

## EFFECT OF PLYOMETRIC TRAINING AND RESISTANCE TRAINING ON PHYSICAL AND MENTAL PERFORMANCE IN COLLEGIATE MALE FOOTBALL PLAYERS

**PRATIK VAKHARIYA<sup>1</sup>, CHINTVIKA PATEL<sup>2</sup>, AKSHAY BHAVSAR<sup>2</sup>**

1. Assistant Professor, Shree B. G. Patel College of Physiotherapy, Sardar Patel University, VallabhVidhyanagar.
2. Intern, Shree B. G. Patel College of Physiotherapy, Sardar Patel University, VallabhVidhyanagar.

### Abstract

**Background:** Marked evidence indicates that regular participation in a resistance training program or a plyometric training program can improve measures of strength and power in adults. Studies also suggest that changes in motor performance skills resulting from the performance of combined resistance training and plyometric training are greater than with either type of training alone. Thus, both resistance training and plyometric training are typically recommended for adults when gains in motor performance are desired.

**Aims:** To determine the Effect of Plyometric training and Resistance training on Aerobic endurance, Agility, Psychology, Reaction time, speed, Strength and power in collegiate male Football players.

**Methodology:** Study Design: Pre-test – Post-test Experimental Study, Sampling: Simple Random Sampling, Outcome Measures: Aerobic endurance was measured by Balke VO<sub>2</sub>Max Test, Agility was measured by Illinois agility run Test, Psychology was measured by Sport Competition Anxiety Test, Reaction Time was measured by Ruler Drop Test, Speed was measured by 300-yard shuttle Test, Elastic Strength was measured by Standing Long Jump Test, Duration of Study: 6 Week, Group Wise Interventions: Group 1: Plyometric Training Group. 30 subjects were given plyometric regime, Group 2: Resistance Training Group. 30 subjects were given resistance regime, Sample Size: 60 collegiate male football players from Anand District were selected and divided into 2 groups. Each group had 30 subjects.

**Statistical Analysis** Paired and Unpaired T-test were used to analyze the obtained data.

**Conclusion:** At the end of this study, we concluded that plyometric training is effective in improving agility, speed and elastic strength whereas resistance training is beneficial in enhancing aerobic endurance, reaction time and psychology.

**KEYWORDS:** Football; Plyometric; Resistance; Agility; Speed; Elastic strength; Aerobic Endurance; Reaction time and Psychology

## INTRODUCTION

Football (Soccer) is one of the most widely played sports in the world and is a sport characterized by short sprints, rapid acceleration or deceleration, turning, jumping, kicking, and tackling<sup>1</sup>.

Injury was defined as described by Ekstrand as any injury occurring during a scheduled training session or match causing the player to miss the next training session or match<sup>2</sup>.

Many recent studies on male elite players, however, tend to show a dominance of non-contact injuries, which probably reflects the high proportion of muscle strain injuries in modern elite footballers. Between 52-55% contact injuries have been reported from studies on female players. From studies at the national team level, between 73-91% of match injuries in men, and 79-84% in women, have been due to player contact. Tackling (24-27%) and collisions (6-27%) are the most common contact injury

mechanisms in male football, whereas non-contact injuries usually result from such actions as sprinting (18-19%), shooting/kicking (4-14%) or cutting/turning (6-8%)<sup>3</sup>.

Plyometric training is defined as a quick, powerful movement involving an eccentric contraction, followed immediately by an explosive concentric contraction. This is accomplished through the stretch-shortening cycle or an eccentric-concentric coupling phase. The eccentric concentric coupling phase is also referred to as the integrated performance paradigm, which states that in order to move with precision, forces must be loaded (eccentrically), stabilized (isometrically), and then unloaded/accelerated (concentrically). Plyometric exercise stimulates the body's proprioceptive and elastic properties to generate maximum force output in a minimum amount of time<sup>4</sup>.

Resistance exercise is any form of active exercise in which dynamic or static muscle contraction is resisted by an outside force applied manually or mechanically<sup>5</sup>.

A program of exercise in which force is exerted against a load in order to develop

For Correspondence:  
Chintvika Patel, Email: patelchintvika@yahoo.com

strength is known as resistance training. It is perhaps the most common method of training to improve muscle strength and enhance muscle hypertrophy<sup>6</sup>.

Resistance training has also become an essential method to improve athlete's speed and explosive power<sup>7</sup>.

## AIM OF THE STUDY

To determine the effect of plyometric training and resistance training on aerobic endurance, agility, psychology, reaction time, speed, strength and power in collegiate male Football players.

## METHODOLOGY

### *Research Design*

Pre-test and Post-test Quasi experimental study was performed.

### *Inclusion criteria*

Subjects who were playing football regularly for minimum 1 year were included. They are collegian student of age group 16-25 years.

### *Exclusion criteria*

Subjects who had any kind of musculoskeletal injury were excluded from the study. Subjects suffering from any kind of other general medical or surgical condition were excluded from the study.

### *Outcome Measures*

The Illinois agility test (IAT) was used to measure agility during sprints including direction changes without stopping, and running at different angles. Participants performed two trials of the agility test with five minutes recovery between trials. The best time of the two trials was considered for analysis. Time to complete the agility tests were measured every time using a stop watch. The average of the time was used for statistics. The Illinois agility test was used to determine the ability to accelerate, decelerate, turn in different directions, and run at different angles.

Balke VO<sub>2max</sub> Test. The objective of this test was to monitor the development of the athlete's general endurance (VO<sub>2max</sub>). Required resources for this were 400m track, stop watch, and Assistant. The Balke test were conducted as follows: A windless day was chosen and subject was made to run around a track for 15 minutes – the aim was to run as far as possible, the assistant noted the total distance achieved in the 15 minutes to the nearest 25 metres. The distance

achieved was used to predict the athlete's VO<sub>2max</sub>.

SCAT measured continuous competition anxiety levels and was developed in order to measure the level of anxiety of competitors in a competition by Martens (1977). This test was composed of 15 items aiming to measure anxiety level in a competition. While 10 of these 15 items were related to anxiety, 5 of them were testing items which aimed to reduce subjective answers. All items were answered as Never, Sometimes and Frequently.

The 300-yard shuttle run test was first described in 1983 by Gilliam G.M. and Marks M. and was used as a test to measure anaerobic capacity (Semenick, 1984; Baechle & Earle, 2008). The 300-yard shuttle run test was supposed to simulate an actual American football game with short, fast sprints and changes of direction (Gilliam & Marks, 1983). Therefore, an improvement in the 300-yard shuttle run test was suitable test for anaerobic performance assessment.

**Standing Long Jump:** The long jump was performed on a long jump mat. Subjects began the long jump with their toes behind the marked line fixed at the 0-cm mark on the mat. The distance from the rearmost heel strike to the starting line was measured. A standing jump (SJ) was performed with the player holding his hands on the iliac crest, bending his knees to 90°, stopping there observably for 1–2 s, and then extending his knees and hips and jumping as high as he could.

**Ruler-Drop Reaction Time Test:** Simple reaction time was estimated by asking the participants to catch a falling ruler. They were invited to sit on a chair with their dominant hand kept in the mid-prone position, elbow flexed to 90°, and forearm supported on a table. The assessor held the ruler vertically, with its lower end between the participant's thumb and index finger (i.e., web space). He was then instructed to catch the ruler using a pinch grasp as quickly as possible when the assessor released it at an unannounced time.

### *Settings of the Study*

Shree B G Patel College of Physiotherapy, Anand & Shastri Ground, VallabhVidhya Nagar.

Population – Male Football Player with Age Group of 16 -25 Years.

Sample: 60 Male Football Player with Age Group of 16 -25 Years

Sampling technique: Simple random sampling was done.

Sample size - 60 collegiate male football players from Anand District were selected and divided into 2 groups. Each group consisted of 30 subjects.

Method of data collection: 60 subjects from various colleges around Anand were taken. BalkeVO<sub>2max</sub> test, Illinois agility test, 300-yard shuttle test, SCAT, reaction time and standing long jump was performed to assess physical and mental abilities of football players. Intervention was given 2 times a week and for 6 weeks. After 6 weeks, post data was obtained.

#### **Procedure**

60 male college students of age group 16-25years were randomly assigned into resistance training group and plyometric group. Written informed consent were obtained from them. Following protocol were given twice a week and for six weeks.

For plyometric group, following protocol was given twice a week for six weeks.

weeks 1 and 2 1-2 sets / 10 repetitions	weeks 3 and 4 1-2 sets / 8 repetitions	weeks 5 and 6 1-2 sets / 6 repetitions
<ul style="list-style-type: none"> <li>• Double leg jump forward</li> <li>• Double leg jump backward</li> <li>• Double leg “x” hop MB (medicine ball) ‘stuffer flutter’</li> <li>• Standing jump &amp; reach lateral taps on MB</li> <li>• MB overhead throw MB single leg dip arrow cone drill* figure 8 drill*</li> </ul>	<ul style="list-style-type: none"> <li>• Ankle jumps</li> <li>• Hurdle hops</li> <li>• Lateral cone hops</li> <li>• Zig-zag jump drill</li> <li>• Mb chest pass</li> <li>• Jump &amp; turn 90°</li> <li>• High-5 drill</li> <li>• Mb backwards throw</li> <li>• Mb split squat</li> <li>• Power skipping</li> <li>• Clock drill*</li> <li>• T-drill*</li> </ul>	<ul style="list-style-type: none"> <li>• Dot drill</li> <li>• Single leg cone hops</li> <li>• Long jump and sprint</li> <li>• Single leg zig-zag drill MB lunge chest pass</li> <li>• Jump and turn 180° tuck jumps</li> <li>• Mb partner push pass split squat jump</li> <li>• Alternate bounding</li> <li>• X-drill*</li> <li>• Shuttle drill*</li> </ul>

Other group, resistance training group were given following protocol for 2 days a week for 6 weeks<sup>8</sup>.

- One day 1: 3 sets/10 repetitions
  - Squat
  - Bench press
  - Overhead pull
  - Lateral pull down
  - Standing calf raise, and
  - Biceps curl.
- On day 3: 3 sets/ 10 repetitions
  - Front squat
  - Incline press
  - Lateral pull down
  - Upright row
  - Standing calf raise and
  - Triceps extension.

Pre and post intervention test were performed and data was obtained. Further data was analyzed using paired and unpaired t test.

#### **Data analysis**

Paired and Unpaired t test was used to analyze the obtained data.

## **RESULTS**

Results were obtained by comparing Pre and Post interventions of outcome measures (Balke VO<sub>2max</sub>, SCAT, Reaction time, 300yard shuttle test, Standing long jump and IART) by using paired t-test whereas between group comparison of post data mean and SD using unpaired t-test.

**Table 1: Pre and Post comparison in Group 1**

	Outcome measures	PRE		POST		T value	P value
		Mean	SD	Mean	SD		
1	Aerobic Endurance	38.13	3.25	39.03	2.57	3.18	<0.0001
2	IART	12.47	1.25	11.53	3.21	3.04	<0.0001
3	SCAT	18.4	3.21	17	2.48	2.33	<0.0001
4	Reaction time	0.15	0.03	0.14	0.03	1.78	<0.0001
5	Long Standing Jump	199.17	20.47	216	16.16	1.78	<0.0001
6	300yard shuttle test	60.1	3.28	58.9	2.55	2.49	<0.0001

**Table 2: Pre and Post comparison in Group 2**

	Outcome measures	PRE		POST		T value	P value
		Mean	SD	Mean	SD		
1	Aerobic Endurance	37.04	4.1	38.23	3.86	3.26	<0.0001
2	IART	12.3	1.68	11.63	1.65	2.71	<0.0001
3	SCAT	16.13	3.1	15.57	2.39	1.17	<0.0001
4	Reaction time	0.14	0.02	0.13	0.02	0.31	<0.0001
5	Long Standing Jump	196.5	23.05	212.16	30.19	4.9	<0.0001
6	300yard shuttle test	61.33	5.13	59.43	5.27	2.15	<0.0001

**Table 3: Post comparison in-between Group 1 and Group 2**

	Outcome measures	Group 1		Group 2		T value	P value
		Mean	SD	Mean	SD		
1	Aerobic Endurance	38.23	3.86	39.03	2.57	0.95	<0.0001
2	IART	11.53	1.25	11.63	1.65	0.26	<0.0001
3	SCAT	17	2.48	15.57	2.39	2.28	<0.0001
4	Reaction time	0.14	0.02	0.13	0.02	1.19	<0.0001
5	Long Standing Jump	216	16.16	212.17	30.19	0.61	<0.0001
6	300yard shuttle test	58.9	2.55	59.43	5.27	0.49	<0.0001

## **DISCUSSION**

This study aimed to compare the effects of plyometric training and resistance training on aerobic endurance, agility, psychology, reaction time, speed and strength in collegiate male football players.

Plyometric training is effective in increasing agility when compared with resistance training with regard to showing on Illinois agility run test post intervention.

Overall, improvements in agility after plyometric training can be attributed to neural adaptation, specifically to increased intermuscular coordination. In our training protocol we also applied single leg jumps in lateral directions with the goal to increase joint stability and proprioception, important factors in performance when agility tasks are performed with stops and direction changes.

Similar results were obtained when Thomas et al. (2009) found that despite that sprint time was unchanged, six weeks of PT significantly improved agility (9%) in semi-professional adolescent soccer players. The greatest improvement in agility (10%) was found in children soccer players after 8 weeks of PT (Meylan and Malatesta, 2009)<sup>9</sup>.

Miller et al. (2006) found 5 and 3% improvements in the T agility and Illinois agility tests, respectively, after 6 weeks of PT. Their results indicated that the plyometric training improved times in the agility test measures because of either better motor recruitment or neural adaptations<sup>11</sup>.

Plyometric training is effective in increasing speed compared to resistance training group with the regard to 300yard shuttle test post intervention.

Faigenbaum et al. conducted the study to investigate effects of a short-term plyometric and resistance training program on fitness performance in boy's age 12 to 15 years and the results showed that plyometric training and resistance training can increase speed in adults (Delecluse et al, 1995)<sup>8</sup>.

Also studies done by Myer and colleagues (2005) demonstrated that a 6-week multi-component training program that included resistance training, plyometric training and speed training enhanced 9.1 m sprint performance in adolescent female athletes<sup>8</sup>. Kotzamanidis (2006) reported that running velocity improved in prepubertal boys following 10 weeks of plyometric training<sup>10</sup>.

Plyometric training is effective in increasing elastic strength with regard to standing long jump post intervention.

High velocity plyometric which consist of a rapid eccentric muscle action followed by a powerful concentric muscle action are important for enhancing the rate of force development during jumping and sprinting whereas heavy resistance training is needed to enhance muscular strength and acceleration (Fleck and Kraemer, 2004)<sup>8</sup>.

Faigenbaum et al. conducted a study that showed plyometric and resistance training group also made significantly greater improvements in long jump performance than the static stretching and resistance training group (6.0% vs. 1.1%, respectively)<sup>8</sup>.

Fatouros and colleagues (2000) reported that after 12 weeks of training adult subjects who combined plyometric training with resistance training increased vertical jump performance by 15% whereas gains of 11% and 9% were reported for subjects who performed only resistance training or plyometric training, respectively<sup>8</sup>.

Resistance training is effective in increasing aerobic endurance with regard to showing improvement in BalkeVO<sub>2max</sub> post intervention.

Sporiš, G. et al conducted a study to investigate the effects of strength training on aerobic and anaerobic power in female soccer players. Three to five sets of 8-12 repetition were performed for all exercises. The major findings of this study were the improvement of muscular strength as well as the improvement of aerobic and anaerobic power after 12 weeks of strength training in female soccer players<sup>12</sup>.

Amrinder singh et al. conducted a study to find the effects of 6 weeks of preseason concurrent muscular strength and plyometric training in professional soccer players showed that training improve both explosive performance and aerobic endurance<sup>13</sup>.

Resistance training is effective in decreasing reaction time on ruler drop test.

Resistance training is effective in increasing psychology and showed greater significant in reducing anxiety.

The relation between sport experience, physical self-perception and competitive anxiety is negatively correlated, but the relation between physical self-perception and sport experience is positively correlated.

Jones reported that elite performer interpreted anxiety as more facilitative to performance, the present study found that pressure causes a deterioration of performance<sup>14</sup>.

Masami Horikawa et al. conducted a study that showed that competitive situation by the instruction, that is, the pressure for success, increased the anxiety level and produced a deterioration of goal performance<sup>15</sup>.

## CONCLUSION

At the end of this study, we concluded that plyometric training is effective in improving agility, speed and elastic strength whereas resistance training is beneficial in enhancing aerobic endurance, reaction time and psychology.

