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A CLINICAL STUDY ON THE EFFECT OF ASANAS ON MUSCLE STRENGTH IN PATIENTS OF POST STROKE HEMIPLEGIA (PAKSHAGHATA)

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ABSTRACT

The function of *Mamsa dhatu* (muscle tissue) is plastering or *lepana* (binding). Muscles are like a gelatinous covering and serve to cover and give strength to basic bodily frame. They give capacity to work and action. When *Mamsa dhatu* (muscle tissue) is deficient one lacks cohesion and integration of body structure. When it is in sufficient quantity, courage, confidence and strength, along with the capacity for openness, forgiveness and happiness comes. The term *Mamsa* itself comes from the root '*mam*' meaning to hold firm. It was found that the strength of muscles became weak and atrophied in many diseases, for example, as seen in *Pakshaghata* (Post Stroke Hemiplegia) which is a *Vata* disorder. A stroke patient may have problems with the simplest of daily activities, such as walking, dressing, eating, and using the bathroom. Muscles nevertheless, play a key role in some movement and knowledge of this is of considerable importance in the diagnosis of muscle paralysis- an essential element in determining the presence, site, and degree of injury to nerves. Human body has also been considered as most vulnerable because *Acharya Charaka* had stated "Leaving everything else, one should maintain the body, because everything available in the world is due to this body, if it got destroyed nothing can be achieved from this world." In the body, the practice of *Yogic Asanas* promotes positive health to prevent debilitating disorders. In the present study, *Asanas* are practiced by the hemiplegic patients and healthy volunteers and after follow ups muscle strength is measured. For clinical study total 120 cases were registered. 120 cases were divided into two groups of 60 cases each. Out of 120 cases 60 cases from OPD of Neurology, S.S. Hospital, BHU and 60 cases from Department of *Rachana Sharir* IMS, BHU. Patients of group A were randomly selected diagnosed cases of *Pakshaghata* (Post stroke Hemiplegia) and cases of group B were randomly selected healthy individuals (Randomized Sampling - Unrestricted Randomized Stratified Method). Both groups further divided into two subgroups: 1) Group A (Gr-A1-patient control and Gr-A2-patient intervention) and 2) Group B (Gr-B1-volunteer control and Gr-B2-volunteer intervention), consisting of 30 in each. In the present study, all the two intervention groups were advised to do the practice a set of selected *Asanas* for the period of 4 months. After the period of 4 months, it was noticed that muscle strength is increased in patients as well as in healthy volunteer intervention groups.

KEYWORDS: *Mamsa dhatu*; muscle; muscle strength; *Pakshaghata*; Post Stroke Hemiplegia etc.

INTRODUCTION

According to the study of paralysis research centre (2011) shows that 1 in 50 people living with paralysis. That is approximately 6 million people. In which it shows the main cause are stroke (29%), spinal cord injury (23%), multiple sclerosis (17%), neurofibromatosis (4%), cerebral palsy (7%), traumatic brain injury (5%) and others (9%). The disability rate studies (2011) in India shows approximately 90 million peoples are disabled in which 6 million are handicapped due to various reasons. The prevalence rate for physical disability among males are (22.77/1000) and (16.94/1000) among females. Andhra Pradesh has the higher disability rate that is 24.98/1000 and Karnataka have the incidence rate of 21.31/1000 people. The prevalence rate in Bangalore is 6.31/1000 peoples. According to WHO statistics 15 million people suffer stroke worldwide each year. Out of them 5 million die and 5 million are permanently paralysed.

Researchers concluded that passive exercises have a positive impact on immobilisation, improving circulation and prevention on further complications. A study was conducted in Philadelphia on reduction of muscle hypertonia during repeated passive knee movement. Sixty nine ischemic shock patients selected. The results concluded that passive movement of knee induced a decrease of spastic hypertonia. These studies give indication for further to explore the field related to such type of disease as post stroke Hemiplegia. That’s why researcher has selected present topic for the study.

Muscles and movement

When a muscle shortens, either or both ends may move, but it is usual to consider one end (the origin) as fixed while the other (the insertion) moves. Which attachment moves is determined by other forces in action at the time and is not an intrinsic property of the individual muscle. Thus muscles passing from the leg into the foot will move the foot when it is off the ground, but will move the leg on the foot when the foot is on the ground. Similarly, muscles which are used to pull downwards on a rope can also be used to climb up it.

Most muscles are attached to the bones close to the joints on which they act. Thus they lose mechanical advantage over the fulcrum (joint) but gain in speed and range of movement through the levers (bones) on which they act. In many cases, muscles which are clustered round a joint are less concerned with the movement of that joint than with maintaining its stability in any position. Thus they act as ligaments (extensile) of variable length and tension in place of the usual ligaments which would inevitably restrict movement, e.g. at the shoulder joint.[1]

Flexibility and strength are about the relationship between the nervous system and the muscles

A classic definition of flexibility is the ability of the muscle to lengthen, and a classic definition of strength is the ability of the muscle to generate force and speed. Both flexibility and strength in the muscles are functions of the nervous system as much as they are functions of the ability of the muscle fibers and connective tissues to adapt in length.

In the vast majority of situations, flexibility is not determined by the actual physical length of the muscle or of the muscle fibers that compose that muscle. The resting length of the muscle, its tone, and the amount it will lengthen are all set by the proprioceptive nerve endings in the muscle. This setting is established in the nervous system through previous experiences regarding what is appropriate, safe, and functional. The amount of strength a muscle has is more dependent on its physical properties, including the actual number of muscle fibers. Muscle strength is also a product of the way that the nervous system recruits fibers and organizes the surrounding muscles and kinetic chains. When the nervous system is inefficient in the way it recruits and organizes muscles, it diminishes the functional strength of a muscle by creating a situation where the muscle has to exert effort to overcome resistance from other muscles in the body. Increasing flexibility and strength is a process of reeducating the nervous system through conscious attention and practice as much as it is about stretching and repetitions.

