (B/L). With help of modified mercurial type adult sphygmomanometer (Diamond Mercurial Blood Pressure Apparatus, Manufactured by Industrial Electronic And Allied Products, Pune, Maharashtra, India) both hand grip strength were measured in sitting position with elbow flexed in 90 degrees, shoulder

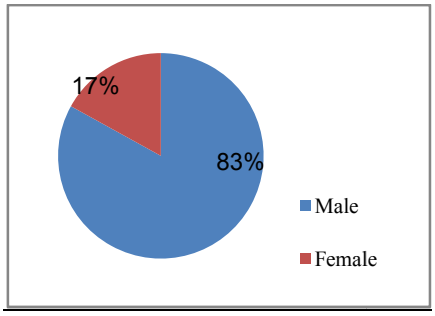
adducted, forearm in mid prone position with wrist in neutral position and cuff inflated up to 20 mmHg (testing position as per American Society of Hand Therapist) [6]. Every participant musician was told to press the cuff of adult sphygmomanometer as hard as possible for 3 times with expiration and the data was collected of their hand grip strength. 5 minutes of rest period was given in-between every trail. The mean score among 3 trails was been recorded for data calculations in unit of mmHg.

RESULTS AND STATISTICAL ANALYSIS

Gender Distribution

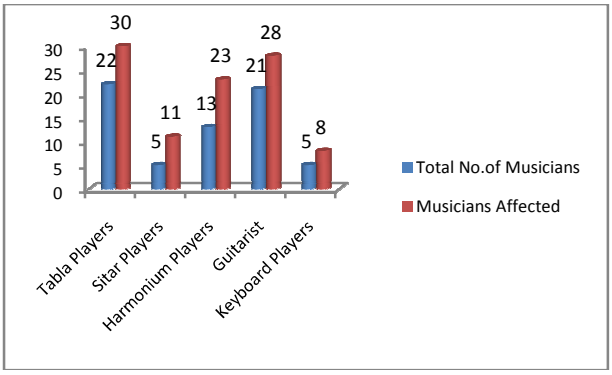
Table 1

Gender	No. of Musicians Participated
Female	17
Male	83



Graph 1

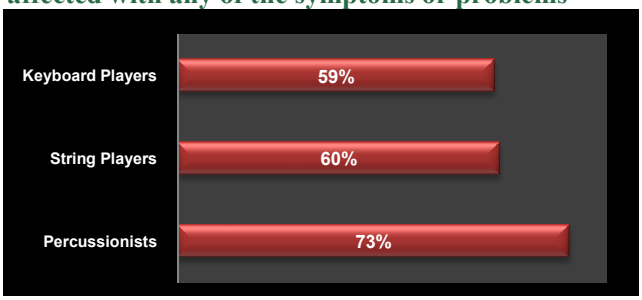
2. Musicians affected with any of the symptoms or problems



Graph 2

66 Musicians out of 100 were having some or the other, performance related symptoms or problems experienced in upper limb.

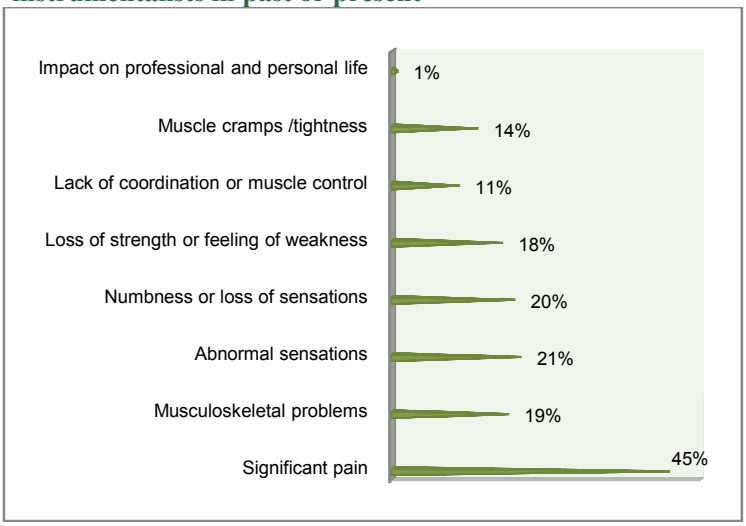
3. Comparison among the Instrumentalist who are affected with any of the symptoms or problems



Graph 3

Overall 66% of instrumentalists were having some or the other, performance related symptom or problem experienced in upper limb.