## CONFLICT OF INTEREST

None

## SOURCE OF FUNDING

Self-funding

## REFERENCES

1. Arnason A, Sigurdsson SB, Gudmundsson A, Holme I, Engebretsen L, Bahr R. Physical fitness, injuries, and team performance in soccer. *Medicine & Science in Sports & Exercise.* 2004 Feb 1;36(2):278-85.
2. Waldén M, Hägglund M, Ekstrand J. UEFA Champions League study: a prospective study of injuries in professional football during the 2001–2002 season. *British journal of sports medicine.* 2005 Aug 1;39(8):542-6.
3. Hägglund M. Epidemiology and prevention of football injuries. 2007
4. Clark M, Lucett S, Kirkendall DT. NASM's essentials of sports performance training. Lippincott Williams & Wilkins; 2010.
5. Kisner C, Colby LA. Therapeutic exercise: foundations and techniques. Fa Davis; 1996.
6. Birch K, George K, McLaren D. Instant Notes in Sport and Exercise Physiology. Taylor & Francis; 2004 Sep 1.
7. Taheri E, Nikseresht A, Khoshnam E. The effect of 8 weeks of plyometric and resistance training on agility, speed and explosive power in soccer players. *Eur J Exp Biol.* 2014;4(1):383-6.
8. Faigenbaum AD, McFarland JE, Keiper FB, Tevlin W, Ratamess NA, Kang J, Hoffman JR. Effects of a short-term plyometric and resistance training program on fitness performance in boys age 12 to 15 years. *J Sports Sci Med.* 2007 Dec 1;6(4):519-25.
9. Thomas K, French D, Hayes PR. The effect of two plyometric training techniques on muscular power and agility in youth soccer players. *J Strength Cond Res.* 2009;23(1):332-5.
10. Kotzamanidis C. Effect of plyometric training on running performance and vertical jumping in prepubertal boys. *J Strength Cond Res.* 2006;20(2):441-5.
11. Miller MG, Herniman JJ, Richard MD, Cheatham CC, Michael TJ. The effects of a 6-week plyometric training program on agility. *J Sports Sci Med.* 2006;5:459–465.
12. G. Sporiš, M. Jovanovic, I. Krakan, F. Fiorentini, Effects of strength training on aerobic and anaerobic power in female soccer players, *Sport Sci.*, 4 (2011)
13. Amrinder Singh, Kartik Kulkarni, Shweta Shenoy, Jaspal Sandhu, Effect of 6 Weeks of Pre-season Concurrent Muscular Strength and Plyometric Training in Professional Soccer Players. *International Scientific Journal of Sport Sciences* 2013: 2277-2804
14. Jones G, Hanton S, Swain A. Intensity and interpretation of anxiety symptoms in elite and non-elite sports performers. *Personality and Individual Differences.* 1994 Nov 30;17(5):657-63
15. Horikawa M, Yagi A. The relationships among trait anxiety, state anxiety and the goal performance of penalty shoot-out by university soccer players. *PloS one.* 2012 Apr 23; 7(4): e35727

## COMPARISON OF LIMB LENGTH DISCREPANCY BETWEEN UNILATERAL AND BILATERAL T.K.R.

ALPA PUROHIT<sup>1</sup>

1. Vice-Principal, AIMS-Physiotherapy College, Ahmedabad, Gujarat

### Abstract

**AIMS & OBJECTIVES:** To find out the difference of leg length in unilateral & bilateral TKR & find out clinical management of leg length discrepancy for improving patients function.

**Purpose of the Study:** To find out the difference of leg length between unilateral v/s bilateral T.K.R. and to find out the patients level of discomfort during walking.

**METHODOLOGY: STUDY DESIGN:** cross sectional observational study. **Sample Population and Sample Size-** 30 patients included according to criteria. In Group -A-15, unilateral Total knee replacement patients & in Group B - 15, bilateral Total knee replacement patients were included. **Sampling Technique:** Convenient sampling according to selection criteria.

**OUTCOME MEASURES:** Limb length was measured by using Tape measurement method (TMM) in centimeters.

**DATA COLLECTION & ANALYSIS:** Data were collected from sterlign hospital, Ahmedabad at post 3 months of surgery. Limb length measurement was done in the supine position with pelvis squared. The lower limbs were placed parallel to the body and limb length measurement (in centimeters) done from the anterior superior iliac spine to the medial malleolus using a measure tape. The measurement was taken twice by two different observers and the mean of the two values was recorded. Outcome parameters were analyzed with t-test in both group.

**RESULTS:** Data was analyzed by using Paired t-test. The t-value for unilateral T.K.R. was 9.73 ( $p<0.001$ ) highly significant and bilateral T.K.R was 3.58 ( $p<0.05$ ) respectively.

**CONCLUSION:** In unilateral T.K.R. there is a significant difference in leg length between operated & non-operated leg & in bilateral. There is no much leg length discrepancy between both operated legs. So in unilateral T.K.R., Limb length discrepancy is due to other leg's arthritis condition which may cause imbalance in gait.

**KEYWORDS:** limb length discrepancy; unilateral- bilateral T.K.R.

## INTRODUCTION

Leg-length inequality, defined as a difference in lengths of the 2 legs, is very common, occurring in up to 70% of the population<sup>1</sup>.

Improved surgical techniques and rehabilitation protocols have resulted in excellent knee function and range of motion following total knee arthroplasty<sup>2</sup>.

Limb length discrepancy and its effects on patient function have been discussed in depth in the literature with respect to hip arthroplasty but there are few studies that have examined the effect on function of limb length discrepancy following total knee arthroplasty (TKA)<sup>3,4</sup>.

Nevertheless, there remain 15-20% of patients with persistent dysfunction that is difficult to treat<sup>5,7</sup>.

Although problems after total knee arthroplasty are frequently linked to prosthetic mal-alignment, radiographic loosening, and comorbidities, some cases are related to functional problems that are less evident clinically and/or radiographically.

Functional problems following total knee arthroplasty may be incapacitating as a result of persistent pain<sup>8</sup>, instability<sup>9</sup>, and limited range of motion<sup>10,11</sup>.

Patients who experienced more pain and functional impairment after total knee arthroplasty were less likely to be satisfied with the procedure.

## AIMS & OBJECTIVES

- To find out the difference of leg length in unilateral & bilateral TKR.
- Find out solution of leg length discrepancy for improving patients function & satisfaction.

## METHODOLOGY

### Sample size

Group A: 15, Unilateral Total knee replacement patients

Group B: 15, Bilateral Total knee replacement patients

## STUDY DESIGN

Cross sectional observational study

## INCLUSION CRITERIA

- Patients were operated with midline incision with primary T.K.R.
- Age-group 50-70yrs
- Post op 3 month

- Post op same exercises program in both group
- In both group pre op FFD 10-15degree & 8-10 degree varus deformity
- No any mal-alignment, component malposition, loosening, or patellar maltracking
- No hamstring tightness
- No any hip joint pathology & SI joint dysfunction

### EXCLUSION CRITERIA

- Other surgical technique
- Other than high flex knee joint
- Other than midline incision
- Post op less than 3 month
- Any mal-alignment, component malposition, loosening, or patellar maltracking
- Hamstring tightness.
- Any hip joint pathology & SI dysfunction & postural deviation.
- Marked abductor weakness.
- Pre-operative limb length discrepancy

### METHODS

Data were collected from sterling hospital, Ahmedabad at post 3 months of surgery.

Limb length measurement was done in the supine position with pelvis squared.

The lower limbs were placed parallel to the body and limb length measurement (in centimeters) done from the anterior superior iliac spine to the medial malleolus using a measure tape<sup>12</sup>.

The measurement was taken twice by two different observers and the mean of the two values was recorded.

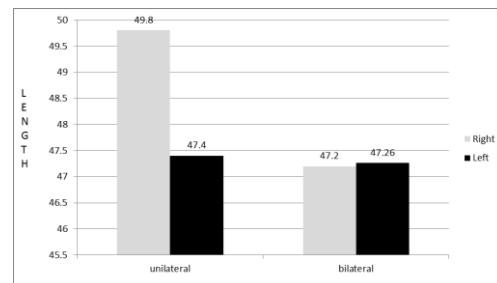
### OUTCOME MEASURES

Limb length was measured by using Tape measurement method (TMM) in centimeters<sup>13,14</sup>.

### RESULTS

**TABLE 1: VALUE OF UNILATERAL AND BILATERAL T.K.R.LEG LENGTH**

Unilateral	Average Length	Bilateral	Average Length
Limb-1(Operated)	49.8	Limb-1(Operated)	47.2
Limb-2(Non-Operated)	47.4	Limb-2(Operated)	47.26



**FIGURE 1: COMPARISON OF UNILATERAL AND BILATERAL T.K.R.LEG LENGTH**

### DISCUSSION

A persistent limp is one of the most frustrating symptoms after total knee arthroplasty.

There are many causes of limp; however, leg length discrepancy is one of the common reason for litigation after successful total knee arthroplasty<sup>3,4,12</sup>.

Leg-length inequality may be an important risk Factor for the longer leg exhibited increased ground-reaction forces and therefore should be at greater risk for osteoarthritis.

Limb length discrepancy affects functional outcome after total knee arthroplasty<sup>7,15</sup>.

Bhave et al.<sup>7</sup> showed that the operated leg gained length compared to the contralateral un-operated leg due to correction of the varus deformity.

A number of factors may be responsible for the limb length discrepancy, including correction of the varus alignment after surgery, the amount of preoperative flexion deformity, and the postoperative flexion deformity

In present study it was obvious difference in both leg length in unilateral knee replacement patients who having limp during walking & there is no as such any major difference between limb length bilateral knee replacement.

### CONCLUSION

In unilateral T.K.R. there is a significant difference in leg length between operated & non-operated leg & in bilateral there is no much leg length discrepancy between both operated legs.

So in unilateral T.K.R., Limb length discrepancy is due to other leg's arthritis condition which may cause imbalance in gait.

### CLINICAL IMPLICATION

We can give sole compensation for correcting LLD & improving function.

## LIMITATIONS

- Sample size is small.
- Measurements of leg length, are subject to measurement error, which could result in misclassification.

## FUTURE STUDY

- Outcome measure for functional activity
- Comparison of LLD between unilateral operated patient & those same operated for second time knee replacement

## REFERENCES

1. Harvey WF, Yang M, Cooke TD, Segal NA, Lane N, Lewis CE, Felson DT. Association of leg-length inequality with knee osteoarthritis: a cohort study. *Annals of internal medicine*. 2010 Mar 2;152(5):287-95.
2. Vaidya SV, Patel MR, Panghate AN, Rathod PA. Total knee arthroplasty: limb length discrepancy and functional outcome. *Indian journal of orthopaedics*. 2010 Jul 1;44(3):300.
3. Austin MS, Hozack WJ, Sharkey PF, Rothman RH. Stability and leg length equality in total hip arthroplasty. *The Journal of arthroplasty*. 2003 Apr 30;18(3):88-90.
4. Attarian DE, Vail TP. Medicolegal aspects of hip and knee arthroplasty. *Clinical orthopaedics and related research*. 2005 Apr 1;433:72-6.
5. Jane K, Charles LN, Paul AL. Stiffness after total knee arthroplasty: prevalence of the complication and outcomes of debridement. *Journal of Bone and Joint Surgery*. 2004;86(7):1479.
6. Ranawat CS, Ranawat AS, Mehta A. Total knee arthroplasty rehabilitation protocol: Whatmakes the difference?. *The Journal of arthroplasty*. 2003 Apr 30;18(3):27-30.
7. Bhave A, Mont M, Tennis S, Nickey M, Starr R, Etienne G. Functional problems and treatment solutions after total hip and knee joint arthroplasty. *J Bone Joint Surg Am*. 2005 Dec 1;87(suppl 2):9-21.
8. Dahlen L, Zimmerman L, Barron C. Pain perception and its relation to functional status post total knee arthroplasty: a pilot study. *Orthopaedic Nursing*. 2006 Jul 1;25(4):264-70.
9. Gonzalez MH, Mekhail AO. The failed total knee arthroplasty: evaluation and etiology. *Journal of the American Academy of Orthopaedic Surgeons*. 2004 Nov 1;12(6):436-46.
10. Pariente GM, Lombardi Jr AV, Berend KR, Mallory TH, Adams JB. Manipulation with prolonged epidural analgesia for treatment of TKA complicated by arthrofibrosis. *Surgical technology international*. 2005 Dec;15:221-4.
11. Padua R, Ceccarelli E, Bondi R, Campi A, Padua L. Range of motion correlates with patient perception of TKA outcome. *Clinical orthopaedics and related research*. 2007 Jul 1;460:174-7.
12. Iagulli ND, Mallory TH, Berend KR, Lombardi Jr AV, Russell JH, Adams JB, Groseth KL. A simple and accurate method for determining leg length in primary total hip arthroplasty. *American journal of orthopedics (Belle Mead, NJ)*. 2006 Oct;35(10):455-7.
13. EWALD FC. The Knee Society total knee arthroplasty roentgenographic evaluation and scoring system. *Clinical orthopaedics and related research*. 1989 Nov 1;248:9-12.
14. Edeen J, Sharkey PF, Alexander AH. Clinical significance of leg-length inequality after total hip arthroplasty. *American journal of orthopedics (Belle Mead, NJ)*. 1995 Apr;24(4):347-51.
15. Bhave A, Marker DR, Seyler TM, Ulrich SD, Plate JF, Mont MA. Functional problems and treatment solutions after total hip arthroplasty. *The Journal of arthroplasty*. 2007 Sep 30;22(6): 116-24

## A STUDY TO FIND OUT TEST RETEST RELIABILITY AND VALIDITY OF GUJARATI VERSION OF SHOULDER PAIN AND DISABILITY INDEX (SPADI) AMONG GUJARATI SPEAKING INDIAN POPULATION WITH SHOULDER PAIN – A CORELATIONAL STUDY

**ANUJ GULWANI<sup>1</sup>, NAMRATA SOJITRA<sup>1</sup>, DEVANGI VAISHNAV<sup>2</sup>, ASHISH  
KAKKAD<sup>3</sup>**

1. 2<sup>nd</sup> year M.P.T. Student (*Musculoskeletal and Sports conditions*), Shree K. K. Sheth Physiotherapy College)
2. H.O.D., G. T. Sheth orthopedic Physiotherapy Department
3. I/C Principal, Shree K.K. Sheth Physiotherapy College

### ABSTRACT

**Background:** Shoulder disorders are still one of the major health problems in clinical practice, and shoulder pain is the third most common type of musculoskeletal pain after spinal and knee pain. The shoulder pain and disability index (SPADI) is a self-report questionnaire developed to measure the pain and disability associated with shoulder pathology. SPADI was developed by Roach et al, and has been found to be the quickest (within five minutes) and easiest to complete.

**Method:** The study was carried out in three phases: the first was translation into Gujarati and cultural adaptation of the questionnaire; the second phase was pilot study to assess comprehensibility of the pre final version; third was the validity and reliability study of the final version of the questionnaire. Total 100 patients aged between 30 to 60 years were included in the study. Then they were asked to fill the SPADI questionnaire twice with the time interval of 24 hours in order to assess test retest reliability of the questionnaire. The test retest reliability and internal consistency were measured.

**Result:** The obtained data of 100 patients were analyzed by SPSS version 20. Reliability estimated by internal consistency using Cronbach's alpha (0.99) and test retest reliability estimated by interclass correlation coefficient (0.99) (Spearman's correlation coefficient) suggest excellent test retest reliability and high correlations between baseline and retest questionnaires of Gujarati version of shoulder pain and disability index (SPADI).

**Conclusion:** Gujarati version of shoulder pain and disability index (SPADI) is valid and reliable tool for assessment of functional status among Gujarati speaking Indian population with shoulder pain.

**KEYWORDS:** Shoulder pain and disability index (SPADI); Shoulder pain; Test retest reliability; Validity; Gujarati version; Interclass correlation coefficient (ICC).

## INTRODUCTION

Shoulder disorders are still one of the major health problems in clinical practice, and shoulder pain is the third most common type of musculoskeletal pain after spinal and knee pain. The annual prevalence of shoulder pain accompanied by disability in the general population is approximately 20%, with the rates increasing among the elderly, according to several epidemiological studies<sup>1</sup>. The shoulder pain and disability index (SPADI) is a self-report questionnaire developed to measure the pain and disability associated with shoulder pathology<sup>2,3</sup>. SPADI was developed by Roach et al, and has been found to be the quickest (within five minutes) and easiest to complete<sup>1</sup>.