Muscle Strength

Muscle strength refers to the amount of force; a muscle can produce with a single maximal effort. Size of muscle cells and the ability of nerves to activate them are related to muscle strength. Muscular strength is increased by performing progressive resistance training over time to improve the endurance of the muscle. Building muscle strength takes time. The initial benefit of increasing muscle strength is that it improves performance and physical fitness. Other benefits include improved joint health, cardiovascular endurance, flexibility, increased bone density, and a leaner physique with lower body fat, among many others. Several investigators however have found that improvement in muscle force, aerobic capacity and timed mobility in subjects with exercise training.[2]

Regular repeated activities such jogging and aerobic dancing increase the supply of oxygen - rich blood available to skeletal muscles for aerobic cellular respiration. By contrast, activities such as weight lifting rely more on anaerobic production of ATP through glycolysis. Such anaerobic activities stimulate synthesis of muscle proteins and result, over time, in increased muscle size (muscle hypertrophy). Athletes who engage in anaerobic training should have a diet that includes an adequate amount of proteins. This protein intake will allow the body to synthesize muscle proteins and to increase muscle mass. As a result, aerobic training builds endurance for prolonged activities; in contrast, anaerobic training builds muscle strength for short term feats. INTERVAL TRAINING is workout regimen that incorporates both types of training – for example, alternating sprints with jogging.[3]

Anaerobic provision of ATP for muscular work

At the onset of exercise and during short term exhaustive work, skeletal muscle fibres meet their ATP requirements initially (first 3-5 s) from the limited ATP and creatine phosphate pool within the fibres and subsequently from anerobic glycolysis with the concomitant production of lactate . In every vigorous exercise, anaerobic metabolism ensures a rapid turnover of ATP which may exceed 1mol min^{-1}. Muscle lactate production increases linearly but the blood lactate concentration increases in a curvilinear fashion, with the onset of blood lactate accumulation occurring at a lactate concentration of about 2-4 mmol litre^{-1}. This point represents a rate of lactate production that exceeds the rate of lactate removal. A blood lactate concentration in excess of 4 mmol litre^{-1} is indicative of a significant increase in sympathetic nervous activity with a significant positive correlation between free plasma noradrenaline and muscle lactate concentration.

Muscle fatigue

During exercise in which anaerobic metabolism is the major source of ATP, there is a decrease in muscle pH. This decrease in pH interferes with the contractile process and energy metabolism, which subsequently limits the capacity of the muscle fibres to perform work. Under such circumstances muscle fatigue seems to be due to biochemical rather than a neural mechanism. However, during first 60 s of maximum work when the motor units are all initially maximally active, there are electromyographic (EMG) changes which are indicative of neural fatigue.

Aerobic provision of ATP for muscular work

When the blood lactate concentration is less than about 4 mmol litre^{-1}, ATP is predominantly supplied by aerobic metabolism, and performance time is lengthened while the rate of work (power output) is reduced.[4]

***Asanas* for Body**

Asanas' in *Sanskrita* means postures. There are around 84 *Asanas* - each one has a special name, special form and a distinct way of performing. *Asanas* are designed to promote, a state of mental and physical well-being or good health. This may be defined as the condition that is experienced when all the organs function effectively under the intelligent control of the mind. *Asanas* have an extraordinary capacity to overhaul, rejuvenate and bring the entire system into a state of balance. Their aim is to establish proper system in the neuromuscular tonic impulses and improve the general muscle tone.

The seven exercises which appertain to this Training of the body are following- Purificatory, strengthing, steadying, calming and leading to lightness, perception and isolation.

1st – The Purification is acquired by the regular performance of six practices to be mentioned shortly; (*Dhauti*, *Basti*, *Neti*, *Lauliki*, *Trataka*, *Kapalabhati* are the *shatkarma* or six practices, known as *shodhana*- the six purifiacatory processes.

2nd – *Asana* or posture gives *Driddhata* or strength;

3rd- *Mudra* gives *sthirta* or steadiness;

4th- *Pratyahara* gives *Dhairyata* or calmness;

5th - *Pranayama* gives lightness or *Laghima*;

6th - *Dhyana* gives perception (*pratyakshatwa*) of self;

7th - *Samadhi* gives isolation (*nirliptata*), which verify the freedom.

MATERIAL AND METHOD

Present study was conducted to collect the information in the context of utility of selected *Asanas* for the promotion of muscle strength component on patients of post stroke hemiplegia as well as volunteers. For this the researcher had chosen experimental method. The methodology adopted for collecting the data include:

- Experimental design,
- Selection of sample,
- Selection of scales,
- Selection of Instruments,
- Criterion measure,
- Procedure,
- Technique of intervention,
- Statistical tools etc.

The present study was conducted in the following Departments and Hospital, Institute of Medical Sciences,

B. H. U., *Varanasi*

- (A) Department of *Rachana*, *Sharir*, Faculty of *Ayurveda*,
- (B) Department of *Svasthavritta* and *Yoga*, Faculty of *Ayurveda*,
- (C) Neurology OPD, Faculty of Modern Medicine, Sir Sunder Lal Hospital.

Statement of the problem

A study to assess the effectiveness of selected *Hatha yogic Asanas* for improving muscle strength of the hemiplegic patients in Neurology O.P.D., Sir Sunder Lal Hospital, B.H.U., *Varanasi*.

AIM OF STUDY

This study was aimed:

Functional assessment of muscle strength through various measures after the implementation of *Yogic Asana* (*HATHA YOGA*) in healthy volunteers as well as post stroke hemiplegic patients.

OBJECTIVES OF THE STUDY

1. To review the *samhitas* and literature related to present study.
2. To assess the pre-test and post-test score of muscle strength (regarding selected *Asanas*) for hemiplegic patients.
3. To assess the pre-test and post-test score of muscle strength (regarding selected *Asanas*) for healthy volunteers.
4. To determine the effectiveness of structured *Hatha yogic Asanas* among the hemiplgic patients and healthy volunteer.

Sample Selection

For clinical study total 120 cases were registered. 120 cases were divided into two groups of 60 cases each. Out of 120 cases 60 cases from OPD of Neurology, S.S. Hospital, BHU and 60 cases from Department of *Rachana Sharir*, IMS, BHU. Patients of group A were randomly selected diagnosed cases of *Pakshaghata* (Post stroke Hemiplegia) and cases of group B were randomly selected healthy individuals. (Randomized Sampling - Unrestricted Randomized Stratified Method)

Both groups further divided into two subgroups:

1) Group A (Gr-A1-patient control and Gr-A2-patient intervention) and
2) Group B (Gr-B1-volunteer control and Gr-B2-volunteer intervention), consisting of 30 in each. In the present study, all the two intervention groups were advised to do the practice a set of selected *Asanas* for the period of 4 months.

Exclusion Criteria

- Patients with age group >75 years or <15 years.
- Abuse of drugs and alcohol.
- Patients of quadriplegia and paraplegia.
- Patients, suffering from respiratory disorders.
- Patients with altered sensorium.

Inclusion Criteria

- Patients between age group 15-75 years.
- Patients diagnosed with *Pakshaghata* (Post Stroke Hemiplegia) only.

Assessment criteria

The improvement provided by the *yoga* therapy was assessed by clinical sign & symptoms of Post Stroke Hemiplegia. For this purpose a special research proforma was developed to assess the detailed history of the patients. The tools, scales, scoring and gradation pattern for the assessment is shown below-

Selection of Tools

Handgrip Dynamometer- Handgrip Strength Test

Hand grip strength can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer. The force has most commonly been measured in kilograms and pounds, but also in millilitres of mercury and in Newtons.