4. Comparison of symptoms or problems seen in instrumentalists in past or present



Graph 4

5. Comparison of Hand Grip strength, measurement in mmHg

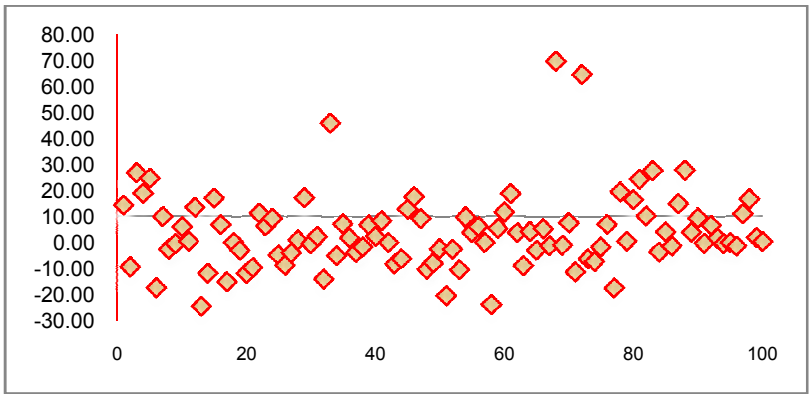
Table 2

Hand	n	Mean	S.D	S.E
Dominant	100	213.8676	52.8933	5.2893
Non-Dominant	100	208.3970	54.6957	5.4696

Paired sample t-test = 2.15, DF: 99, p value = 0.034

The result shows that there is a significant difference between the dominant and non-dominant hand grip strength. (t = 2.15 p = 0.034).
(Win-Pepi software was used to calculate, paired t test values)

6.Comparison of Hand grip strength to check the 10 % rule of hand dominace



Graph 6: X-axis: Musicians Y-axis: Hand Grip Strength in %

1. Musicians who have 10 % or more Hand grip strength in their dominant hand than non-dominant hand : 25
2. Musicians who have Hand grip strength in between 0-9.99% in their dominant hand than non-dominant hand : 30
3. Musicians who have exactly equal Hand grip strength in their dominant hand and non-dominant hand : 4
4. Musicians who have more Hand grip strength in their non-dominant hand than dominant hand : 41

Right hand dominant musicians: 99 Hand grip strength in Rt.> Lt. Hand: 55
Left hand dominant musician: 1 Hand grip strength in Rt.< Lt. Hand: 41

DISCUSSION

The present study conducted on 100 instrumental musicians in Pune suggests that 66% musicians have experienced performance related symptoms or problems in upper limb in past or present. All the instrumentalists answered the given questionnaire with their experience about the symptoms and problem mentioned in questionnaire. Mostly pain symptom was dominant in 45% of musicians. This significant pain was mainly present in upper limb and musicians experienced it when they were amateur or some had due to over practice. Compared to other instrumentalists, guitarists (75 %) showed much of the performance related symptoms or problems in their upper limb. Second part of this study was to assess the hand grip strength of all 100 musicians and record the normative data with help of modified mercurial type adult sphygmomanometer. Almost all 100 musicians were unaware of their hand grip strength, so it was a great help to them to know about the measurement and thus to keep record of the hand grip strength with their personal record. As the modified mercurial type adult sphygmomanometer is easily useable and low at cost, they can monitor their hand grip strength every year and compare with previous readings. This will be a good self monitored prognostic tool available to the musicians if any one suffers with any upper limb injury. Thus during the rehabilitation phase, by comparing the pre and post injury measurements of hand grip strength, the musicians and physiotherapist can plan fast and reliable rehabilitation protocol.

Guitarists

All 28 guitarists who participated in this study were provided with their hand grip strength normative values. 14/28 was having more hand grip strength in their non-dominant hand. Before and after the session of playing, stretching of the flexor group of muscles should be done in order to keep muscle balance proper and normal. To maintain good hand grip strength, regular intrinsic muscle strengthening exercise should be done under the guidance of physiotherapist.