The SPADI contains 13 items that assess two domains; a 5-item subscale that measures pain and an 8-item subscale that measures disability. There are two versions of the SPADI; the original version has each item scored on a visual analogue scale (VAS) and a second version has items scored on a numerical

rating scale (NRS). The latter version was developed to make the tool easier to administer and score (Williams et al 1995). Both versions take less than five minutes to complete (Beaton et al 1996, Williams et al 1995)<sup>4</sup>. The pain dimension consists of five questions regarding the severity of an individual's pain. Functional activities are assessed with eight questions designed to measure the degree of difficulty an individual has with various ADL that require upper extremity use. To answer the questions, patients place a mark on a 10-cm visual analog scale for each question. Verbal anchors for the pain dimension are "no pain at all" and "worst pain imaginable," and those for the functional activities are "no difficulty" and "so difficult it required help." The scores from both dimensions are averaged to derive a total score<sup>5</sup>.

The questionnaire was developed and initially tested in a mixed diagnosis group of male patients presenting to ambulatory care reporting shoulder pain (Roach et al 1991). The SPADI has since been used in both primary care on mixed diagnosis (Beaton et al 1996, MacDermaid et al 2006) and surgical patient

populations including rotator cuff disease (Ekeberg et al 2008), osteoarthritis, and rheumatoid arthritis (Christie et al 2010), adhesive capsulitis (Staples et al 2010, Tveita et al 2008), joint replacement surgery (Angst et al 2007), and in a large population-based study of shoulder symptoms (Hill et al 2011)<sup>4</sup>.

The SPADI has been already translated to many languages including Persian, Tamil, Danish, German, Slovenian, Thai, Italian and Portuguese. It has been revalidated in several study population and has shown stable psychometric properties<sup>6</sup>.

Reliability is defined as the extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials. It shows the stability or consistency of scores over time or across raters. There are three aspects of reliability, namely: equivalence, stability and internal consistency (homogeneity)<sup>7</sup>.

Studies of test-retest reliability for health related quality of life instruments have been used with varying intervals between test administrations. The interval has been ranged from 10 minutes to 1 month.

Validity is defined as the extent to which the instrument measures what it purports to measure. There are many different types of validity, including: content validity, face validity, criterion-related validity (or predictive validity), construct validity, factorial validity, concurrent validity, convergent validity and divergent (or discriminant validity)<sup>7</sup>.

However, till date no date of Guajarati version of Shoulder Pain and Disability Index has been developed. In addition to the lack of a standard reliable and valid instrument in Guajarati for measuring pain and disability in shoulder pain, the purpose of this study is to find out test retest reliability and validity of Guajarati version of shoulder pain and disability index (SPADI) among Guajarati speaking Indian population with shoulder pain.

## HYPOTHESIS

### *Null hypothesis*

Gujarati version of shoulder pain disability index is not reliable and valid tool for assessing disability among Guajarati speaking Indian population with shoulder pain.

### *Experimental hypothesis*

Gujarati version of shoulder pain disability index is reliable and valid tool for assessment of functional status among Guajarati speaking Indian population with shoulder pain.

## SELECTION CRITERIAS

### *Inclusion criteria*

- Subject with shoulder pain.
- Subjects must be able to read and understand Guajarati language.
- Age 30 – 60 years.

### *Exclusion criteria*

- Illiterate people with shoulder pain.
- Subjects who cannot able to read and understand Guajarati language.
- Uncooperative patients.

## MATERIAL AND METHODOLOGY

### MATERIAL USED

- Consent form
- Shoulder pain and disability index
- Pen

### METHODOLOGY

Study design: A correlational study

Sampling technique: purposive sampling

Study setting: physiotherapy centers of Rajkot.

Sample size: 100 subjects

Study population: subjects with shoulder pain aged between 30 - 60 years

The study was carried out in three phases: the first was translation into Guajarati and cultural adaptation of the questionnaire; the second phase was pilot study to assess comprehensibility of the pre final version; third was the validity and reliability study of the final version of the questionnaire.

### *Translation and cultural adaptation*

For the translation the recent guidelines for cross cultural adaptation was used.<sup>5</sup> Two translation of original shoulder pain and disability index from English to Guajarati were performed by two bilingual translators whose mother tongue was Guajarati allowing detection of errors and divergent interpretations of items with ambiguous meaning in the original instrument. The first translation was done by a translator from medical background that was aware of the process and purpose. The other translation was done by a native translator from non-medical background that was unaware of the translation objectives and this was useful in eliciting unexpected meanings of the original tool<sup>7,8</sup>.

Both the translations were then compared for inconsistencies and a pre final version of two translations was synthesized working from the original questionnaire as well as the first and second translator's versions. The pre final version was then back translated by two

native English speakers who were able to read and understand Gujarati. Each translation was then compared with the original Shoulder pain And Disability index and checked for inconsistencies and then the Gujarati version was reviewed by the expert committee, including the translators, physiotherapists etc. to assure semantic and idiomatic equivalence (i.e. to check for ambiguous words or inappropriately translated colloquialisms) and to address any peculiarities specific to the cultures examined between the Gujarati and English versions of questionnaire<sup>7,8</sup>.

#### **Pilot study and modification of the pre final version**

A pilot study was done on 10 subjects of shoulder pain. The subjects were selected purposively based on inclusion and exclusion criteria. The patient was asked to fill the questionnaire and give feedback and comments regarding questions and to identify words or sentences that were difficult to understand at the end of filling questionnaire. On the basis of their reviews the final version was developed which was again checked and approved by committee.

#### **Reliability and validity**

The study was carried out at various physiotherapy centers of Rajkot. Total 100 patients aged between 30 to 60 years were included in the study. Both male and female subjects were selected for the study on the basis of inclusion and exclusion criteria. The informed written consent was taken from patients. Then they were asked to fill the SPADI questionnaire twice with the time interval of 24 hours in order to assess test retest reliability of the questionnaire.

The test retest reliability was measured by comparing the results of first and second administrations of the SPADI. Intra class correlation coefficient (ICC) was used to evaluate test retest reliability<sup>7,8</sup>.

The internal consistency of a scale relates to its homogeneity and hence, Cronbach's alpha was used to evaluate the same. Face and content validity was judged by health professionals. It was also assessed by examining the completeness of item responses, the distribution of the scores and magnitude of ceiling and floor effects i.e. a proportion of best and worst possible scores, respectively<sup>7,8</sup>.

## **RESULTS**

The obtained data of 100 patients were analyzed by SPSS version 20. Reliability estimated by internal consistency using Cronbach's alpha and test retest reliability

estimated by interclass correlation coefficient (spearmen's correlation coefficient).

Obtained value of Cronbach's alpha is 0.99 which shows excellent homogeneity between all the items of SPADI and obtained value of ICC assessed at time interval of 24 hours is 0.99 which shows excellent test retest reliability and high correlations between baseline and retest questionnaires of Gujarati version of shoulder pain and disability index (SPADI).

Results show that the translated version is reliable with a low standard error of measurement. It shows moderately positive correlation between the scores of the each item of SPADI at different administration intervals with total score.

**TABLE 1: INTERCLASS CORRELATION COEFFICIENT (ICC) OF TOTAL SCORE OF SPADI**

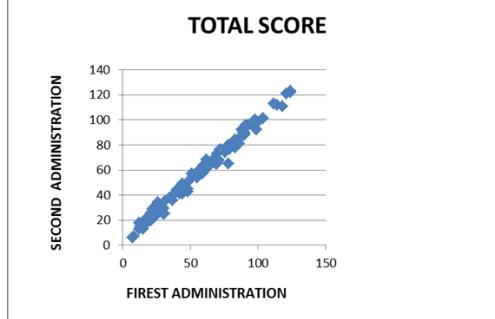
			Pre	Post
Spearman's rho	Pre	Correlation Coefficient	1.000	.991**
		Sig. (2-tailed)	..	.000
		N	100	100
	Post	Correlation Coefficient	.991**	1.000
		Sig. (2-tailed)	.000	..
		N	100	100

\*\* Correlation is significant at the 0.01 level (2-tailed).

**TABLE 2: TEST RETEST RELIABILITY BY CHRONABACH'S ALPHA**

#### **Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.997	.997	2



**GRAPH 1: SCATTER PLOT FOR FIRST AND SECOND ADMINISTRATION OF TOTAL SCORE OF SPADI**

## **DISCUSSION**

The result shows that Gujarati version of shoulder pain and disability index is reliable and valid tool for assessment of functional status among Gujarati speaking Indian population with shoulder pain. The study is supporting experimental hypothesis of this study.

The value of ICC in this study (0.99) is more than the original English version of

shoulder pain disability (0.89). One reason for this difference could be the time interval between the baselines and retest administration of the questionnaires by the original author in their study. It is seen that ICC values decreases with increase in time interval between the two administrations of the questionnaire.

Joy C MacDermid(2006) demonstrated factor, construct and longitudinal validity of The Shoulder Pain and Disability Index and concluded that The SPADI is a valid measure to assess pain and disability in community-based patients reporting shoulder pain due to musculoskeletal pathology<sup>2</sup>.

Toni SRoddy (2000) the university of california–losangeles shoulder scale and the simple shoulder test (SST) with the shoulder pain and disability index and showed SPADI pain subscale, SPADI disability subscale, and the SST have good group-level reliability<sup>9</sup>.

Susan L Heald (1997) measure the construct validity and responsiveness of a region-specific disability measure of the shoulder pain and disability index and showed construct validity of the SPADI is moderately strong, based on the patterns of correlations with the Sickness Impact Profile (SIP) and The standardized response mean (SRM) values for the SIP and SPADI indicate that the SPADI is more responsive to change than the SIP<sup>5</sup>.

Bicer A, Ankarali H (2010) performed a validation study in Turkish women and suggest that the SPADI is a valid and reliable instrument to assess shoulder pain in Turkish female patients<sup>1</sup>.

Catherine L Hill (2011) performed a study on Factor structure and validity of the shoulder pain and disability index in a population-based study of people with shoulder symptoms and showed The SPADI is a valid measure to assess pain and disability in people with shoulder pain in a population-based study. In this setting, the SPADI had a bidimensional structure with both pain and disability subscales<sup>10</sup>.

Einar Kristian Tveita (2008) has showed superior responsiveness of the Shoulder Pain and Disability Index in patients with adhesive capsulitis than other shoulder scales<sup>11</sup>.

Kaia Engebretsen (2010) performed a study on Determinants of the shoulder pain and disability index in patients with subacromial shoulder pain and concluded that the determinants explained 26% of the variance of the Shoulder Pain and Disability Index, but explained only a minor proportion when pain and function were included. This supports the Shoulder Pain and Disability Index as a shoulder pain and disability questionnaire<sup>12</sup>.

Cross-cultural adaption, reliability and validity of an Indian (Tamil) version for the Shoulder Pain and Disability Index has been established by Shri Ramchandran Physiotherapy College in 2010<sup>13</sup>.

The Brazilian version of Shoulder Pain and Disability Index – translation, cultural adaptation and reliability is established by Jaquelin EMartins et al., (2010)<sup>14</sup>.

Face validity is concerned with whether a measurement seems to be assessing intended parameters in the given situation. In this study the translation of the questionnaire seemed to be valid and instrument was well accepted by the patients as well as approved by the committee comprising of translators, physiotherapist, health professionals etc. The layout of the questionnaire and clear structure and clarity of the questions enhanced its face validity.

## LIMITATION

Small sample size

## FURTHER RECOMANDATIONS

- This study can be done with large sample size
- This study can be done with varying time interval between test retest.
- This study can be done by taking specific population with shoulder pain for example Adhesive capsulitis.

## CONCLUSION

Gujarati version of shoulder pain and disability index (SPADI) is valid and reliable tool for assessment of functional status among Guajarati speaking Indian population with shoulder pain.

## CLINICAL IMPLICATION

Gujarati version of shoulder pain and disability index (SPADI) can be recommended for clinical trials to investigate the effectiveness of the therapeutic interventions status among Guajarati speaking Indian population undergoing in clinical set ups.

## ACKNOELEDGEMENT

My heartfelt gratitude to my dear parents and god who have guided me this far and to whom goes all the honor and glory for the successful completion of this study, With due respect I would like to express my sincere thanks to all my classmates and participants of my study

without whom this task would not have been possible.

## CONFLICT OF INTEREST

None

## SOURCE OF FUNDING

Self

## REFERENCES

1. Bicer A, Ankarali H. Shoulder pain and disability index: a validation study in Turkish women. *Singapore Med J*. 2010 Nov 1;51(11):865-70.
2. MacDermid JC, Solomon P, Prkachin K. The Shoulder Pain and Disability Index demonstrates factor, construct and longitudinal validity. *BMC musculoskeletal disorders*. 2006 Feb 10;7(1):1.
3. Roach KE, Budiman-Mak E, Songsiridej N, Lertratanakul Y. Development of a shoulder pain and disability index. *Arthritis & Rheumatism*. 1991 Dec 1;4(4):143-9..
4. Breckenridge JD, McAuley JH. Shoulder pain and disability index (SPADI). *Journal of physiotherapy*. 2011 Dec 31;57(3):197.
5. Heald SL, Riddle DL, Lamb RL. The shoulder pain and disability index: the construct validity and responsiveness of a region-specific disability measure. *Physical Therapy*. 1997 Oct 1;77(10):1079-89..
6. Phongamwong C, Choosakde A. Reliability and validity of the Thai version of the Shoulder Pain and Disability Index (Thai SPADI). *Health and quality of life outcomes*. 2015 Sep 4;13(1):1.
7. Kamdar K, Kakkad A. A study to find out test retest reliability and validity of Gujarati version of neck disability index among Guajarati speaking Indian population with neck pain—a correlational study. *INDIAN JOURNAL OF PHYSICAL THERAPY*. 2015 Jun 11;2(2).
8. Misterska E, Jankowski R, Glowacki M. Cross-cultural adaptation of the Neck Disability Index and Copenhagen Neck Functional Disability Scale for patients with neck pain due to degenerative and discopathic disorders. Psychometric properties of the Polish versions. *BMC musculoskeletal disorders*. 2011 Apr 29;12(1):1.
9. Roddey TS, Olson SL, Cook KF, Gartsman GM, Hanten W. Comparison of the University of California–Los Angeles shoulder scale and the simple shoulder test with the shoulder pain and disability index: single-administration reliability and validity. *Physical therapy*. 2000 Aug 1;80(8):759-68.
10. Hill CL, Lester S, Taylor AW, Shanahan ME, Gill TK. Factor structure and validity of the shoulder pain and disability index in a population-based study of people with shoulder symptoms. *BMC musculoskeletal disorders*. 2011 Jan 12;12(1):1.
11. Tveitå E, Ekeberg O, Juel N, Bautz-Holter E. Responsiveness of the shoulder pain and disability index in patients with adhesive capsulitis. *BMC musculoskeletal disorders*. 2008 Dec 3;9(1):1.
12. Engebretsen K, Grotle M, Bautz-Holter E, Ekeberg OM, Brox JI. Determinants of the shoulder pain and disability index in patients with subacromial shoulder pain. *Journal of rehabilitation medicine*. 2010 May 1;42(5):499-505.
13. Jeldi AJ, Aseer AL, Dhandapani AG, Roach KE. Cross-cultural adaption, reliability and validity of an Indian (Tamil) version for the Shoulder Pain and Disability Index. *Hong Kong Physiotherapy Journal*. 2012 Dec 31;30(2):99-104.
14. Martins J, Napoles BV, Hoffman CB, Oliveira AS. The Brazilian version of Shoulder Pain and Disability Index: translation, cultural adaptation and reliability. *Brazilian Journal of Physical Therapy*. 2010 Dec;14(6):527-36.

## COMPARISON OF EFFICACY BETWEEN TENS AND IFC IN TREATMENT OF TRIGEMINAL NEURALGIA

NP SINGH<sup>1</sup>

1. Reader, Jammu College of Physiotherapy

### ABSTRACT

TN occurs more frequently in second and third division of trigeminal nerve, so deep and limited to the territory of trigeminal distribution. The attacks are accompanied by salivation, lacrimation, rhinorrhea, nasal mucosa congestion, skin redness, facial swelling and/or contraction of the muscles acting on jaw. It is also characterized by regions of increased arousal, called trigger zones. There is gamut of medical and surgical treatment modalities available for trigeminal neuralgia, with other treatment methods like physiotherapy, acupuncture and psychological methods.<sup>5</sup> To control pain in patients with TN, carbamazepine should be offered and oxcarbazepine, baclofen, lamotrigine and pimozide may be considered.<sup>6</sup> Physiotherapy is one of the methods to treat TN, pain control is usually achieved by means of electrical stimulation. The two currents most often used to achieve this intention are pulsed current usually referred as transcutaneous electrical nerve stimulation (TENS) and burst modulated medium frequency alternating current in the form of interferential current (IFC).