Purpose

The purpose of this test is to measure the **maximum isometric strength** of the hand and forearm muscles.

Selection of Scales

STUDENT SELF –EVALUATION SCALE

This scale can be used to evaluate student's progress in all the Classical Yoga Postures. By keeping an accurate record of their practice, they can more readily determine their progress in making changes to their health and stamina. It may be ideal to have their instructor evaluate them according to these standards, especially if they are uncertain of their performance in the *Yoga* poses, or to find out whether they are using the proper muscles meant to be utilized in the *Yogasanas.*[5]

The grading of scale is ranges from Grade 5 to Grade 1 as below-

Grade 5. Full strength-An ability to hold the pose steadily and comfortably without trembling at any position along its arc of range of motion for 12 full breaths.

Grade 4. Average strength- An ability to hold the position steadily and comfortably at only the end point of full range of motion for 12 breaths.

Grade 3. Fair strength- The posture can be done for 6 to 12 breaths with the requisite muscles functioning fully, and is accompanied with mild discomfort and trembling.

Grade 2. Poor strength- The posture cannot be achieved with the designated muscles contracting. The body compensates and does a rudimentary resemblance of the pose using adjacent or accessory muscle groups to achieve the position.

Grade 1. Trace strength- The posture is done relying on the joints to hold the position. Minimal muscle strength is utilized. "Locked" or hyperextended joints especially characterize this posture, with soft muscle tissue opposing taut, overstretched muscle tissue. Often seen in hypermobile practitioners doing "advanced" *yogasanas*.

BROOKES SCALE

The common functional scale to rate the grade of disease severity is the Brooke Scale designed for DMD, and nowadays have been used in many neuromuscular diseases. The Brooke scale[6] was designed to assess the upper extremity function. The grades of the Brooke scale range from 1 to 6.

Grading system for the Brookes scale

1. Starting with arms at the sides, the patient can abduct the arms in a full circle until they touch above the head
2. Can raise arms above head only by flexing the elbow (shortening the circumference of the movement) or using accessory muscles
3. Cannot raise hands above head, but can raise an 8-oz glass of water to the mouth
4. Can raise hands to the mouth, but cannot raise an 8-oz glass of water to the mouth
5. Cannot raise hands to the mouth, but can use hands to hold a pen or pick up pennies from the table
6. Cannot raise hands to the mouth and has no useful function of hands.

MUSCLE STRENGTH SCALE[7]

Major skeletal muscles can be functionally assessed for their strength. Muscles are evaluated individually with comparison to that of the same muscle on the opposite side of the body. Muscle strength can be monitored over time to follow progression or remission of disease.

Table No. 1: Showing Grading of the muscle strength scale ranges from Grade 5 to Grade 0 as follows:

Findings	Grade
Normal motor power	5
Able to overcome gravity and significant resistance but strength not quite normal	4++
Able to overcome gravity and moderate resistance	4+
Able to overcome gravity and mild resistance	4
Able to overcome gravity but not resistance	3
Unable to overcome the force of gravity but able to move in the plane of the supported extremity	2
Flicker movements only	1
Total paralysis	0

In the present study, a set of selected *Asanas* and *Pranayama* formed the independent variables. They are listed below:

1. *HASTTOTHANA-ASANA*
2. *TRIKONA-ASANA*
3. *UTTHANPADA-ASANA*
4. *PAVANMUKTA-ASANA*
5. *BHUJANGA-ASANA*
6. *SHAVA- ASANA*

On the basis of the guidance of Dr. Mangalagowri V. Rao, Assistant Professor, Department of *Swasthavritta* and *Yoga* Faculty of *Ayurveda*, IMS, BHU, *Varanasi* and with reference to the advantages and disadvantages of various *Yogic* exercises for the patients of poststroke hemiplgia of age group15-65 and volunteers of age group 17-30, it was advisable to select the above set of yogic exercises for the study.

OBSERVATION AND RESULTS

Observational Table No. 1: Showing the effect in term of Brook scale in *Asanas*, initially and at follow ups, in 60 patients of Group-A (group of *Pakshaghata* patients), further divided into 2 sub-groups, Gr-A1 (*Pakshaghata* control group) and Gr-A2 (*Pakshaghata* intervention group):

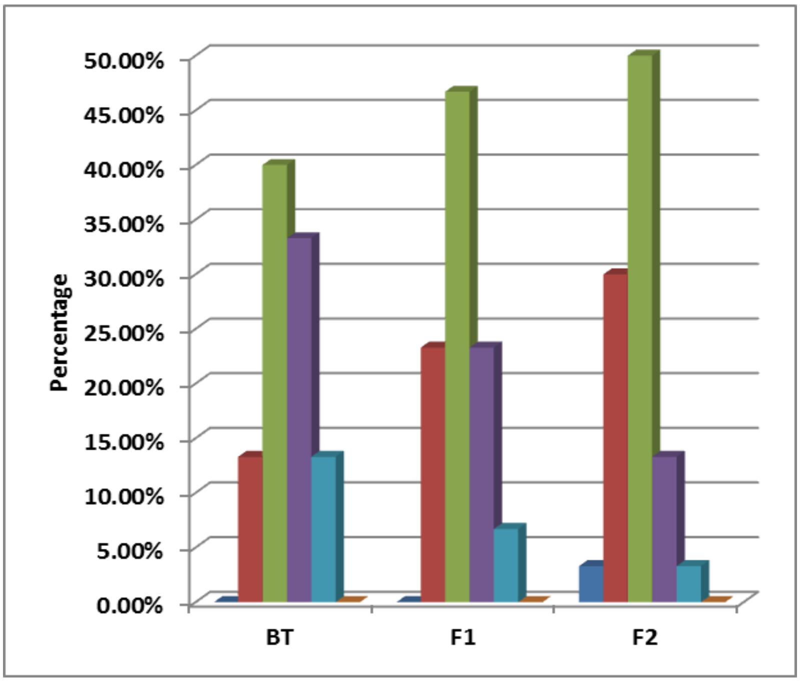
Group	Grade	Brook scale Number and % of cases			Within the group comparison Friedman test
		BT	F1	F2	
Patient control	Abduct arm in full circle until they touch above head	0 (0.0%)	0 (0.0%)	1 (3.3%)	χ^2 =17.575 p=0.000
	Raise arm above head only by flexing the elbow	4 (13.3%)	7 (23.3%)	9 (30.0%)	
	Cannot raise hands above head but raise 8-oz glass to the mouth	12 (40.0%)	14 (46.7%)	15 (50.0%)	
	Can raise hands to the mouth, but cannot raise an 8-oz glass to the mouth	10 (33.3%)	7 (23.3%)	4 (13.3%)	
	Cannot raise hands to mouth, but can hold pen or pick up pennies	4 (13.3%)	2 (6.7%)	1 (3.3%)	
	Cannot raise hands and has no useful function of hands	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Patient intervention	Abduct arm in full circle until they touch above head	0 (0.0%)	0 (0.0%)	13 (43.3%)	χ^2 =59.051 p=0.000