Possible causes of the symptoms

1. Armature guitarists
2. Over practice
3. Faulty posture
4. Lack of warm up
5. Change of instrument
6. Quality of instrument

Tabla Players

Tabla players have to strike continuously the right index finger on the drum and left side wrist landed on the other drum. This action is rhythmic so requires continues muscle work and holding of wrist in extension. To hold the wrist in upward position, strong stabilization of shoulder is important. If the shoulder is not fixed the elbow and wrist position gets altered and it might sound wrong. So there is much of the load on shoulder muscles and extensor group of muscles of forearm. They have to

be in contracted state for much of the time, till tabla is been played.

Possible causes of the symptoms:

1. Armature tabla players.
2. Over practice
3. Faulty posture
4. Lack of warm up
5. Faulty Instrument position.

Sitar

Difficult part of playing sitar is not the hand movements, but holding the body posture. In this study it was found that sitarist complain of significant pain in muscle and joint, mainly upper limb. As the strings of sitar are very sharp and are hard to press, it requires more strength in fingers to press. While moving tip of the finger on sharp strings, the tip of figures gets injured. After many years of playing sitar you develop hard cuts on the skin. Thus, there is little loss in superficial sensation, and pulp of the figure becomes hard. Many of the sitarist believe this is an un-avoidable impact on skin.

Harmonium

While playing the harmonium both finger movements have different action to perform. Left hand mainly close and open up, to press bellows which requires little hand grip strength and continuous movement of finger flexors and extensors. The bellows is hold in two positions, when it is hold from up it requires more grip strength to catch the bellows with full fingers extended and stretched. While the other method which is catching the bellows from side, which requires proper fixation of thumb. Both the positions have their advantages and disadvantages, but it is wholly depended upon individual's style and habit which is taught by his/her guru. Left hand mainly involves in pulling the bellows, so it requires considerable amount of hand grip strength, as more air pressure creates good and loud sound, as experienced by some musicians. Thus, it may have impact on the hand grip strength in future as age progress, and can make intrinsic muscles weak. So, yearly recording of hand grip strength values was advised to musicians, to which they agreed to do as self assessment tool, by measuring the hand grip strength of both hands with help of Modified Mercurial type Adult Sphygmomanometer as explained to them during this study.

Keyboard Players

When you play the piano or keyboard it is very important to position your hands, fingers, wrist, arm and the whole rest of your body correctly. Moving the fingers in a correct way and positioning the hand and the wrist in the best way guarantees the keyboard player the possibility to play the chords correctly and in turns minimizes mistakes. One needs to sit right (not too high and not too low) your arms, forearms, wrists and hands have to be on the same axle to the height of your keyboard. In this sitting position, placing your hands on your keys, you must keep your hands arched and your fingers slightly curled. This benefits you and pays off in the long run. Your hands don't tire as easily, are less likely to cramp and your fingers can reach the keys more easily. Loss of muscle strength seems to begin in the fourth decade of life. The changes in muscle strength have a significant relationship with aging.[7] Following table will prove this statement as there was decline seen in average hand grip strength of musicians.

Table 3

Age Group	Lt. Hand	Rt. Hand	No. of Samples
20-30 yrs	222.62	221.16	n = 47
31-40 yrs	203.74	212.85	n = 24
41-50 yrs	194.18	197.72	n = 21

Mean average age was 33.95. Yrs Unit of hand grip strength in mmHg.

Several studies have confirmed that grip strength is significantly higher in men than in women in all age groups studied [8,9]. Following table proves this statement in my study.

Table 4

Sex	Avg. Lt. Hand grip strength	Avg. Rt. Hand grip strength	No. of Samples
Female	160.78 mmHg	169.95 mmHg	n = 17
Male	219.14 mmHg	221.86 mmHg	n = 83

As the sample size are not same, there can't be comparison directly of male and females, but looking at values of mean hand grip strength it looks male have better average grip strength vales than females. Considering the major change in the position of women in modern society, these changes may illustrate the growing demands in women's occupations [7, 10]. In this study the loss of strength in musicians began during the third decade of life. As isometric grip hand strength began to decline in the fourth decade. The awareness of losing muscle strength and endurance was also reported to occur at about age 40. These variations may be due to different anthropometric characteristics and habitual level of functional activity.[8] As this musicians are playing their musical instrument it requires strength of intrinsic muscle of hand, following table will show the effect of playing for many years, has impact on hand grip strength.