Efficacy of TENS and IFC on Trigeminal Neuralgia have been studied separately but studies on comparison are not available. So present study was taken up with the purpose of comparing efficacy of TENS and IFC on trigeminal neuralgia.

Both TENS and IFC has significant efficacy in case of Trigeminal Neuralgia when studied separately. But in comparative study between efficacy of TENS and IFC in Case of Trigeminal Neuralgia, TENS was found to be better option over IFC.

**KEYWORDS:** TENS; IFC; Trigeminal Neuralgia

### INTRODUCTION

The incidence of trigeminal neuralgia (TN) is 4.3 percent per 100,000 persons every year, with slightly higher incidence among women<sup>1</sup>. TN is defined by IASP as “sudden, usually unilateral severe, brief, stabbing, recurrent pain in the distribution of one or more branches of fifth cranial nerve”<sup>2</sup>. TN occurs more frequently in second and third division of trigeminal nerve, so deep and limited to the territory of trigeminal distribution. The attacks are accompanied by salivation, lacrimation, rhinorrhea, nasal mucosa congestion, skin redness, facial swelling and/or contraction of the muscles acting on jaw. It is also characterized by regions of increased arousal, called trigger zones<sup>3</sup>. Detailed clinical history, neurological examination and finding of trigger zones verifies diagnosis of Trigeminal neuralgia<sup>4</sup>. There is gamut of medical and surgical treatment modalities available for trigeminal neuralgia, with other treatment methods like physiotherapy, acupuncture and psychological methods<sup>5</sup>. To control pain in patients with TN, carbamazepine should be offered and oxcarbazepine, baclofen<sup>1</sup>, lamotrigine and pimozide may be considered. For patients with TN refractory to medical therapy early surgical therapy, percutaneous procedures on Gasserian ganglion, gamma knife and micro vascular decompression<sup>6</sup>. Physiotherapy is one of the

methods to treat TN, pain control is usually achieved by means of electrical stimulation. The two currents most often used to achieve this intention are pulsed current usually referred as transcutaneous electrical nerve stimulation (TENS) and burst modulated medium frequency alternating current in the form of interferential current (IFC)<sup>7,8</sup>. TENS and IFC are forms of electro analgesia based on gate control theory of pain perception. According to this theory, stimulation of large diameter primary sensory afferent cutaneous fibers activates inhibitory inter neurons in spinal cord dorsal horn and thus may ease the transmission of nociceptive signals from small diameter A delta and C fibers<sup>9</sup>. TENS is an effective, easy to use and with minimal side effects in patients suffering from trigeminal neuralgia not responding to conventional therapy<sup>10</sup>. Studies have shown that IFC is more effective than medication for reducing pain in Trigeminal Neuralgia<sup>11</sup>. If both TENS and IFC are effective in inducing hypoalgesia, it is much more demanding to evaluate whether one is better than the other<sup>12</sup>. The present study is taken up with the purpose of comparing the efficacy of TENS and IFC in treatment of Trigeminal Neuralgia.

### METHODOLOGY

Present study is a different subject design conducted on a group of thirty female subjects diagnosed with case of Trigeminal Neuralgia, between the age group of 30-50 years

For Correspondence: N.P.Singh  
navinder8678@gmail.com

with mean age of 39.2. The selection was done on random basis. The sample was then randomly divided into equal groups of 15 subjects each, into Group A (on which TENS was applied) and Group B (on which IFC was applied). Subjects with cardiac pacemakers, skin allergies, mental confusions and lack of skin sensations formed the exclusion criteria in selecting the subjects. Both Group A and Group B were treated with TENS and IFC respectively, with placement of electrode just before the ear and other one at the end of respective nerve. Group A was assigned with electrical stimulation with TENS in continuous mode with pulse duration of  $< 150 \mu\text{s}$  and frequency of  $> 80 \text{ Hz}$  for 30 min duration with intensity depending upon subject's tolerance for 6 days a week for three weeks and outcome of functional status was recorded by means of visual analogue scale (VAS) at 0 week and 3rd week. Whereas Group B was assigned with electrical stimulation with IFC as bipolar method with pulse duration of  $250 \mu\text{s}$  and frequency of machine circuit interference of frequency between 4000 Hz with 4100 Hz with beat frequency of 100bps for 30 min duration with intensity depending upon subject's tolerance for 6 days a week for three weeks and outcome of functional status was recorded by means of visual analogue scale (VAS) at 0 week and 3rd week.

## RESULTS

Within group comparison between Group A and Group B for Vas score was done by Wilcoxon Signed Rank Test. In both groups there was significant difference in VAS score between 0 week and 3rd week with p value of  $< 0.01$ . There is significant reduction in VAS. Mann Whitney U Test was performed for comparison of VAS between Group A and Group B. These tests were performed among pretest value at 0 week and posttest value at 3rd week. Comparison of VAS of both the groups was done. There was no significant difference between VAS score between pretest value at 0 week but at 3rd week there was significant difference in VAS score of both the groups with  $p < 0.01$ . Whereas Group A showed highly significant improvement than Group B with U value of 33.5 and p value  $< 0.01$ .

**Table 1: Intra Group Comparison of Visual Analogue Scale between Group A and Group B with Mann-Whitney U Test**

	Group A	Group B	Combined A and B
Sum of Ranks	311.5	153.5	465
Mean of Ranks	20.77	10.23	15.5
Expected sum of Ranks	232.5	232.5	-
Expected mean of Ranks	15.5	15.5	-

Standard deviation	0.84515	1.12546	24.1091
U-Value	33.5	191.5	-

For Group A, U value is 33.5. The critical value of U at  $p < .01$  is 56. Therefore the result is significant at  $p < .01$ .

The Z score is 3.25603. The p value is .00056. The result is significant at  $p < .01$ .

**Table 2: Inter Group Comparison of Visual Analogue Scale with in Group A Using Wilcoxon Signed Rank Test**

W-value	0
Mean Difference	7.4
Sum of Positive Ranks	120
Sum of Negative Ranks	0
Z-value	-3.4078
Mean(W)	60
Standard Deviation	17.61
Sample Size	15

Z-Value is -3.4078. The p-value is 0.00032. The result is significant at  $p \leq 0.01$

W-Value is 0. The critical value of W for N=15 at  $p \leq 0.01$  is 19. Therefore result is significant at  $p \leq 0.01$ .

**Table 3: Inter Group Comparison of Visual Analogue Scale within Group B Using Wilcoxon Signed Rank Test**

W-value	0
Mean Difference	5.4
Sum of Positive Ranks	120
Sum of Negative Ranks	0
Z-value	-3.4078
Mean(W)	60
Standard Deviation	17.61
Sample Size	15

Z-Value is -3.4078. The p-value is 0.00032. The result is significant at  $p \leq 0.01$

W-Value is 0. The critical value of W for N=15 at  $p \leq 0.01$  is 19. Therefore result is significant at  $p \leq 0.01$ .

## DISCUSSION

Efficacy of TENS and IFC on Trigeminal Neuralgia have been studied separately but studies on comparison are not available. So present study was taken up with the purpose of comparing efficacy of TENS and IFC on trigeminal neuralgia, the result of the study for inter group comparison of VAS with in Group A show significant decrease in Vas value from 0 to 3rd week which indicates towards the efficacy of TENS in treatment of Trigeminal Neuralgia which is well supported by study of Singla et.al.on 30 patients with trigeminal neuralgia who were given continuous burst of current for 20 minutes daily for 20-40 days over the path of affected nerve with portable TENS machine. Patients were subsequently evaluated at 1 and 3 months interval for pain by VAS, VPS and functional outcome scale which showed significant decrease in pain<sup>13</sup>. Similar results were reported in a case of 36 year old man that

showed immediate and long term remission of symptoms when intense discharge of TENS was delivered accidentally. Hence thought that TENS at an intense level may result in long lasting effects<sup>14</sup>. The results of laboratory studies suggest that electrical stimulation delivered by a TENS unit reduces pain through nociceptive inhibition at presynaptic level in dorsal horn thus limiting the central transmission, thus helps in treating variety of medical conditions like neurogenic pain, post herpetic neuralgia, trigeminal neuralgia, brachial plexus avulsion<sup>15</sup>. Significant results were found in present study for inter group comparison of VAS in Group B treated with IFC, Soomro et.al. Illustrated the effect of IFT on reducing pain for patients with trigeminal neuralgia by having them received 15 sessions of IFT with treatment duration of 30 min. The intensity of impulse varied according to patient's tolerance. The result suggested that IFT could be considered as one of the physical modalities in reducing pain for trigeminal neuralgia<sup>11</sup>. Another study on 49 patients suffering from post-herpetic neuralgia conclude that interferential current and narrow band UV B were effective in acute and sub-acute neuralgia, while only interferential is effective in established neuralgia<sup>16</sup>. The efficacy of IFC in Trigeminal Neuralgia can be attributed to the fact that IFC is a medium frequency current that exerts lower resistance to the skin than TENS. This could be due to the stronger penetration power of IFC. Therefore IFC is likely to be more effective in penetrating through skin and stimulating the deep nerve tissue underneath<sup>17</sup>. Studies have shown that IFC is an afferent stimulation applied to skin, its analgesic mechanism involves gate control theory, the physiological block and the endogenous pain inhibitory system similar to that of TENS<sup>18</sup>. The results of the study for intra group comparison for VAS score between group A and Group B show highly significant improvement in Group A than in Group B can be explained by study of Shanahan et.al which found that TENS was significantly more effective than premodulated IFC in elevating pain threshold<sup>19</sup>. It is unknown whether the analgesic effect of IFC is superior to concomitant interventions. IFC alone was not significantly better than placebo or other therapy at discharge or follow up<sup>20</sup>. Balance of evidence suggest that IFC Is also an effective electrotherapeutic treatment for pain management, but the evidence are less strong than that for TENS. TENS was shown to be more adaptable method of stimulating the nerve pathways than IFC<sup>21</sup>. The evidence suggest that both TENS and IFC has significant analgesic efficacy but comparative study show that TENS has better analgesic efficacy in treatment of Trigeminal Neuralgia than IFC. However there

has been very little research into the comparative effectiveness of TENS and IFC in case of Trigeminal Neuralgia which makes it much more demanding to evaluate which one is better than other and requires further study to find out difference in efficacy of TENS and IFC in case of Trigeminal Neuralgia.

## CONCLUSION

Both TENS and IFC has significant efficacy in case of Trigeminal Neuralgia when studied separately. But in comparative study between efficacy of TENS and IFC in Case of Trigeminal Neuralgia, TENS was found to be better option over IFC.

## REFERENCES

1. Obermann M. Treatment options in trigeminal neuralgia. Therapeutic Advances in Neurological Disorders. 2010;3(2):107-115.
2. Merskey H, BogdukN. Classification of chronic pain .Descriptors of chronic pain syndromes and definitions of pain terms.2nd edn.Seattle: IASP Press, 1994.
3. Goto F, Ishizaki K, Yoshikawa D, Obata H, Arii H, Terada M. The long lasting effects of peripheral nerve blocks for trigeminal neuralgia using a high concentration of tetracaine dissolved in bupivacaine. Pain. 1999 Jan 1;79(1):101-3.
4. Toda K. Trigeminal Neuralgia—Symptoms, Diagnosis, Classification, and Related Disorders—. Oral Science International. 2007 May 31;4(1):1-9.
5. Shamimul Hasan et.al. Trigeminal Neuralgia: An Overview Of Literature With Emphasis On Medical Management IRJP 2012,3(11),p.235-238.
6. Walsh DM, Howe TE, Johnson MI, Moran F, Sluka KA. Transcutaneous electrical nerve stimulation for acute pain. The Cochrane Library. 2009 Jan 1.
7. Robertson VJ, Spurritt D. Electrophysical agents: implications of their availability and use in undergraduate clinical placements. Physiotherapy. 1998 Jul 31;84(7):335-44.
8. Pope GD, Mockett SP, Wright JP. A survey of electrotherapeutic modalities: ownership and use in the NHS in England. Physiotherapy. 1995 Feb 28;81(2):82-91.
9. Chung JM. Anti-nociceptive effects of peripheral nerve stimulation. Prog Clin Biol Res 1985; 176:147-61.
10. Yameen F, Shahbaz NN, Hasan Y, Fauz R, Abdullah M. Efficacy of transcutaneous electrical nerve stimulation and its different modes in patients with trigeminal neuralgia.

- JPMA-Journal of the Pakistan Medical Association. 2011 May 1;61(5):437.
11. Soomro N, Hamid M, Yamin F, Bibi R. The Efficacy of Interferential Current on Trigeminal Neuralgia. Medical Channel. 2012 Apr 1;18(2).
  12. Ward AR, Lucas-Toumbourou S, McCarthy B. A comparison of the analgesic efficacy of medium-frequency alternating current and TENS. Physiotherapy. 2009 Dec 31;95(4):280-8.
  13. Singla S, Prabhakar V, Singla RK. Role of transcutaneous electric nerve stimulation in the management of trigeminal neuralgia. Journal of neurosciences in rural practice. 2011 Jul 1;2(2):150.
  14. Thorsen SW, Lumsden SG. Trigeminal neuralgia: sudden and long-term remission with transcutaneous electrical nerve stimulation. Journal of manipulative and physiological therapeutics. 1996 Dec;20(6):415-9
  15. Vladimir Kaye. Transcutaneous Electrical Nerve Stimulation; Medicine Journal, Jan 29, 2002, Vol 3, Number 1.
  16. Waked IS. Interferential Current Therapy versus Narrow Band Ultraviolet B Radiation in the Treatment of Post Herpetic Neuralgia. Indian Journal of Physiotherapy and Occupational Therapy-An International Journal. 2013;7(1):70-5.
  17. Cheing GL, Hui-Chan CW. Analgesic effects of transcutaneous electrical nerve stimulation and interferential currents on heat pain in healthy subjects. Journal of rehabilitation medicine. 2003 Jan 1;35(1):15-9.
  18. Dalal VP, Sheth MS, Vyas NJ. Comparison of analgesic effect of interferential therapy and transcutaneous electrical nerve stimulation on pressure pain threshold on young healthy individuals. Journal of Clinical & Experimental Research | May-August. 2014;2(2):129.
  19. Shanahan C, Ward AR, Robertson VJ. Comparison of the analgesic efficacy of interferential therapy and transcutaneous electrical nerve stimulation. Physiotherapy. 2006 Dec 31;92(4):247-53
  20. Fuentes JP, Olivo SA, Magee DJ, Gross DP. Effectiveness of interferential current therapy in the management of musculoskeletal pain: a systematic review and meta-analysis. Physical therapy. 2010 Jul 20.
  21. Palmer ST, Martin DJ, Steedman WM, Ravey J. Alteration of interferential current and transcutaneous electrical nerve stimulation frequency: effects on nerve excitation. Archives of physical medicine and rehabilitation. 1999 Sep 30;80(9):1065-71.

## EFFICACY OF AQUATIC THERAPY IN IMPROVING FUNCTIONAL OUTCOMES IN CHILDREN WITH CEREBRAL PALSY: A SYSTEMATIC REVIEW

**AMY TREMBACK-BALL, PHD, PT\***; **CHRISTOPHER BROZENA, DPT\***; **LAUREN CLEMSON, DPT\***; **KATLYNN FICKINGER, DPT\***; **NICOLE NAJAKA, DPT\***

\* Misericordia University, Dallas, PA USA

### **ABSTRACT**

**Purpose:** This systematic review was conducted in order to determine if aquatic therapy is an effective intervention to improve treatment outcomes in children with cerebral palsy. **Methods:** CINAHL, Academic Search Premier, and Medline were searched for published research reports on the topic. Studies were included if they met the criteria of population (aged 0-21), diagnosis (any form of cerebral palsy), and intervention (aquatic therapy). Studies that met inclusion and exclusion criteria were analyzed using the PEDro scale and summarized in a matrix. **Results:** Fourteen studies were included. Data were reported for a variety of functional measures, strength, ROM, energy expenditure, vital capacity, spasticity, gait, balance, emotional health, behavior, quality of life, and swimming ability. **Conclusion:** The available evidence in this systematic review suggests that aquatic therapy is an effective intervention when used in conjunction with traditional physical therapy.