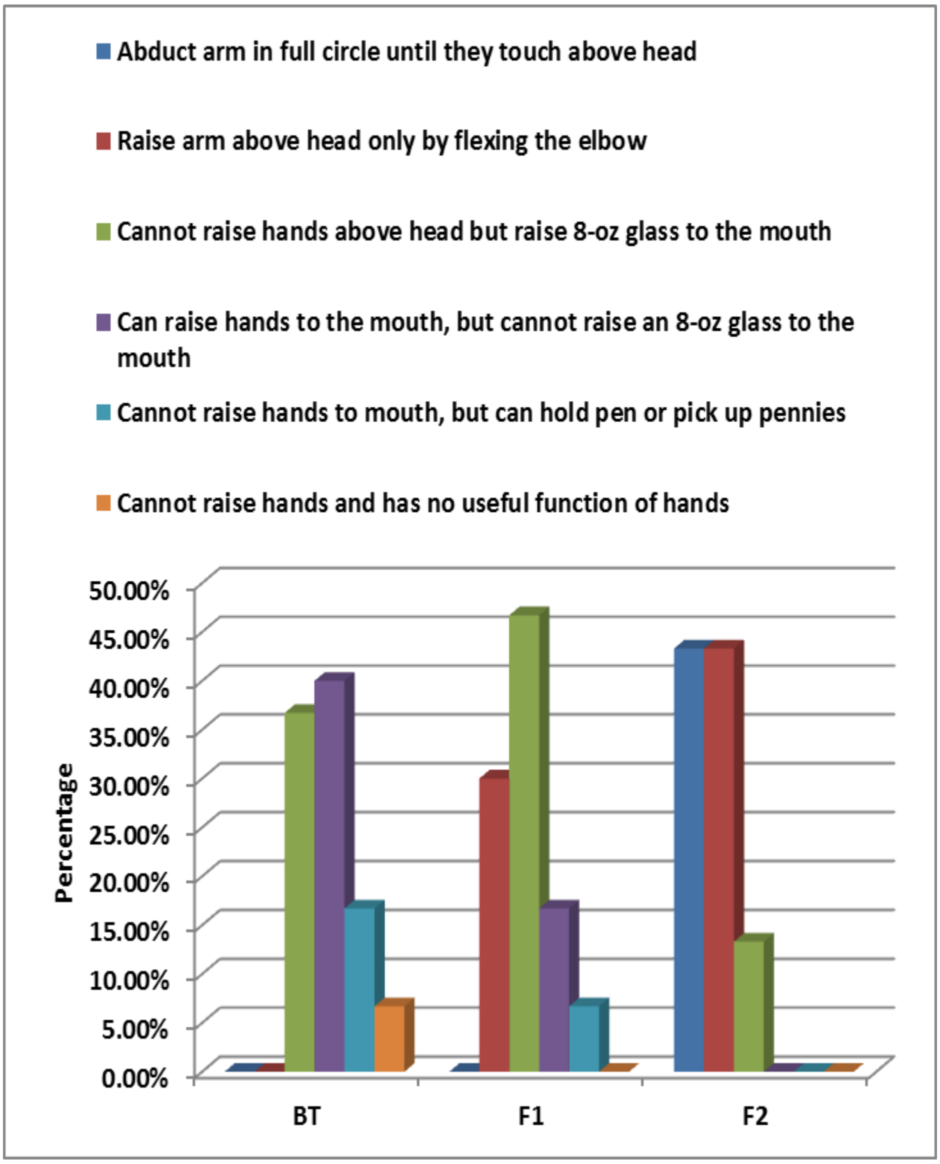
	Raise arm above head only by flexing the elbow	0 (0.0%)	9 (30.0%)	13 (43.3%)	
	Cannot raise hands above head but raise 8-oz glass to the mouth	11 (36.7%)	14 (46.7%)	4 (13.3%)	
	Can raise hands to the mouth, but cannot raise an 8-oz glass to the mouth	12 (40.0%)	5 (16.7%)	0 (0.0%)	
	Cannot raise hands to mouth, but can hold pen or pick up pennies	5 (16.7%)	2 (6.7%)	0 (0.0%)	
	Cannot raise hands and has no useful function of hands	2 (6.7%)	0 (0.0%)	0 (0.0%)	
Between group comparison Chi- square		χ^2=6.336 p=0.175	χ^2=0.583 p=0.900	χ^2=22.381 p=0.000	

There is some decrease grade of disease severity in each group. The intra group comparison of Brookes Scale was found statistically highly significant (0.0%) in each group.

The inter group comparison of Brookes Scale was found statistically highly significant ($p<0.05$) at the end of 2nd follow up which was initially insignificant ($p>0.05$).

The decreasing in the grade of disease severity was more pronounced in the intervention group in comparison to the control group. This table shows that the movement of the upper limb was increased in the intervention group.





Graph No. 1-2: Showing the effect in term of Brook scale in *Asanas*, initially and at follow ups, in 60 patients of Group-A (group of *Pakshaghata* patients), further divided into 2 sub-groups, Gr-A1 (*Pakshaghata* control group) and Gr-A2 (*Pakshaghata* intervention group).

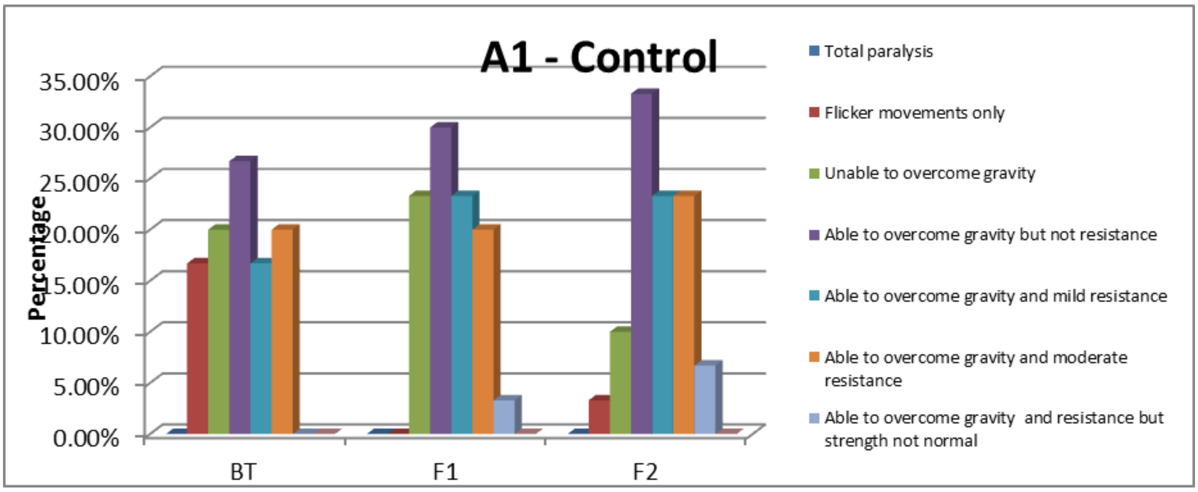
Observational Table No. 2: Showing the effect in term of Muscle strength scale in *Asanas*, initially and at follow ups, in 60 patients of Group-A (group of *Pakshaghata* patients), further divided into 2 sub-groups, Gr-A1 (*Pakshaghata* control group) and Gr-A2 (*Pakshaghata* intervention group):