Table 5

Playing Experience	Avg. Lt. Hand grip strength in mmHg	Avg. Rt. Hand grip strength in mmHg	No. of Samples	% of dominance in dominant hand	Average playing time.
2-5 yrs	224.71	226.26	n = 32	0.68 %	2 hrs 18 min
6-10 yrs	199.81	194.75	n = 18	1.50 %	2 hrs 15 min
11-15 yrs	210.78	216.42	n = 11	2.67 %	3 hrs 12 min
16-20 yrs	227.03	236.66	n = 08	4.24 %	2 hrs 5 min
21- 30 yrs	205.01	211.35	n = 15	3.09 %	3 hrs 20 min
Above 30 yrs	182.78	194.60	n = 16	6.64 %	3 hrs 12 min

All above tables suggest that there is strong relation of hand grip strength to age, gender, work you do, time and years of activity. Muscle mass decreases fast under the condition of aging, however, decreasing the activity of muscle due to damage when the subjects repetition on used their dominant-hand.[11] In this study among the 100 musicians, over all difference of 2.62% in grip strength was recorded in dominant hand as compared to non-dominant. Thus in this study on musicians the rule of 10% dominance is not seen. Hence, the results support the conclusion derived out of the studies done by Harkonen *et al* 1993 ; Harth and Vetter 1994 ; Jarjour *et al* 1997, who found that this difference is less than 10%.[9]

Tips to prevent performance related upper limb injuries in Musicians :[1,4,11, 12]

1. Early recognition
2. Frequent breaks when practicing
3. Warm up before practicing
4. Cool down after practicing
5. Maximize playing time in good posture
6. Technical awareness
7. Instrument supports and splinting
8. Mental training
9. Fitness/relaxation
10. Stretching and strengthening exercise

Physiotherapy is slowly showing presence in the society. Not only in sports, it's been effective in domestic level and hospitals also. Physiotherapy also helps in maintaining physical fitness, thus preventing from the occupational injuries. Musicians who know about this field and their benefits are not far behind in utilizing its services. But in the survey it was noticed that 67 % of musicians do not know about physiotherapy and its treatment. So there is high need of creating awareness about physiotherapy among musicians. To conclude, it's a proud feeling that 100 musicians were provided a good and thorough knowledge about physiotherapy and its professional guidance and benefit mutually. As a hand therapist I was also successful in forcing the musicians to keep record of their hand grip strength normative values.

CONCLUSION

This study proves that, musical instrumentalist who participated in this study (100 Musicians) around Pune are experiencing performance related upper limb injuries (66%). Symptoms such as significant pain in musculoskeletal system, abnormal sensation were noticed in finger tips, weakness in muscles and loss of sensation in fingers. These were mainly symptoms seen in musicians who were experiencing performance related symptoms in upper limb. As this study was only related to upper limb the data and result was only analyzed about the upper limb, but questionnaire gave information that, musicians also had performance related symptoms in the body other than upper limb. So the focus should also be on the spine and lower limb related symptoms experienced by musicians and how to prevent them. Thus the alternative hypothesis assumed before the study is true. Musicians can have performance related symptoms or problems in upper limb. Assessment of grip strength is an essential evaluation method and is very useful to keep normative data of hand grip strength for musicians and for physiotherapist also. Grip strength can easily be measured by modified mercurial type adult sphygmomanometer as it is of very low cost and easy to use. Hand grip strength is an indicator of physical health and as age progress the hand grip strength tends to decline. Normative value information helps in planning the treatment and also for musicians to plan their career and when to begin the playing of their musical instrument in post-injury rehab phase. Lastly, there is very less awareness among the musicians about physiotherapy, efforts should be made to educate this community about the performance related injuries and its treatment, so that their passion for music is kept alive and our joy of listening also.

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