**KEYWORDS:** physical therapy; pediatrics, exercise

## **INTRODUCTION**

Cerebral palsy (CP) is the most common neuromuscular disorder in children<sup>1</sup>. This neurologic condition is caused by a non-progressive lesion in the immature brain which results in permanent impairments in movement and postures<sup>1,2</sup>. CP can lead to diminished quality of life by limiting participation in both activities of daily living as well as various leisure activities secondary to physical disability<sup>1</sup>. The reported incidence of this neuromuscular disease ranges from 1.5 to more than 4 per 1,000 live births<sup>3</sup>. CP can manifest during gestation, at birth, or immediately after birth. An interruption of oxygen to the brain of the fetus or newborn results in impairments that may include abnormal muscle tone and contraction, bone abnormalities, abnormal joint motion, muscle weakness, deficits in balance, changes in spinal reflexes, and low cardiovascular endurance<sup>4,5</sup>. These impairments often have an effect on the attainment of developmental milestones so one may also see developmental delay<sup>4,6</sup>. Further, the symptoms of CP can lead not only to physical disability in children but may also impair a child's social and psychological development as well.

The various types of CP are classified based on movement differences and include spastic diplegia, hemiplegia, quadriplegia, dyskinetic, ataxic, and mixed types<sup>7,9</sup>. The most common type of cerebral palsy is spastic CP, which typically affects the lower extremities more so than the upper extremities<sup>10</sup>. Children

with CP are often categorized into levels of severity based on their functional abilities with tools such as the Gross Motor Function Classification System (GMFCS). It is a five-level, age categorized system that emphasizes a child's performance in sitting, walking, and wheelchair mobility<sup>11</sup>. The Gross Motor Function Measure (GMFM) is a more in depth, standardized tool for evaluating motor function in children with CP<sup>12</sup>. This tool, which examines 5 dimensions of motor function and development, is the gold standard for evaluating the functional status of these individuals. These dimensions are outlined in Table 1. The type of CP, the GMFCS level, and the GMFM score all provide insight on how the disorder may impact the child's functional abilities at home, in the community, and overall quality of life.

**Table 1 Gross Motor Function Measure**

GMFM Section	Example Tasks
Section A: Lying & Rolling	Gathering to midline, reaching across midline, lifting head when prone.
Section B: Sitting	Pull to sitting, remaining upright with static sitting, reaching from sitting.
Section C: Crawling & Kneeling	Weight bearing through 4 points, reciprocal crawling, high kneeling.
Section D: Standing	Pull to stand, single leg stance, pick up object off floor.
Section E: Walking, Running, & Jumping	Cruising, ball kicking, hopping, stair navigation.

Children with CP are also susceptible to many associated conditions such as general deconditioning, overuse syndromes, contractures, and generalized weakness<sup>4,5</sup>. This can result in decreased activity tolerance, decreased gait efficiency, and decreased postural and core stability. Because of this, children with CP may be less likely to participate in physical activity

For Correspondence:  
AMY TREMBACK-BALL  
Email: atball@misericordia.edu

than children without CP. Early diagnosis and a heavy emphasis on physical activity programs is a crucial part of the rehabilitation process to preserve activity and functional capabilities in children with CP<sup>10</sup>. Physical therapy is an essential part of the specialized interdisciplinary services that help children with CP reach their full potential and limit the impact of secondary impairments<sup>4</sup>. Physical therapy is often focused on increasing range of motion, strengthening musculature, reducing the risk of further complications, and improving functional independence<sup>13</sup>.

There are many traditional therapeutic exercises appropriate for the treatment of CP including treadmill training, running, cycle ergometer, and other land based exercises. However these activities have not always been considered “fun” for a child. This can negatively impact participation in treatment. Due to the natural qualities of water, aquatic therapy is an option to allow full participation in physical exercise that is more purposeful and enjoyable. Further, water provides a therapeutic environment because of its natural properties including viscosity, buoyancy and hydrodynamics. Preliminary research suggests that aquatic therapy activities allow unrestrained movement and facilitation of muscles that normally have difficulty overcoming gravitational forces to become unloaded and work with more ease<sup>10</sup>. Aquatic therapy can decrease many negative forces faced on land, while also permitting a variety of strengthening and aerobic exercises with the resistant forces of buoyancy and viscous drag to challenge the cardiovascular and musculoskeletal systems<sup>14</sup>. An individual submerged up to his/her umbilicus effectively loses approximately 50% of their body weight<sup>15</sup>.

Hydrodynamic forces of water can be used to support an individual as well as uniquely challenge them. While standing static the force of the water helps facilitate balance and proper posture, however when moving, drag safely adds an extra degree of challenge<sup>15</sup>. These forces can increase the demand not only on skeletal musculature but on the cardiovascular system as well<sup>15</sup>. Aquatic therapy may help train and strengthen the weakened respiratory muscles of individuals with CP. At rest the total work of breathing for a tidal volume of 1 liter increases 60% when submerged up to the neck<sup>15</sup>. It has been hypothesized that this can help train and strengthen the weakened respiratory muscles of individuals with CP and help improve the efficiency of cardiovascular and musculoskeletal systems. Lastly, the thermal properties of water may assist with achieving a better workout with individuals with high muscle tone. Heat transfer

from warm water to spastic muscles has been found to decrease spasticity and involuntary movements<sup>16</sup>.

## PURPOSE

The purpose of this systematic review is to evaluate the efficacy of aquatic therapy programs in obtaining significant functional improvements in children with CP. This review aims to provide insight on aquatic therapy that can be adapted and practiced by current and future rehabilitation clinicians, especially physical therapists. The underlying goal of this review is to provide the latest research on aquatic therapy to healthcare professionals so that they may be educated and able to provide children with CP the most effective and beneficial treatments. This in turn may help optimize the children’s functional abilities and improve their overall quality of life.

## METHODOLOGY

A search of the electronic databases CINAHL, Academic Search Premier, and MEDLINE was conducted using the term “cerebral palsy” in combination with each of the following: “aquatic therapy,” “aquatic exercise,” “hydrotherapy,” “children,” and “swimming.” The search was limited to journal articles written in English, published within the last 20 years (1994-August 2014), and all systematic reviews and meta-analyses were excluded. Additional articles were reviewed if they were referenced by an included article and appeared to meet the inclusion criteria.

Titles and abstracts were reviewed and the articles were included if they met the criteria of population (aged 0-21), diagnosis (any form of CP), and intervention (aquatic therapy). Case studies that included children with CP as well as other conditions were included if at least one participant had cerebral palsy.

Studies that met all inclusion criteria were individually analyzed and summarized in a matrix (Table 2) incorporating article reference, study type, PEDro score, number of subjects and groups used, diagnosis and functional inclusion/exclusion criteria, intervention performed, assessment tools utilized, intervention outcomes, study limitations, conclusions drawn from the study. PEDro score was taken from their official database when available or was determined by researcher consensus using the published PEDro scale<sup>17</sup>.

Table 2

Citation	Study Type	Pedro Score	Number Subjects/Groups	of Ages	Diagnoses & Functional Inclusion Criteria	Intervention	Assessment Tools	Significant Outcomes	Limitations	Conclusion
Ballaz, 2011 <sup>14</sup>	Single Group Pre-Post	4	N=10 One Group: Aquatic Therapy	13-21 years old	Spastic CP  Independent walking with or without device for 5 min.  Ability to follow simple verbal instructions	45 minutes, 2x/week, 10 weeks  10 min warm up (stretching, aerobic exercise)  15 min relay race 5 min floating/ relaxation 15 min aquatic play (balloon pass, synchronized swim, balance on a board, volleyball)	Energy expenditure index  Gait analysis  Isometric quad & hamstring strength  GMFM (Parts D & E)	Decreased energy expenditure  No significant gait change  No significant strength change  Significant GMFM change in only one subgroup	Program was not gait-specific; difficulty recording HR in the water; no control; short training period; small sample size	Group training is possible  Cardio improvement was made  Motor improvement may require more specificity
Chrysagis, 2009 <sup>19</sup>	RCT	6	N=12 Two Groups: Aquatic Therapy & Control	13-20 years old	Spastic CP or Tetraplegia or Diplegia  Ability to walk with or without aids  Ability to follow simple commands	~55 minutes, 2x/week, 10 weeks  10 min warm up (static stretching, walking) 35 min training in backstroke and front crawl Cool down (free swimming, stretching)	GMFM (Parts D & E)  Modified Ashworth Scale (hip adductors and knee flexors)  ROM (shoulder, hip, and knee)	GMFM increase approached significance  Decreased spasticity scores for both hip adductors and knee flexors  PROM for hip abduction and knee extension improved  AROM for shoulder flexion and abduction also improved	Small sample size; different categories of spastic tetra- and diplegia; familiarization of examiner; day to day changes in spasticity	Aquatic training can improve gross motor function, ROM, and spasticity
Lai, 2014 <sup>18</sup>	NRT	8	N=24 Two Groups: Aquatic Therapy & Control	4-12 years old	Spastic CP GMFCS I-IV  Ability to follow instructions	60 min, 2x/week, 12 weeks  5-10 min warm up and stretch 40 min. pool exercises (per Halliwick) 5-10 min cool down	Modified Ashworth Scale (elbow flexors, wrist flexors, knee flexors, plantar flexors)  GMFM-66  Physical Activity	No significant difference in spasticity scores  GMFM scores improved  Increased Physical Activity Enjoyment score	Small sample size; short duration; final tests performed on a non-therapy day; lack of randomization; lack of pain measurement	GMFM improved but did not translate to ADL's or Quality of Life  Higher Physical Activity Enjoyment rating may indicate improved compliance

							Enjoyment Scale Vineland Adaptive Behavior Scale Cerebral Palsy Quality-of-Life parent proxy scale	No significant difference between groups No significant difference between groups		
Dimitrijevic 2012 <sup>13</sup>	RCT	5	N=27  Two Groups: Aquatic Therapy & Control	5-14 years old  Ability understand instructions to	55 min, 2x/week, 6 weeks  10 min warm-up (aerobic exercises) 40 min swimming techniques (blowing bubbles, floating, gliding, swimming) 5 min play (ball games, chasing games)	GMFM-88  Water Orientation Test Alyn 2	GMFM scores improved  Improved water orientation scores	Short intervention time; use of individualized aquatic intervention; control group received no intervention	Aquatic therapy can improve gross motor function	
Dorval, 1996 <sup>25</sup>	RCT	5	N=20  Two Groups: Conventional Aquatic Therapy & Experimental Aquatic Therapy	10-17 years old  Capable of following simple verbal orders	55 min, 1x/week, 10 weeks  Conventional: Warm up & Relaxation 15 min swimming skills and games Free Play Cool down & Relaxation  Experimental: Preparation and entry Warm-up Individual exercises Group Activities Relaxation  *This group also received additional self-esteem training	Rosenberg's Self-Esteem Scale  Functional Independence Measure children	Both groups saw a short-term increase, no difference between groups.  Conventional group saw a short-term increase, experimental group scores were increased both short term and at follow-up.	Small sample size; very limited response rate at nine-month follow-up; unbalanced use of emotional support	Aquatic exercise with both high and low amounts of structure show potential in improving self-esteem and functional independence in those with CP	
Fragala-Pinkham, 2009 <sup>20</sup>	Case Study	3	N = 2  Combination of Aquatic & Land Based Therapy	Case 1: 7 year old  Case 2: CP, Right	Case 1: Spastic diplegia GMFCS level I  Case 2: 2x/wk for 60	Case 1 – 2x/wk, 6 wks for 60 min (8 pool sessions & 4 land)  Case 2 – 2x/wk for 60	Case 1- COPM, GMFM,, 3 min fast walk, standing functional reach, peak isometric strength, PROM	Case 1 – Significant improvements in gross motor function, balance, & LE ROM	Patients received both aquatic therapy & land based therapy interventions; case study design; no control	Aquatic & land PT allowed for improvements in impairment for both children, including ROM, strength, balance, & functional mobility

			Case 2: 10 year old	hemiplegia. GMFCS level I	min for 2.5 months, then 1x/wk for 60 min for 5.5 months (76% of sessions in pool)	Case 2- COPM, PEDI, floor to stand, 3 min fast walk, timed single leg stance, MMT	Case 2 – Improvements on PEDI, floor to stand, ankle PROM, & 3 min. fast walk		
Hutzler, 1998 <sup>16</sup>	RCT	4	N=46 Two Groups: Aquatic Therapy & Control	5-7 years old	CP  30 min, 3x/week, 6 months  2x/week: Individual aquatic exercise 30 min water orientation and swimming skills  1x/week: Group movement exercise 30 min land based locomotion and ball-handling skills	Vital capacity  Water orientation checklist	Both groups saw an increase in vital capacity; aquatic group's improvement was significantly greater than control  Water orientation scores improved	Small sample size; more overall treatment time for experimental group; only examined vital capacity and not other indications of motor function	Aquatic therapy can show greater improved vital capacity in those with CP than more traditional PT
Jorgic, 2012 <sup>10</sup>	NRT	4	N=7 One Group: Aquatic Therapy	7-11 years old  Walk (I) with/without assistive device  Follow simple verbal instructions  Any level of swimming ability  Written consent from parents or physician	Spastic CP  45 min, 2x/week, 6 weeks  Hallwick Method, swimming exercises for healthy population(s)	GMFM-88  Water Orientation Test Alyn 2	Increases were present in both section E and total scores  Improved water orientation scores	Small sample size	Aquatic swimming programs have positive effects on the GMFM D &E dimensions and overall improvement  The A, B, & C dimensions didn't score high because of high score at baseline. These results are in accordance with prior research studies.
Maniu, 2013 <sup>26</sup>	Single Group Pre-Post	4	N = 24 One Group: Combination of Aquatic & Land Therapy	8-16 years old  Spastic CP, paraparesis, tetraparesis, hemiparesis, dyskinetic CP & ataxic CP  Ability to follow simple verbal instructions	6 months, 2 weekly sessions of 45 min aquatic therapy & 2 land PT sessions  Program for teaching swimming to individuals with neuromuscular disorders	Physical Activity Index  Spirometry  KINDLR	Increase in activity scores  Vital capacity increased  Improved KINDLR scores	No control group; received aquatic & regular PT; specific therapy intervention not reported	The combination of aquatic & land based PT can improve respiratory function in children with CP

Retarekar, 2009 <sup>21</sup>	Single Subject Design	2	N=1  One Aquatic Exercise	5 years old  Group: Aerobic	Spastic diplegia  Medical stability or clearance  No history of orthopedic surgery or botulinum injections  Not receiving intervention that included aerobic endurance	3x/week, 12 weeks 1 rest day in between exercise day when possible  5 min warm up 30-40 aquatic aerobic exercise including treadmill walking, shuttle running, running, jumping, deep water running, creeping, kicking, and swimming 5 min cool down	COPM  GMFM  6 Minute Walk Test  Modified Energy Expenditure Index	Participation component consistently above +2SD at week 4. Satisfaction component showed improvement.  Increase in GMFM scores, maintained through follow-up  Walking endurance increased during intervention phase, but returned to baseline during follow-up  Decreased energy expenditure during intervention, returned to baseline during follow-up	Small sample size; limited data collection during intervention phase; GMFM repeated multiple times- could have introduced training effect; moderate interrater reliability; no control group	Based on GMFM reference curves (mean change 3.3 points for child of her GMFM level and age), subject increased 10 percentile points which exceeds the predicted for short time frame. MEEI decreased. Walking endurance increased. Parent reported significant increase in mobility in home and classroom.
Fragala-Pinkham, 2014 <sup>24</sup>	Time Series Group Design	5	N=8  One Group: Aquatic exercise	6-15 years old  6-18 years old  Medically able to participate in exercise program  Can follow directions and adhere to program  No anticipated changes in meds/rehab	CP (GMFCS Level I or III)  Walk (I) with/without assistive device  6-18 years old  Medically able to participate in exercise program  Can follow directions and adhere to program  No anticipated changes in meds/rehab	2x/week for 14 weeks 60 minute individual pool session  - 2 to 5 min warm-up - 40 to 45 min aerobic exercise (70-80% MHR) - 5 to 10 min strength training - 5 to 10 minute cool down and stretch  Aerobics included: Deep water walking, pool treadmill walking, step climbing, running, jumping, hopping, basketball drills, treading water, swimming, prone kicking  Strength training included:	GMFM D & E combined  6 Minute Walk Test  Brockport modified curl-up / Brockport isometric push-up / Lateral step-ups / Shuttle run test / Pediatric Berg Balance Scale	GMFM score improved  Ambulation endurance improved  All trended towards improvement but were not statistically significant	Small sample size; no control group; possible ceiling effect (GMFCS Level I); floor effect on muscular strength outcomes (GMFCS Level III); HR monitor problems; length of testing sessions varied	A 14-week aquatic exercise program can improve the gross motor skills and walking endurance in children with Cerebral Palsy who have mild- to-moderate physical impairments

					services during study Willingness to enter water	Leg, arm, and trunk movements with noodles, leg weights, fins, and water resistance				
Mackinnon1997 <sup>22</sup>	Single Subject Case Study	2	N=1	8 year old	Mild spastic diplegia	16 swimming sessions over 9 months (10 sessions between March and Oct, 6 week period of weekly sessions Oct to Dec)  Swimming was taught using the Halliwick method	Swimming With Independent Measurement  GMFM  Video analysis	Improvements in vertical and horizontal balance; able to float on back w/o aid and swim a short distance  GMFM scores improved  Improvement noted in confidence, single leg stance, balance; predominantly flat-footed gait w/ narrower base of support	Small sample size; lack of enthusiasm; patient reluctant to carry out session with mother	Doing Halliwick swimming with children who have spastic diplegia CP can improve both swimming and physical skills
Ozer, 2007 <sup>23</sup>	RCT	6	N=23  Two Groups: Aquatic Therapy & Control	5-10 years old	Both groups consisted of children with tetraplegia, diplegia, hemiplegia, or triplegia  Ambulatory	14 week, 30min sessions, 3x/week  First two weeks attempted to acclimate children to the pool  After 2 weeks “exercises and drills” in water were started  Aquatic Sports Skills Program started in 4th week (training session gradually increased to 60 min)	Body Awareness  Child Behavior Checklist, parent and teacher forms	Swimming group saw scores increase  No significant effect on internal or external behavior problems	Small sample size; maturation; exact IQ scores not known; some of children’s behavioral issues were not at the clinical level; no follow up of CBCL; CBCL limitations in applicability (life activities of children w/ mod/severe mental disability)	Swimming training produced a significant improvement in body awareness in children with CP, while no effect was evident on competence and behavior problems on CBCL
Thorpe, 2005 <sup>23</sup>	Single Group Pre-Post	5	N=7  One Group: Aquatic Therapy	7-13 years old	CP  Able to ambulate 100 ft with or without a device  Able to follow	45 min, 3x/week, 10 weeks  Stretching and Warm-up Strengthening (hip flexors, hip abductors, hip extensors, knee flexors and extensors, hip	Lower extremity strength (isometric hip, knee and ankle flexors and extensors)  Gait Velocity	Trended toward improvement but did not reach significance  Trended toward improvement but did	Small sample size; investigator bias; limit to ambulatory children	Aquatic therapy can result in significant improvement in GMFM and Timed Up & Go scores