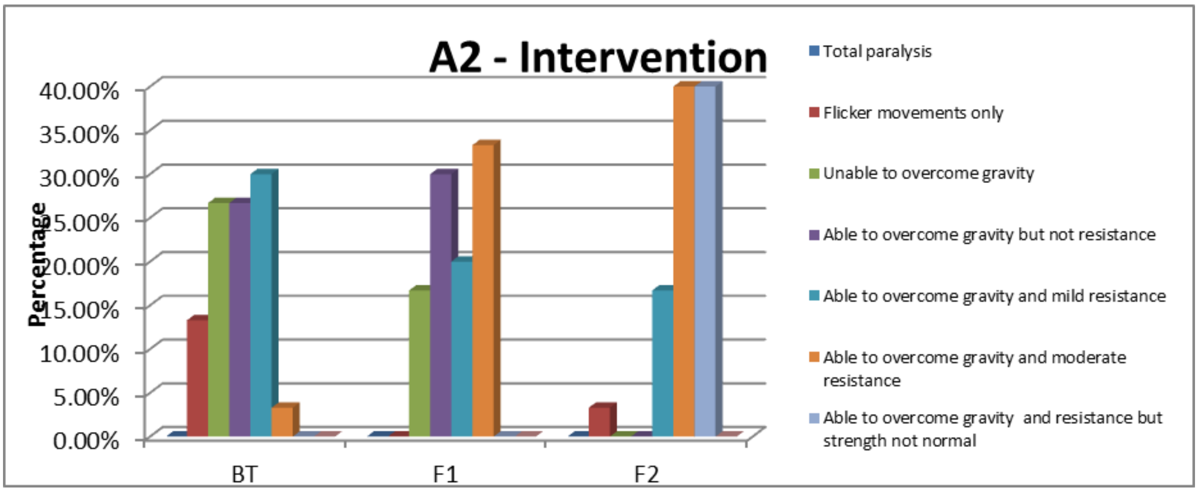
Group	Grade	Muscle strength scale Number and % of cases			Within the group comparison Friedman test
		BT	F1	F2	
Patient control	Total paralysis	0 (0.0%)	0 (0.0%)	0 (0.0%)	χ^2 =18.659 p=0.000
	Flicker movements only	5 (16.7%)	0 (0.0%)	1 (3.3%)	
	Unable to overcome gravity	6 (20.0%)	7 (23.3%)	3 (10.0%)	
	Able to overcome gravity but not resistance	8 (26.7%)	9 (30.0%)	10 (33.3%)	
	Able to overcome gravity and mild resistance	5 (16.7%)	7 (23.3%)	7 (23.3%)	
	Able to overcome gravity and moderate resistance	6 (20.0%)	6 (20.0%)	7 (23.3%)	
	Able to overcome gravity and resistance but strength not normal	0 (0.0%)	1 (3.3%)	2 (6.7%)	
	Normal motor power	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Patient intervention	Total paralysis	0 (0.0%)	0 (0.0%)	0 (0.0%)	χ^2 =51.322 p=0.000
	Flicker movements only	4 (13.3%)	0 (0.0%)	1 (3.3%)	
	Unable to overcome gravity	8 (26.7%)	5 (16.7%)	0 (0.0%)	
	Able to overcome gravity but not resistance	8 (26.7%)	9 (30.0%)	0 (0.0%)	
	Able to overcome gravity and mild resistance	9 (30.0%)	6 (20.0%)	5 (16.7%)	
	Able to overcome gravity and moderate resistance	1 (3.3%)	10 (33.3%)	12 (40.0%)	
	Able to overcome gravity and resistance but strength not normal	0 (0.0%)	0 (0.0%)	12 (40.0%)	
	Normal motor power	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Between group comparison Chi- square		χ^2=5.111 p=0.276	χ^2=2.410 p=0.661	χ^2=21.792 p=0.001	

There is some increase in muscle strength in each group. The intra group comparison of Muscle strength was found statistically highly significant (0.0%) in each group.

The inter group comparison of Muscle strength was found statistically highly significant ($p<0.05$) at the end of 2nd follow up which was initially insignificant ($p>0.05$).

The increasing in the Muscle strength was more pronounced in the intervention group in comparison to the control group.