INDIAN JOURNAL OF PHYSICAL THERAPY VOLUME 5 ISSUE 2 (JULY– DECEMBER 2017)

				multi-step commands No severe behavior issues	external rotators, dorsiflexors) Bicycling Walking/Running Games	Timed Up & Go GMFM Energy Expenditure Index Functional Reach Test Self-Perception Scale for Children and Adolescents	not significant Scores improved significantly Significant score improvement, specifically Section E No significant improvement noted No significant improvement noted No significant improvement noted	reach		
--	--	--	--	--	--	--	---	-------	--	--

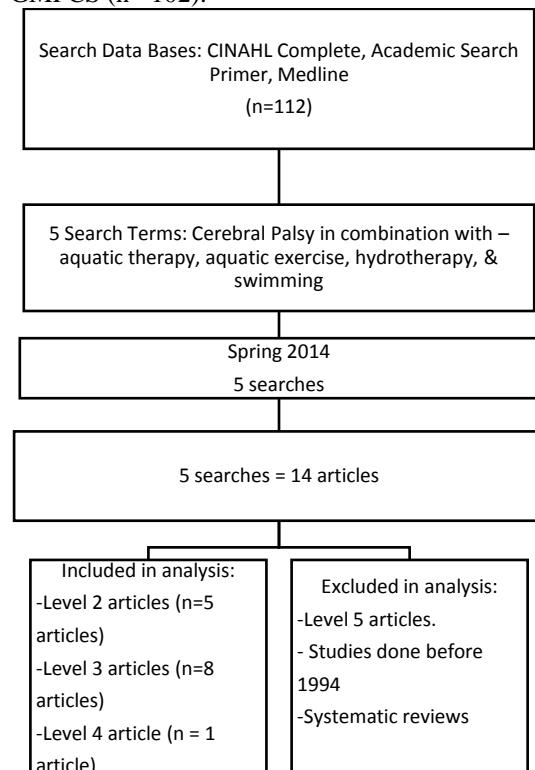
Permission to use granted by: Mary Hastings, PT, DPT, ATC and Washington University Program in Physical Therapy, updated last in 2009

CP-Cerebral Palsy; GMFM-Gross Motor Function Measure; HR-Heart rate; RCT-Randomized Control Trial; ROM-Range of Motion; PROM-Passive ROM; AROM-Active ROM; NRT-Non-randomized Trial; GMFCS-Gross Motor Functional Classification Scale; ADL-Activities of daily living; COPM-Canadian Occupational Performance Measure; PEDI-Pediatric Evaluation of Disability Inventory; MMT-Manual muscle test; LE-Lower extremity; PT-Physical Therapy; (I)-Independently; SD-Standard deviation; MEEI-Modified Energy Expenditure Index; MHR-Maximal Heart Rate; CBCL-Child Behavior Checklist

## RESULTS

The electronic search of databases and inclusion criteria resulted in a total of 112 articles that were found (Figure 1). Of these articles, 14 were acceptable to be included in this literature review on the efficacy of aquatic therapy on the functional outcomes of children with CP. PEDro scores ranged from 2 to 8 points. The mean PEDro score of the articles included is 4.5 points. The PEDro score for each article is included in Table 2.

In the articles reviewed, there were a total of 212 participants aged 4-21 years old with the diagnosis of CP. The most frequently studied population was spastic CP. Tetraplegia, diplegia, paraparesis, hemiparesis, dyskinetic, and ataxic CP were also included in the articles selected. The number of participants ranged in each study ranged from 1 to 45 subjects. The studies included participants with varying levels of functional ability classified in respect to GMFCS levels with the following distribution: GMFCS level I (n=25), level II (n =33), level III(n = 32), level IV (n = 11), and level V (n = 9). There were also 5 studies that did not use the levels of the GMFCS (n=102).



**Figure 1:**

Of the articles included in the review, 9 studies investigated aquatic therapy intervention alone. Of these 9 there were 2 articles that compared aquatic therapy to a control that

received conventional therapy, 1 study that compared an experimental aquatic therapy to a conventional aquatic control group and 1 study that compared their aquatic intervention to a no-intervention/control group. There were also 5 articles that participants received aquatic therapy along with conventional land based therapy. Eleven studies provided an aquatic intervention based on aerobic exercises that consisted of but is not limited to swimming skills, group activities, ball games, free play, individual aerobic exercise, strengthening exercises, and stretching. Two studies based their aquatic intervention on the Halliwick concept, which was developed by James McMillian and is often used for children with disabilities<sup>18</sup>. It follows a 10-point program addressing mental adjustment, disengagement, transversal rotation control, sagittal rotation control, longitudinal rotation control, combined rotation control, up thrust, stillness balance, turbulent gliding, simple progression, and basic swimming movements<sup>15,18</sup>. Also, there was one study that focused their aquatic intervention on aquatic sports skills.

Functional gains were measured with a broad range of outcome measures. The researchers separated the different outcome measures into categories based on what each specifically measured. In total 29 different outcome measures were analyzed, ranging from simple strength measures to detailed standardized assessments. The findings of each study were organized based on the aspect of function examined: GMFM, other functional outcome measures, strength, range of motion, energy expenditure, respiratory capacity, spasticity, gait, balance, emotional health, behavior, quality of life, and swimming. These results are summarized in Table 3. Overall improvements were seen in 12 out of the 13 categories, with behavior being the lone exception.

**Table 3:**

Gross Motor Function Measure <small>10,13,14,18-24</small>
8 out of 10 studies showed significant improvement in GMFM scores. Both 66 and 88 item versions of the GMFM were utilized. Section E typically saw the majority of the score improvement. Studies varied on which GMFCS levels saw significant score increases. Of the 3 studies that utilized a follow-up period >10 weeks, 2 indicated improvement was maintained.

Other Functional Outcome Measures <a href="#">6,20,21,25,26</a>
Significant improvement in WeeFIM scores were found during intervention period.*
Those with aquatic therapy and emotional support were able to maintain the WeeFIM improvements during follow-up.
In a single-subject study improvements in PEDI scores were reported.*
Increase in both activity participation and satisfaction observed using the COPM.
Strength <a href="#">20,23</a>
Improvements on MMT measures.
Increase in peak isometric strength of knee extensors, ankle DF, ankle PF >MDC.
Increase in lower extremity strength.
Increase in Knee flexor strength.*
ROM <a href="#">19,20</a>
Changes in PROM/AROM of UE & LE.*
Increase in PROM in ankle DF.
Interaction effect for shoulder flexion, shoulder abduction, hip abduction, and knee extension.*
Not a significant interaction effect of shoulder flexion and shoulder abduction.
Decrease in popliteal angles, >MDC.
Energy Expenditure <a href="#">14,23</a>
Decrease in energy expenditure during gait activities.*
Decrease in walking HR.*
GMFCS levels III-IV greater decreases in EEI vs GMFCS levels I-II.
Increased gait efficiency during aquatic intervention phase.
Respiratory Volume <a href="#">16,24,26</a>
Observable reduction in respiratory function of children with CP.
Change in VC observed in treatment group.
Increase in vital capacity*, increase of 56.7% compared to baseline.
Aerobic capacity.*
Spasticity <a href="#">19</a>
Interaction found for spasticity of hip abduction and knee flexors.*
Gait <a href="#">14,20,23,24</a>
Strong trend seen with increasing gait velocity with a mean overall increase in speed.
Decrease in TUG scores.
MDC in distance ambulated for 3 minute fast walk test.
Improvements in walking endurance &>MDC walking speed.
Increase in gait toe off variables.*
Balance <a href="#">20,23</a>
Increase in trend of functional reach.
Standing functional reach >MDC.
Floor to stand transfer, MDC.
Pediatric Berg Balance.*
Emotional Health <a href="#">18,23,25</a>
Improvement in self-esteem. (significant pre-post intervention, but not pre-intervention to follow up)
Greater enjoyment of intervention.
Behavior <a href="#">6,18</a>
Comparable Vineland Adaptive Behavior Scale scores between aquatic and control groups.
Aquatic therapy had no significant effect on internal or external behavior problems in the child behavior checklist.
Quality of Life <a href="#">18,25,26</a>
More types of leisure activities. (Aquatic: 7, Conventional: 6)
Health-related QOL comparable.
Increase in KINDLR score (23.7%).*
Significant increases were seen in KINDLR score for all GMFCS levels.*
Swimming <a href="#">10,13,16,22</a>
WOTA2 increased in overall score, mental adaptation, and water movement/swimming pre to post intervention.*
Maintained WOTA2 scores at follow-up.
Improvement in water orientation.

## DISCUSSION

While there is much research on the efficacy of traditional land based therapy on improving functional outcome measures in children with CP, research for the effectiveness of aquatic therapy is limited and in high demand. Despite increasing research into the benefits of aquatic therapy as a whole, only 14 articles were found examining its potential benefits in the treatment of children with cerebral palsy.

Of the ten included studies that looked at aquatic therapy's effects on GMFM score, eight saw significant improvement. Several of the studies looked specifically at improvements in section D (standing) and section E (walking, running, and jumping) of the GMFM. None of these studies saw a significant improvement in section D following aquatic treatment, and there were mixed results for improvement in section E. Part of this discrepancy may be the result of a ceiling effect. All participants needed to be able to ambulate for inclusion. Therefore, these individuals would presumably have a high starting section D score, and possibly a higher section E score. This potential ceiling effect is further supported by the fact that in these studies those individuals with GMFCS levels III-IV saw greater improvement than those in levels I-II. Significant functional improvements were also observed in the WeeFIM and PEDI, indicating that these improvements can be generalized beyond a single evaluation tool.

The results of this review suggest that these improvements in functional scores were the result of improvements in a variety of aspects of function. Improvements in strength, range of motion, and spasticity indicate that aquatic therapy can positively impact some of the primary musculoskeletal effects of cerebral palsy. These results demonstrate that water can be used to provide adequate resistance to result in strength increases in this population. Improvements in range of motion and spasticity indicate that aquatic therapy may also be effective in preventing contractures, and subsequent surgical releases, in this population. Further research in this area could be very valuable.

One of the most restrictive effects of CP is its impact on a child's ability to ambulate independently. In addition to score improvements in the GMFM's walking, running and jumping section, several other aspects of effective gait saw improvements. Patient balance improved following aquatic treatment, potentially decreasing risk for falls. In addition, improvements in vital capacity and energy expenditure index indicate that aquatic therapy may allow children to ambulate as well as

participate in other activities for longer periods of time without the threat of fatigue. Future research in this area could be used to determine if aquatic therapy can be utilized to decrease a child's reliance on assistive devices when ambulating. This could have significant implications for not only improvement in function but also improving limitation in participation and social restrictions associated with the use of assistive devices.

Along with gross motor improvements seen in the research, the participation component of programs is crucial for measuring their effectiveness on improved function. Participation measures such as the Canadian Occupational Performance Measure (COPM) are important for understanding the consistency and validity of results obtained throughout the program itself. Fragala-Pinkham et al<sup>20</sup> reported that the number of missed appointments was reduced when a child's PT program included aquatic intervention with an increase in motivation and decline in behavior-related obstacles.

Several of the studies reviewed suggest that the potential benefits of aquatic therapy extend beyond improvements in physical condition. These studies indicate that one's emotional health and quality of life may also benefit from these treatments. Aquatic therapy is an environment that encourages the formation of new friendships, not only with peers, but also with teachers and therapists that may be involved in treatment. These new interpersonal relationships help these children gain a sense of social satisfaction and self-esteem. This form of therapy also provides these children with new skills that allow them to be more active in their daily lives. In addition, these swimming skills provide them with the opportunity to participate in a leisure activity or sport for the rest of their lives.

When analyzing the research included in this review there were a number of limitations that were common among several of the articles. Many studies only included a small number of subjects. Other studies have noted that secondary to the diversity of characteristics in children with CP it is difficult to conduct large group randomized control trials<sup>27</sup>. Due to the limited and lack of well-defined research, small group interventions and case studies were included due to their well-described intervention protocols. It was also notable that several of the studies did not include detailed information regarding the types of aquatic intervention performed. Since different types of interventions can lead to very different outcomes, detailed intervention information should be included in all future studies. In addition, several of the studies did not

include control groups, likely as a result of small sample sizes.

Currently, research into the efficacy of specific aquatic interventions is minimal. Almost all of the studies included analyzed the effectiveness of an aquatic intervention in relation to conventional treatments. As aquatic therapy broadly becomes better recognized as an effective way to help individuals with CP, more research will need to be done to identify which specific aquatic interventions are most effective for which symptoms. Furthermore, research needs to be conducted in order to determine how to get the best interaction between land-based and aquatic treatments. Additional research will also need to be completed to look at the relationship between program length and optimal changes in functional status. Future research studies and systematic reviews would need to be conducted to help establish a baseline or gold standard as far as what is the effective frequency and duration for an aquatic therapy program for improving overall function in children with CP.

## **CONCLUSION AND IMPLICATIONS FOR RESEARCH AND CLINICAL PRACTICE**

Current research supports the benefits of land and aquatic therapy when used in conjunction with one another. However, research is limited when comparing one form of therapy to the other. It is with confidence that this systematic review presents the beneficial effects of aquatic therapy in conjunction with traditional therapy in improving functional outcome measures in children with CP. Improvements in functional outcome measures can be seen through positive changes including but not limited to ROM, strength, balance, spasticity, and mobility. While further research is needed to identify best practices for aquatic therapy, future clinicians should consider using therapy under aquatic conditions in addition to traditional therapy for children with CP. Traditional therapy should not be undervalued after this evaluation of research; however, it is with our hope that clinicians and therapists will consider adding therapy under aquatic conditions to their practice in order to help achieve functional gains for children with CP and allow for an improved quality of life.

## **REFERENCES**

1. Rosenbaum P, Stewart D. The World Health Organization International Classification of Functioning, Disability and Health: a model to guide clinical thinking, practice and

- research in the field of cerebral palsy. *SeminPediatr Neurol.* 2004;11:5-10.
2. Auxter D, Pyfer J, Heuttig C. Principles and methods of adapted physical education and recreation. 10th ed. St. Louis, MO: McGraw-Hill; 2005.
  3. Data and Statistics for Cerebral Palsy. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/NCBDDD/cp/data.html> Published December 27, 2013. Accessed January 20, 2015.
  4. Beckung E, Hagberg G. Neuroimpairments, activity, limitations and participation restrictions in children with cerebral palsy. *Dev Med Child Neurol.* 2002;44:309-316.
  5. Laskin JJ. Cerebral palsy. In ACSM's Exercise Management for Persons with Chronic Diseases and Disabilities. Champaign: Human Kinetics; 2003:288-294.
  6. Ozer D, Nalbant S, Aktop A, Duman O, Keleş I, Toraman NF. Swimming training program for children with cerebral palsy: body perceptions, problem behaviour, and competence. *Percept Mot Skills.* 2007;105:777-87.
  7. Cans, C. Surveillance of cerebral palsy in Europe: A collaboration of cerebral palsy surveys and registers. *Dev Med Child Neurol.* 2000;42:816-824.
  8. Sanger TD, Delgado MR, Gaebler-Sira, et al. Taskforce on Childhood Motor Disorders. Definitions and classification of negative motor signs in childhood. *Pediatr.* 2006;118:2159-2167.
  9. Sanger TD, Delgado MR, Gaebler-Spira, et al. Taskforce on Childhood Motor Disorders. Classifications and definition of disorders causing hypertonia in childhood. *Pediatr.* 2003; 111:e89-e97.
  10. Jorgić B, Dimitrijević L, Aleksandrović M, Okicic T, Madic D, Radovanovic D. The swimming program effects on the gross motor function, mental adjustment to the aquatic environment, and swimming skills in children with cerebral palsy: A pilot study. *Serb J Sports Sci.* 2012;11:51-66.
  11. Palisano RJ, Rosenbaum P, Walter S, et al. Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Dev Med Child Neurol.* 1997; 39: 214-223.
  12. Russell D, Rosenbaum P, Cadman D, Gowland, C, Hardy S, Jarvis S. The gross motor function measure: a means to evaluate the effects of physical therapy. *Dev Med Child Neurol.* 1998;31:341-352.
  13. Dimitrijević L, Aleksandrović M, Madić D, Okičić T, Radovanović D, Daly D. The effect of aquatic intervention on the gross motor function and aquatic skills in children with cerebral palsy. *JHumKinet.* 2012;32:167-74.
  14. Ballaz L, Plamondon S, Lemay M. Group aquatic training improves gait efficiency in adolescents with cerebral palsy. *DisabilRehabil.* 2011;33:1616-24.
  15. Becker B. Aquatic therapy: scientific foundations and clinical rehabilitation applications. *Am J Phys Med Rehabil.* 2009;1:859-872.
  16. Hutzler Y, Chacham A, Bergman U. Effects of a movement and swimming program on vital capacity and water orientation skills of children with cerebral palsy. *Dev Med Child Neurol.* 1998;40:176-181.
  17. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. *PhysTher.* 2003;83: 713-721.
  18. Lai CJ, Liu WY, Yang TF, Chen CL, Wu CY, Chan RC. Pediatric aquatic therapy on motor function and enjoyment in children diagnosed with cerebral palsy of various motor severities. *J Child Neurol.* 2014;1-9. doi: 10.1177/0883073814535491.
  19. Chrysagis DN, Douka A, Nikopoulos M, Apostolopoulou F, Koutsouki D. Effects of an aquatic program on gross motor function of children with spastic cerebral palsy. *BiolExerc.* 2009;5:13-25.
  20. Fragala-Pinkham MA, Dumas HM, Barlow CA, Pasternak A. An aquatic physical therapy program at a pediatric rehabilitation hospital: a case series. *PediatrPhysTher.* 2009;21:68-78.
  21. Retarekar R, Fragala-pinkham MA, Townsend EL. Effects of aquatic aerobic exercise for a child with cerebral palsy: single-subject design. *PediatrPhysTher.* 2009;21:336-44.
  22. Mackinnon K. An evaluation of the benefits of halliwick swimming on a child with mild spastic diplegia. *APCP J.* 1997;30-39.
  23. Thorpe DE, Reilly M, Case L. The effects of an aquatic resistive exercise program on ambulatory children with cerebral palsy. *J AquatPhysTher.* 2005;13:21-34.
  24. Fragala-Pinkham MA, Smith HJ, Lombard KA, Barlow C, O'neil ME. Aquatic aerobic exercise for children with cerebral palsy: a pilot intervention study. *Physiother Theory Pract.* 2014;30:69-78.
  25. Dorval G, Tetreault S, Caron C. Impact of aquatic programmes on adolescents with cerebral palsy. *OccupTher Int.* 1996;3:241-261.
  26. Maniu DA, Maniu EA, Benga I. Effects of an aquatic therapy program on vital

- capacity, quality of life and physical activity index in children with cerebral palsy. HVM Bioflux2013;5:117-124.
27. Getz M, Hutzler Y, Vermeer A. Effects of aquatic interventions in children with neuromotor impairments: a systematic review of the literature. ClinRehabil. 2006;20:927-36.

## TO STUDY THE PREVALENCE AND CORRELATION OF FLATFOOT WITH DYNAMIC BALANCE IN SCHOOL GOING CHILDREN IN KOTKAPURA CITY OF PUNJAB

**GAGANDEEP KAUR<sup>1</sup>, KAVITA KAUSHAL<sup>2</sup>, SIMRATJEET KAUR<sup>3</sup>**

1. Intern, College of Physiotherapy, Adesh University, Bathinda (Punjab).
2. Principal, College of Physiotherapy, Adesh University, Bathinda (Punjab).
3. Assistant Professor, College of Physiotherapy, Adesh University, Bathinda (Punjab).

### ABSTRACT

**Background:** Flatfoot is a condition in which the foot does not have a normal medial longitudinal arch when standing. Among children bilateral flatfoot has been found very common.

**Aims & Objective:** The main objective of this paper is to study the prevalence and correlation of flatfoot with dynamic balance in school going children in Kotkapura city of Punjab.

**Materials and Methods:** This is a cross sectional study made on 892 school children between the ages of 8-14 years having flexible flatfoot from 6 government schools of Kotkapura city of Punjab. Three Foot print measurements – Arch Index, Staheli's Arch Index & ChippauxSmirak Index were taken for the diagnosis of flatfoot. Dynamic balance of subjects having flatfoot was measured with Star Excursion Balance Test.

**Result:** The prevalence of flatfoot was calculated by mean percentages of Foot Print Index Scores & the correlation of Flatfoot & Dynamic Balance was calculated with Karl Pearson Coefficient. Out of 892, 163 had unilateral flatfoot & 76 had bilateral flatfoot. Star Excursion Balance Test Score for dynamic balance showed negative correlation with Foot print Index Score of flatfoot.

**Conclusion:** The prevalence of bilateral flatfoot was 46.6%, and Girls were more affected as compare to boys. SEBT Score for dynamic balance was more in dominant side as compare to Non-dominant side. Thus results show negative correlation of flatfoot with dynamic balance in 8,11,13& 14 year of age group.

**Keywords:** Flatfoot; Prevalence; Children; Dynamic Balance; SEBT.

### INTRODUCTION

Flatfoot is a condition in which the foot does not have a normal medial longitudinal arch when standing. Flat feet are considered normal in early childhood and the condition resolves spontaneously and most children become structurally normal when they are 12 or 13 years old<sup>1</sup>. Flat footedness may be classified as pathological or physiological. The pathological or rigid flatfoot is characterized by a fixed arch that is not modified by the support or lack of support of weight. The physiological or flexible flatfoot characterized by normal arch without weight support and flattening of the arch during standing, is often noted during the first decade of life and can be symptomatic or asymptomatic<sup>2</sup>.

Flatfoot in children is often a dynamic and restorable depression of the foot arch during weight bearing, also known as flexible flatfoot. However some of the children with flatfeet might not develop a good foot arch at skeletal maturity and inferior physical fitness was reported in children with flatfeet<sup>3</sup>.

The prevalence for flatfeet diminishes significantly with age, being higher in children with ligament laxity and the early shoe wearing

impairs longitudinal arch development. In 3 year old patients, the condition has been reported up to 54% and in the 6 year old group it has been reported at 24%<sup>2</sup>.

Etiology of flexible flatfeet includes ligamentous laxity, neurologic disorders (Cerebral Palsy, Hypotonia), Muscular abnormalities (Muscular dystrophy), Genetic syndromes (osteogenesis), collagen disorders (ehlers-danlos). Etiology of Rigid flatfeet includes trauma, congenital vertical talus etc<sup>4</sup>.

In normal feet, 61% of the weight is supported in the posterior area, 35% in the anterior area, and only 4% in the mid zone. In flat feet, between 17 and 30% is supported by the mid zone<sup>2</sup>.

Balance is defined as the process that maintains the center of gravity within the body's support base. Balance needs constant adjustments with joint positioning and muscular activity. Many musculoskeletal and nervous system diseases can alter balance control. The literatures reveal controversy about the relation of flat-footedness and disability. Khodadadeh & Welton, 1992 and Lin et al., 2001 stated that flat footedness was related to some kind of disability but Tudor et al., 2009 confirmed that children with flatfeet and children with normal feet were equally successful at accomplishing all motor tests<sup>5,6</sup>.

It is very hard to decide whether flatfoot is a physiologic adaptation or a pathologic

For Correspondence:  
Simratjeet Kaur, Assistant Professor, College of Physiotherapy, Adesh University, Bathinda-151001, Punjab, India.  
E-mail: drsimrat20@yahoo.com

condition. Therefore, it is believed that the decision to treat flexible flatfoot is often difficult<sup>6</sup>. In the light of literature available the purpose of the present study is to study the prevalence & correlation of flatfoot with dynamic balance in school going children.

## AIMS AND OBJECTIVES

To study the Prevalence of flatfoot in school going children in kotkapura city of Punjab.

To find out the correlation of flatfoot with dynamic balance in school going children in kotkapura city of Punjab.

## MATERIALS & METHODS

This was prevalence, cross-sectional study of school going children between 8-14 years of age, studying at 6 government schools in Kotkapura city of Punjab.

**Inclusion criteria:** age between 8-14 years, healthy subjects had bilateral flatfoot, asymptomatic flexible flatfoot.

**Exclusion criteria:** those have past history of any ankle surgery & acute ankle injury, musculoskeletal deformities, lower limb pathology, lower limb neurological condition, congenital flatfoot and those who did not want to participate and those who were absent in the class during the day of study.

After getting the approval from institutional research and ethical committee of College of Physiotherapy, AdeshUniversity. Verbal as well as written approval was taken from Principal, College of Physiotherapy as well as from concerned Principals of 6 Government schools. Informed consent had been signed from parents and class in-charge of subject after explaining the study procedure and benefits to them. Subjects fulfilling the inclusion criteria were selected and Children who did not attend school on the day of clinical evaluation were excluded. There was no dropout during the study procedure.

For the prevalence total 892 subjects were screened from 6 schools after that assessment and Footprint measurements for the diagnosis of flatfoot were obtained with Independent Variable i.e. Foot Print Index. Three footprint measurements- the Arch Index, Staheli's Arch Index &ChippauxSmirak Index were obtained.

For foot print measurements stamp ink was applied to sole of the foot while subject was in sitting position. Foot prints were taken on A4 Sheet that was placed on Glass Base in standing position. Readings were measured in centimeters<sup>3</sup>.

Arch Index=  $B/A+B+C$

Chippaux-Smirak Index=  $B/A \times 100\%$

Staheli's Arch Index =  $B/C \times 100\%$

SEBT (Star Excursion Balance Test) was considered as Dependent Variable to find out the scores for dynamic balance of children had bilateral flatfoot. The SEBT involves having a participant maintain a base of support with one leg while maximally reaching in different directions with opposite leg, without compromising the base of support of the stance leg. Out of 892 subjects 76 subjects had bilateral flatfoot so the SEBT Score of 76 was calculated. The star excursion test layout consisted of four lines, applied to the floor with tape: two forming vertical and horizontal lines and two positioned perpendicular to each other and at 45° with respect to the vertical and horizontal lines. A rectangular representing the starting position of the feet was placed at the centre point. A standard tape measure was used to quantify the distance (cm) from the center point to the point that each subject reached along each diagonal using the distal part of the foot<sup>7,8</sup>. Star excursion balance test was performed with shoes off.

## DATA ANALYSIS

The data was analyzed using Microsoft Excel 2007. To find out the prevalence Mean, Average& Standard Deviation of Plantar Index Score was calculated. To find out the correlation of flatfoot (Plantar Index Score) with dynamic balance (Star Excursion Balance test scores) Karl Pearson Coefficient Correlation (r) was calculated.

## RESULTS

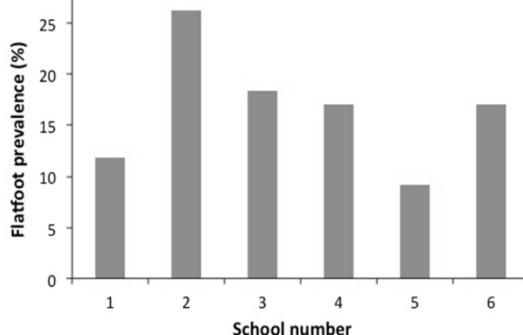
Out of 892 subjects 76 subjects had bilateral flatfoot. Out of 76 children 40 (52.6%) were girls and 36 (47.4%) were boys. Mean age was 11.1 for girls and 11.27 for boys.

First school 138 subjects had been screened for evaluation of bilateral flatfoot out of which 9 subjects were having bilateral flatfoot. 174 subjects had been screened from Second school from which 20 were having bilateral flatfoot. Third school consisted of 168 subjects from which 14 subjects were of bilateral flatfoot. Infourth school out of 96 subjects 13 were of bilateral flatfoot, fifth school out of 49 subjects 7 were having bilateral flatfoot and sixth school consisted 267 subjects from which 13 subjects had bilateral flatfoot.

**Table 1: School Wise Percentage of Subjects having Flatfoot.**

School 1	School 2	School 3	School 4	School 5	School 6
11.84%	26.31%	18.42%	17.1%	9.21%	17.1%

The values are confirmed collectively using Arch index, Chippaux-Smirak index as well as Staheli's Arch index.



Graph 1: School wise Prevalence of Flatfoot.

The results show that there is strong negative correlation of flatfoot and dynamic

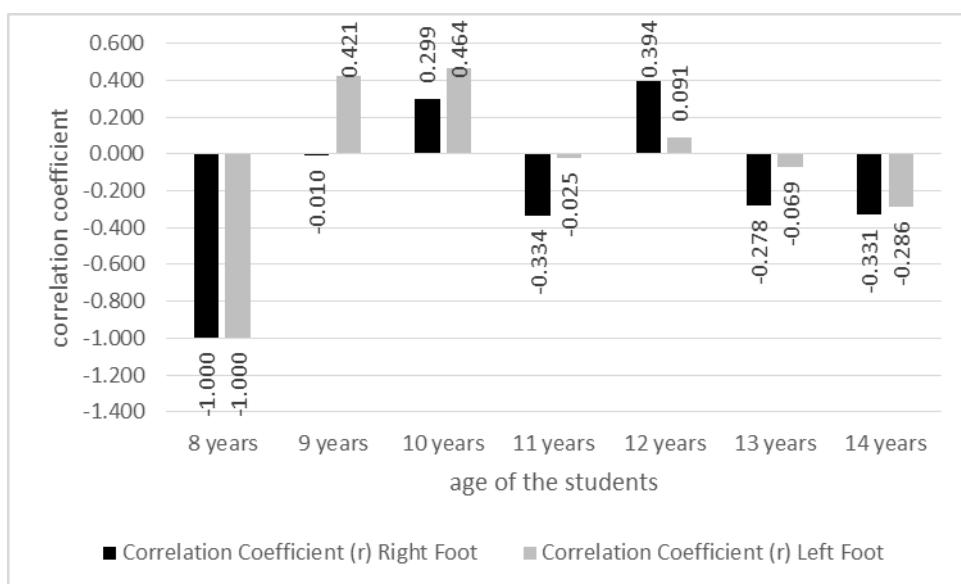
balance in 8 year school going children and in the age group of 11, 13 and 14 year the relationship is also negative.

There is weak positive correlation of flatfoot and dynamic balance in left foot in 9, 10 and 12 year age group. Also there is weak positive correlation of flatfoot and dynamic balance in right foot in 10 and 12 year age group. Interestingly 8 years age group showed absolute negative correlation of -1 of flatfoot and dynamic balance in right as well as left foot. Since it is rare to get such absolute negative correlation, repeated analysis using various other tools revealed similar results, though the exact reasons are unclear.

Table 2: Correlation of flatfoot with dynamic balance.

		8 years	9 years	10 years	11 years	12 years	13 years	14 years
Correlation Coefficient (r)	Right Foot	-1*	-0.0104*	0.298945*	-0.33417*	0.393728*	-0.27783*	-0.33062*
	Left Foot	-1*	0.421011*	0.4641224*	-0.02455*	0.090837*	-0.06892*	-0.28562*

The significant correlations ( $p$ -value  $< 0.05$ ) are denoted with \* in individual values in the table.