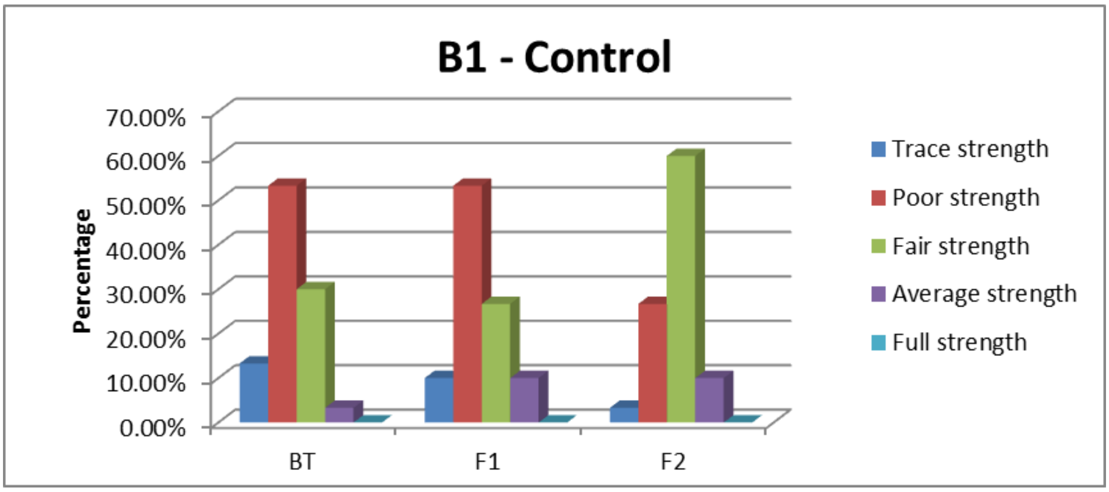


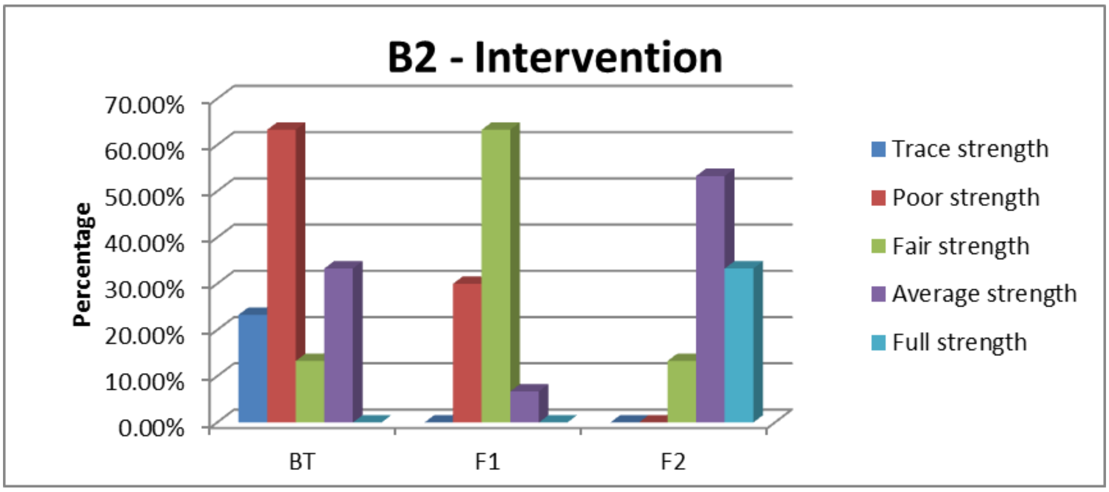
Graph No. 3-4: Showing the effect in term of Muscle strength scale in *Asanas*, initially and at follow ups, in 60 patients of Group-A (group of *Pakshaghata* patients), further divided into 2 sub-groups, Gr-A1 (*Pakshaghata* control group) and Gr-A2 (*Pakshaghata* intervention group).

Observational Table No. 3: Showing the effect in term of Student self- evaluation scale in *Asanas*, initially and at follow ups, in 60 volunteers of Group-B (group of Healthy volunteers), further divided into 2 sub-groups, Gr-B1 (Healthy control group) and Gr-B2 (Healthy intervention group).

Group	Grade	Student self evaluation scale Number and % of cases			Within the group comparison Friedman test
		BT	F1	F2	
Volunteer control	Trace strength	4 (13.3%)	3 (10.0%)	1 (3.3%)	χ^2=17.333 p=0.000
	Poor strength	16 (53.3%)	16 (53.3%)	8 (26.7%)	
	Fair strength	9 (30.0%)	8 (26.7%)	18 (60.0%)	
	Average strength	1 (3.3%)	3 (10.0%)	3(10.0%)	
	Full strength	0 (0.0%)	0 (0.0%)	0(0.0%)	
Volunteer Intervention	Trace strength	7 (23.3%)	0 (0.0%)	0 (0.0%)	χ^2=58.207 p=0.000
	Poor strength	19 (63.3%)	9 (30.0%)	0 (0.0%)	
	Fair strength	4 (13.3%)	19 (63.3%)	4 (13.3%)	
	Average strength	10 (33.3%)	2 (6.7%)	16 (53.3%)	
	Full strength	0 (0.0%)	0 (0.0%)	10 (33.3%)	
Between group comparison Chi- square		χ^2=3.998 p=0.262	χ^2=9.641 p=0.022	χ^2=36.804 p=0.000	

The increasing in the Muscle strength was more pronounced in the intervention group in comparison to the control group.





Graph no. 5-6: Showing the effect in term of Student self- evaluation scale in *Asanas*, initially and at follow ups, in 60 volunteers of Group-B (group of Healthy volunteers), further divided into 2 sub-groups, Gr-B1 (Healthy control group) and Gr-B2 (Healthy intervention group).

Observational Table No. 4: Showing the effect in terms of Isometric strength of right hand in *Asanas*, initially and at follow ups, in 60 volunteers of Group-B (group of Healthy volunteers), further divided into 2 sub-groups, Gr-B1 (Healthy control group) and Gr-B2 (Healthy intervention group):

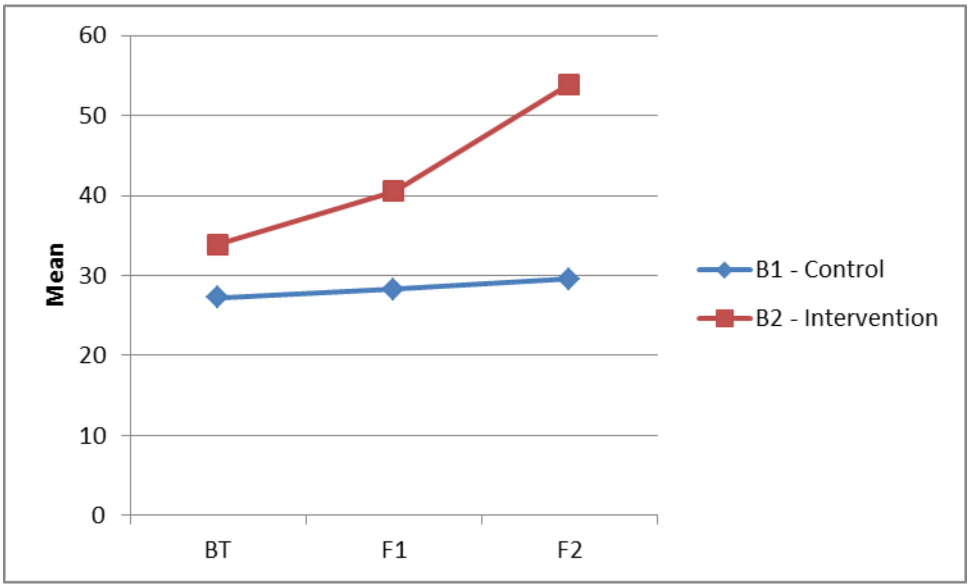
Group	Isometric strength of right hand Mean and ± SD			Within the group comparison Paired t-test
	BT	F1	F2	BT-F2
Volunteer control	27.20± 15.19	28.30± 15.35	29.53± 15.54	-2.33±1.09 t=-11.68 p=0.000
volunteer intervention	33.90± 21.63	40.53± 22.93	53.87±24.97	-19.97±6.27 t=-17.45 p=0.000
Between group comparison Unpaired t-test	t = -1.388 p=0.170	t= -2.428 p=0.018	t= -4.531 p=0.000	

In inter group comparison test difference was statistically significant ($p<0.001$) after 2nd follow-up, which was initially insignificant. This shows better effects of intervention in comparison to control group.

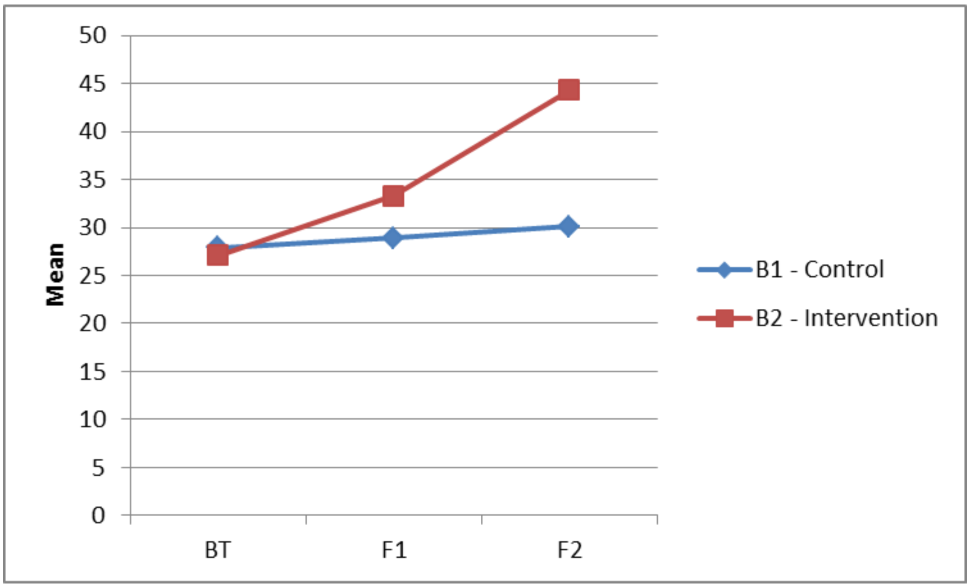
Observational Table no.5: Showing the effect in terms of Isometric strength of left hand in *Asanas*, in 2 sub-groups within group of Healthy volunteer (Gr-B1-control, B2-intervention) initially and follow ups:

Group	Isometric strength of left hand Mean and ± SD			Within the group comparison Paired t-test
	BT	F1	F2	BT-F2
Volunteer control	27.90± 18.37	28.87±18.04	30.07± 18.19	-2.17 ± 1.55 t=-7.62 p=0.000
Volunteer intervention	27.10± 19.50	33.30±20.03	44.33±20.80	-17.23 ± 5.76 t=-16.39 p=0.000
Between group comparison Unpaired t-test	t = 0.164 p=0.871	t= -0.901 p=0.371	t= -2.828 p=0.006	

In inter group comparison test difference was statistically significant ($p<0.05$) after 2nd follow-up, which was initially insignificant. This shows better effects of intervention in comparison to control group.



Graph No. 7: Showing the effect in terms of Isometric strength of right hand in *Asanas*, initially and at follow ups, in 60 volunteers of Group-B (group of Healthy volunteers), further divided into 2 sub-groups, Gr-B1 (Healthy control group) and Gr-B2 (Healthy intervention group).



Graph No. 8: Showing the effect in terms of Isometric strength of left hand in *Asanas*, initially and at follow ups, in 60 volunteers of Group-B (group of Healthy volunteers), further divided into 2 sub-groups, Gr-B1 (Healthy control group) and Gr-B2 (Healthy intervention group)

DISCUSSION

Yogic postures tone up the body and the mind whereas physical exercise affects mainly the body. The caloric requirement in yogic *Asanas* varies from 0.8 to 3 calories per minute while the caloric requirement of a physical exercise varies from 3 to 20 calories per minute.

The position of the *Asana* causes a squeezing action on a specific organ or gland, resulting in the stimulation of that part of the body. This causes an increase in blood supply to the muscles and ligaments as well as relaxing them. It also takes pressure off nerves in the area. This stretching is involved in all the *Asanas*, since it has such a beneficial effect on the body. While holding the *yoga* posture we breathe slowly and deeply, moving the abdomen only (abdominal or low breathing). This increases the oxygen and *prana* supply to the target organ or gland, thereby enhancing the effect of the *Asana*. When exercise is done in combination with *Asanas* than alternate contraction and passive stretching is administered to muscles which along with increasing strength, add new sarcomere to the endings of the muscle.

Yogic exercise aims at both prevention and treatment of various diseases. However, physical exercise wastes more energy due to quick movements and more lactic acids are formed in the muscle fibres. But energy is not wasted in *yoga* practices. *Yoga* postures and breathing exercises unlike physical exercises do not strain the cardio vascular system, and they improve one's physical fitness and muscle strength.[8]

Brookes Scale Analysis (Grading of disease severity)

Brookes scale was firstly designed for DMD, and nowadays have been used in many neuromuscular diseases. The Brooke scale was designed to assess the upper extremity function. The grades of the Brooke scale range from 1 to 6; 1 means that the subject can elevate their arms full range to the head with the arms straight; while 2 means that the shoulder strength is insufficient to elevate their arms and the subject needs to flex the elbow to elevate the arms; in grades 3 and 4, the subject is unable to elevate the shoulders but can raise hands to the mouth with or without weight respectively; grade 5 refers to the subject being unable to raise hands to the mouth and only some hand movement exists, while grade 6 refers to no useful function of hands.

The observational table no.1 clearly depicts that the grading of disease severity in control and intervention group decreases with each follow up.

There is some decrease grade of disease severity in each group. The intra group comparison of Brookes Scale was found statistically highly significant (0.0%) in each group. The inter group comparison of Brookes Scale was found statistically highly significant ($p<0.05$) at the end of 2nd follow up which was initially insignificant ($p>0.05$).The decreasing in the grade of disease severity was more pronounced in the intervention group in comparison to the control group. This table shows that the movement of the upper limb was increased in the intervention group.

According to **Hiller et al.** upper extremity function is strongly correlated with muscle strength of the wrist extensors, radial deviation range of motion and the Brooke scale in DMD.[9]

Functional abilities (grading) in Brooke Scale has good inter-rater and intra-rater reliability and correlated with timed tests in DMD.[10]

Muscle strength analysis (through Muscle strength Scale and Student self evaluation scale)

The observational table no. 2 and 3 clearly depicts that the Muscle strength in control and intervention group increases with each follow up. There is some increase in muscle strength in each group. The intra group comparison of Muscle strength was found statistically highly significant (0.0%) in each group. The inter group comparison of Muscle strength was found statistically highly significant ($p<0.05$) at the end of 2nd follow up which was initially insignificant ($p>0.05$). The increasing in the Muscle strength was more pronounced in the intervention group in comparison to the control group.

According to **Raub J. A. (2002)** the three main elements used in *hatha yoga* to attain its purposes are the body, the physical part of man; the mind, the subtle part; and the element that relates the body with the mind in a special way, the breath. Over the last 10 years, a growing number of research studies have shown that the practice of *hatha yoga* can improve strength, strength endurance and flexibility, and may help control such physiological variables as blood pressure, respiration and heart rate, cardiovascular endurance and maximum oxygen consumption to improve overall exercise capacity. The findings of **Arciero et al. (2009)** has found that the *yoga* and functional resistance training has improved the cardiovascular endurance. The position of the asana causes a squeezing action on a specific organ or gland, resulting in the stimulation of that part of the body. This causes an increase in blood supply to the muscles and ligaments as well as relaxing them. It also takes pressure off nerves in the area. This stretching is involved in all the *Asanas*, since it has such a beneficial effect on the body. While holding the *yoga* posture we breathe slowly and deeply, moving the abdomen only (abdominal or low breathing). This increases the oxygen and *prana* supply to the target organ or gland, thereby enhancing the effect of the *Asana*. Blood always carry oxygen and energy to the particular muscle this may be the reason for the significant improvement of muscular strength, muscular strength endurance flexibility and cardiovascular endurance. Some of the relaxing *Asanas* like *shavasana, vajrasana* and *yogamudra* may have the reason of significant decrease in the in blood pressure and resting pulse rate.

Another study of **Kwon HR et al. (2010)** showed that the low intensity resistance training as like *yogic* exercise was effective in increasing muscle mass and strength. Moreover, the findings of **Jauregui-Ulloa et al. (2007)** showed that the *yoga* practice improves the muscular strength. The findings of **Madanmohan *et al*. (2008)** showed that the *yoga* training for a short period of 6 weeks can produce significant increase in muscle strength and the studies of **Hagins M. et al. (2007)** showed that *yoga* practices improve strength of upper and lower extremities. **Hagins M. et al. (2007)** found that *yoga* practices improve strength of upper and lower extremities, which are also in line with the findings of the present study.

Muscle strength analysis (through Hand grip dynamometer)

The observation table no.4 and 5 depicts that the Mean ±SD of the Isometric strength of right hand and left hand in healthy-intervention, increase with each follow up, which is statistically significant. In inter group comparison test difference was statistically significant ($p<0.001$) after 2nd follow-up, which was initially insignificant. This shows better effects of intervention in comparison to control group.

Madanmohan et al. (2008) to designed to test whether *yoga* training of six weeks duration modulates sweating response to dynamic exercise and improves respiratory pressures, handgrip strength and handgrip endurance.

Ashchoff and Gerkema (1985) said that ultradian rhythm as an economic principle not to spend energy continuously at relative high level but to alternate between expenditure and restoration of energy". These functions were associated with activities such as work (hunting), rest (healing), eating and many other behaviors that were identified by Klietman (1961) as defining the basic rest activity cycle (BRAC). Werntz, Bickford, Bloom, & Shannahoff- Khalsa (1983) have proposed that right nostril dominance coincides with 'resting phase' of the BRAC. A very early description by Wada in 1922, attempted to establish a relationship between basic rhythms (i.e., hunt-eat-rest) and hand grip strength (Shannahoff-Khalsa, 1991; Shannahoff-Khalsa, 2008). Motor activity during wakefulness showed greater hand grip strength during periods of hunger contractions compared to quiescent or post-meal periods.

CONCLUSION

Thus the present study has been conducted from a new dimension. It has evaluated the effect of *Yoga* techniques on the muscle strength interventions (*Asanas*) in the most prevalent psychosomatic condition viz. *Pakshaghata* (post stroke hemiplegia). It is important to point out that this condition is supposed to cause Sarcopenia (loss of skeletal muscle mass and increase in fat mass). Inactivity or immobilization is thought to accelerate sarcopenia; with 2 weeks of inactivity, muscle mass decreases, along with muscle strength. After a stroke, the time spent in bed during the day is greater than 50%. Thus, damage caused by the stroke and decreased mobility would combine to produce a decline in muscle mass in the paretic muscles and, to a lesser extent, in the non-paretic muscles.

Inactivity and prolonged bed rest are unnatural states of human body. Our sense of movement is controlled by communication between sensory nerves and the central nervous system. Disruption of communication of nerve impulses anywhere along the pathway from the brain to muscles can impair control of muscle movement and cause muscle weakness and loss of co-ordination. Muscle weakness can progress to paralysis.

There was significant difference in the objective Parameters before and after the intervention of *yogic Asanas* in both groups i.e. Patient group and Healthy volunteer group. Among the objective parameters, Muscle strength Scale, the Brook Scale, Student self evaluation scale and Hand Grip Test show highly significant as $p<0.05$.

The researcher, during her clinical experiences, has come in contact with many Hemiplegic patients who have reported that they found difficulty in meeting their activities of daily living, and had to depend largely upon others for everything. The investigator also noticed that it is important to educate the relatives regarding selected *Asanas* for paralysed patients. So that the researcher educate to the Caregivers of paralysed patients to provide standardised care to the patient.

The goal of this study was to evaluate the credibility of *yoga* as a complementary treatment and management modality in patients of *Pakshaghata* (post stroke Hemiplegia). Although the present study provided some insight into the benefits of *yoga* in post stroke hemiplegia, most of the studies reviewed were only in the initial stages of understanding the clinical (or symptomatic) benefits of *yoga*. Furthermore, most of these trials had inadequacies in their study designs. Therefore, until studies involving double blinding and randomization with larger samples are employed, these benefits cannot be substantiated to draw proven conclusions of the benefits of *yoga*. Once that has been achieved however, the next phase would be to observe and understand the actual physiological changes and the modifications in pathology occurring with the practice of *yoga*. Until that time, a discussion or classification of the benefits of *yoga* would be highly speculative. However, it is of utmost importance to understand these shortcomings in the study designs used till date, for guiding investigators wishing to pursue this cause further.

Further these interventions are also useful in reducing the level of stress in general and Muscle strength related disease in particular, as revealed by finding related with the instruments. Thus in spite of being a time bound research; the present study has revealed several newer informations and has definitely advanced the knowledge in this field. Thus it can be said beyond doubt that it would enlighten the path for future research workers in this challenging field.

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