Graph 2: Correlation of Right and Left foot with Dynamic Balance.

## DISCUSSION

This study found a prevalence of 46.6% for the population analyzed. The present study shows the negative correlation of Independent Variable (Plantar Index Score) & Dependent Variable (SEBT) in 8 year, 11 year, 13 year & 14 year of age group. This could be due to loss of stability mechanism or dysfunction of the tibialis posterior tendon which can alter balance control<sup>6</sup>. These results agreed with Lin et.al., 2001 who showed poorer performance in children with flexible flatfoot<sup>5</sup> & with Khodadadeh & Welton, 1992 who stated that for some reason,

traditionally, flat footedness is related to some kind of disability: “Children who have flexible flatfoot are often noted to be slow in running or in performing athletic skills” or “people with low-arch feet were often assumed to be inefficient in foot skills and to be predisposed to injuries of the lower limbs. The results of study by Rahnama et al., 2010 are accordance with present study. He concluded that subjects with foot ankle instability demonstrated poorer postural stability when tested at level 5 on the Biodex stability system<sup>9</sup>.

In contrast to the findings of this study HedayatiRozita et al., 2014 conducted a study on the relation between clinical measurements of

plantar characteristics and static and dynamic balance. He confirmed that foot structure changes do not have much effect on the indicators of static and dynamic balance<sup>10</sup>. The study done by Tudor et al., 2009 confirmed that there were no disadvantages in sport performance originating from flat-footedness. Children with “flat” and children with “normal” feet were equally successful at accomplishing all motor tests; thus, they suggested that there was no need for treatment of flexible flatfeet with the sole purpose of improving athletic performance, as traditionally advised by many<sup>11</sup>.

No single study can solve the controversy of flat-footedness and its relation to Balance. The findings of study just make an access for the complete understanding of the functionality of flexible flat-foot and its correlation with Dynamic balance.

## LIMITATIONS OF THE STUDY

There exist several limitations that may have affected the results:

- Area of population was confined.
- 8-14 years children have been included and data holds the results for this age only.
- More than two measuring tools can be used to evaluate Plantar Index and Dynamic balance to make the data statistically more significant.
- Navicular drop was not observed and any Modern technique was not used to diagnose the flatfoot or asses the dynamic balance.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## CONCLUSION

It has been found that there was strong negative correlation of Plantar Index & Star Excursion Balance Score in the age group of 8, 11,13 and 14 year. On the basis of results we will accept the Alternative Hypothesis that means the Independent Variable (PI) & Dependent Variable (SEBT) were negatively related with each other.

However this study doesn't show the comparison of Flatfoot and Dynamic Balance in Dominant & Non-Dominant Side. Type of footwear and socioeconomic status of the subjects were not taken into consideration during the study. The literature shows that plantar arches start to develop at the age of 5-6 years and upto12 years these get matured. So for the better

analysis of flatfoot follow up study from 6 to 12 years can be performed.

## REFERENCES

1. Ali M, AsadUllah M, Amjad I. Prevalence of the flat foot in 6-10 years old school going children. Rawal Medical Journal. 2013;38(4):385-7.
2. Vergara-Amador E, Serrano Sánchez RF, Correa Posada JR, Molano AC, Guevara OA. Prevalence of flatfoot in school between 3 and 10 years. Study of two different populations geographically and socially. Colombia Médica. 2012;43(2):141-6.
3. Chang C-H, Chen Y-C, Yang W-T, Ho P-C, Hwang A-W, Chen C-H, et al. Flatfoot diagnosis by a unique bimodal distribution of footprint index in children. PloS one. 2014;9(12):e115808.
4. Halabchi F, Mazaheri R, Mirshahi M, Abbasian L. Pediatric flexible flatfoot; clinical aspects and algorithmic approach. 2014.
5. Lin C-J, Lai K-A, Kuan T-S, Chou Y-L. Correlating factors and clinical significance of flexible flatfoot in preschool children. Journal of pediatric orthopaedics. 2001;21(3):378-8
6. Ali MMI, Mohamed MSE. Dynamic Postural Balance in Subjects with and without Flat Foot. Bulletin of Faculty of Physical Therapy. 2011;16(1).
7. Gribble PA, Hertel J. Considerations for normalizing measures of the Star Excursion Balance Test. Measurement in physical education and exercise science. 2003;7(2):89-100.
8. Kinzey SJ, Armstrong CW. The reliability of the star-excursion test in assessing dynamic balance. Journal of Orthopaedic& Sports Physical Therapy. 1998;27(5):356-60.
9. Rahnama L, Salavati M, Akhbari B, Mazaheri M. Attentional demands and postural control in athletes with and without functional ankle instability. journal of orthopaedic& sports physical therapy. 2010;40(3):180-7.
10. Hedayati R, Sharq MH, Soltani T, Saeb M, Ghorbani R, Hajihasani A. The Relation Between Clinical Measurements of Plantar Characteristics and Static and Dynamic Balance Indices. Middle East Journal of Rehabilitation and Health. 2014;1(2).
11. Tudor A, Ruzic L, Sestan B, Sirola L, Prpić T. Flat-footedness is not a disadvantage for athletic performance in children aged 11 to 15 years. Pediatrics. 2009;123(3):e386-e92.

## **THERAPEUTIC EFFECTS OF CONSTRAINT INDUCED MOVEMENT THERAPY VS BIMANUAL TRAINING IN CHILDREN WITH CEREBRAL PALSY: A SYSTEMATIC REVIEW**

**VICTORIA ADEYINKA, SPT, MELINDA LABARRE, SPT, AND ALEXA PLEVYAK, SPT, MAUREEN RINEHIMER, PT, MS, MHS, PHD (ABD)**

*Physical Therapy Program, College of Health Sciences, Misericordia University, Dallas, Pennsylvania*

### **ABSTRACT:**

*Constraint Induced Movement Therapy (CIMT) and Bimanual training (BIT) have been shown to improve function of the affected upper extremity of children with spastic hemiplegic cerebral palsy. Purpose: The purpose of this review is to understand the utilization and therapeutic effects of CIMT vs. BIT, while indicating possible factors influencing the efficacy of the interventions. Method: An analysis was conducted between the years of 2015 to 2016 utilizing multiple medical databases. Results: Twelve articles were used in this study for the systematic review based off of the inclusion criteria. Conclusions: Overall CIMT and BIT have been shown to have significant effects on increasing function especially when combined with different factors such as environment, frequency, and age when compared to standard therapy treatments. Clinical application: Understanding the interaction between the aforementioned factors can help guide clinicians toward the most time and cost effective treatment techniques in order to improve the functional outcome of children with cerebral palsy. This knowledge may be useful in developing future modifications to existing practice to improve the overall quality of life during the developmental years of this population.*

**Keywords:** *Cerebral Palsy; Constraint Induced Movement Therapy; Bimanual Therapy; Children; home environment; Infants*

## **INTRODUCTION**

Cerebral Palsy (CP) is a disorder that may occur in utero, during, or shortly after birth that affects one in five hundred live births. Of this statistic, 35% present with hemiplegia which results in functional deficits and stunted development on the ipsilateral upper and lower extremity with increased involvement of the upper extremity.<sup>1</sup> Studies have shown that CIMT and BIT are effective in improving functionality of children especially with intervention of treatments early in life. CIMT is a therapeutic technique in which a therapist restrains the uninvolved upper extremity to prompt the use of the effected extremity.<sup>2</sup> BIT sometimes referred to as HABIT (Hand Arm Bimanual Training), is an approach that targets the use of both upper extremities to complete functional tasks. HABIT focuses on the child's specific functional deficits and incorporates the child's interests into activities.<sup>3</sup> The purpose of the systematic review was to examine the efficacy of CIMT and BIT in the treatment of hemiplegic CP. Further analysis was performed in order to examine the effects of frequency, age, and environment on overall functional outcome and improvement on fine motor skills.

## **METHODOLOGY**

Multiple searches were conducted using<sup>3</sup> databases. These databases included PEDro, CINAHL, and Medline. Initial

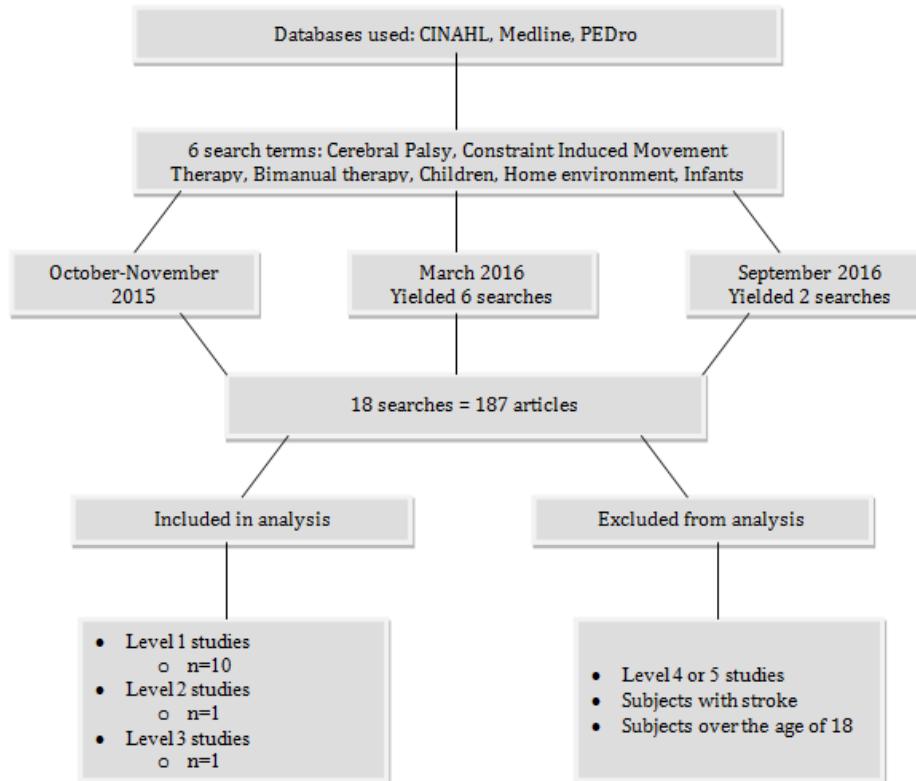
searches were conducted between October 2015 to November 2015 with updated searches performed in March 2016, and September 2016. Six search terms were used to retrieve information regarding CIMT and BIT. See Figure 1 below for further detail. In total, 18 searches were conducted and a total of 187 articles were found. Assessment of articles were completed through the PEDro scale and level of evidence scale in which level 4 or 5 articles were not accepted.<sup>4</sup> Language was not an issue as all the articles studied were accessible in English. Initial searches used articles published between 2010 and 2015 with updated articles including articles from 2016. Study selection was based on search terms and relevance of the information. Data extraction for this study included assessing different factors such as environment, frequency, and age in which the studies took place.

## **RESULTS**

With the search terms (refer to Figure 1 for specific terms used) and inclusion criteria provided, twelve articles were analyzed in the systematic review. No duplicates were found. Figure 2 depicts the PEDro score of each article.<sup>5</sup> The average PEDro score for the articles included were 5.91. One article was excluded from this average as it was a case study and could not be scored using the PEDro scale. When searching for research articles, certain articles provided information regarding CIMT vs BIT but with further analysis of the abstract, it

showed the primary participants were adults, which excluded the article from the systematic review. The level of evidence ranged from level 1 to level 3. Of the twelve articles, ten articles were level 1 randomized control trials, one

article was a level 2b cohort study, and one article included a level 3 case study. Appendix A represents the articles that were included in this study.



**Figure 1. Search Strategies**

## DISCUSSION

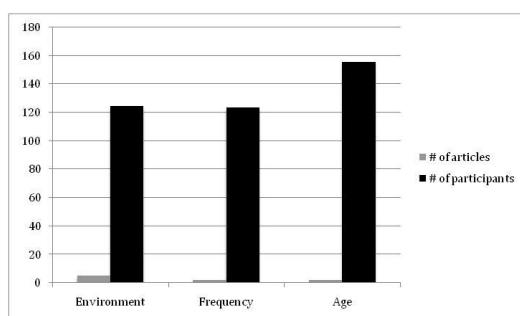
Evidence of use of CIMT and BIT demonstrate that they have significant effects on children with hemiplegic cerebral palsy. Using a quality of life questionnaire to assess children's self-perceived feelings of function and participation in tasks, Sazewski determined that CIMT and BIT influenced changes in the affected upper limb, improving the child's overall quality of life.<sup>1</sup> Additionally, a study by Aarts also provided evidence for the use of modified-CIMT in combination with BIT to improve upper limb function.<sup>6</sup> This study found that children who participate in CIMT or BIT may make better use of already created motor capabilities in the involved upper limb, instead of trying to regain activity of the muscle groups.<sup>6</sup>

As a result of the literature research, the article searches also revealed some differences in CIMT and BIT. A group of participants who

received CIMT had more ability to grasp, and displayed dissociated movements after the intervention, as indicated by scores on the QUEST, (Quality of Upper Extremity Skills Test), outcome measure.<sup>2,7</sup> According to Gordon, bimanual therapy has been indicated to have participants progress towards their goals more efficiently and at a quicker rate than CIMT.<sup>8</sup> This indicates better outcomes for participants who set goals that are important to them while receiving BIT.<sup>8</sup> BIT was also helpful in increasing the likelihood of more unprompted and more naturally occurring use of the affected limb during play.<sup>7</sup> With further analysis of articles, overlying consistencies were found between the data gathered and other influences playing a role in the efficacy of therapeutic approaches. These factors included environment, frequency, and age. Figure 3 displays the breakdown of articles included and the participants per factor.

**Figure 2 PEDro Table**

	Gelkop 2015	Gordon 2011	De Brito Brandão 2012	Deppe 2013	Facchin 2011	Sakzewski 2013	Aarts 2011	Geerdink 2013	Zafer 2016	Rostami 2012	Shetty 2014	Lowes 2014
Eligibility criteria were specified***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	n/a	Yes
Subjects were randomly allocated to groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	n/a	No
Allocation was concealed	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	n/a	No
The groups were similar at baseline regarding the most important prognostic indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	n/a	Yes
There was blinding of all subjects	No	No	No	No	No	No	No	No	Yes	No	n/a	No
There was blinding of all therapists who administered therapy	No	No	No	No	No	No	No	No	No	No	n/a	No
There was blinding of all assessors who measured at least one key component	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	n/a	No
Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	n/a	Yes
All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by “intention to treat”	Yes	No	No	No	No	Yes	No	Yes	Yes	No	n/a	Yes
The results of between-group statistical comparisons are reported for at least one key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	n/a	No
The study provides both point measures and measures of variability for at least one key outcome	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	n/a	Yes
Total PEDro Score	8	7	6	7	4	7	6	6	5	5	n/a	4

**Figure 3. Breakdown of Number of Articles and Participants per Factor**

	# of articles	# of participants
Environment	5	124
Frequency	2	123
Age	2	155

### Environment

Of the 12 articles, 3 articles focused on a home-based setting where other articles

focused on a clinical setting with a component of the treatment completed at home. The last couple of articles focused on a school or day camp setting. Results showed that interventions are more beneficial in a home based setting especially BIT due to the fact that it focuses on the child's interests and incorporates it into their treatments. "Providing therapy in the child's typical environment can have important positive effects on his/her motor development. The motor learning framework suggests adapting the environment as a way to elicit changes in motor behaviors."9Studies showed that children were more likely to use their affected hand at home due to the fact that they were in a more natural environment performing functional activities such as cooking, performing chores, and dressing up.<sup>10</sup> A possible explanation for this finding could be an increased level of comfort for the child. Home-based therapy provides integration of therapeutic approaches that are parallel to household chores vs non meaningful activities that may be completed in a clinic based setting.

In a study by Geerdink et. al, children in a standard therapy (ST) group received treatment at home and at school.<sup>11</sup> Comparisons were made between the ST group and the CIMT/BIT group and found that children in the ST group did not make as much of an improvement as the CIMT/BIT group. This may provide some evidence that a combination of CIMT/BIT and a home based approach may both contribute to a greater overall improvement.<sup>11</sup>

In a study analyzing school based therapy, school based settings indicate a gradual increase in function for both CIMT and BIT groups. From the results found in different types of settings, similar outcomes were found between studies when comparing home based therapy and school based therapy.

Outcomes for children in a clinical setting provided similar results of function. However, several studies show that a home based setting is slightly more effective due to level of comfort for the child and practicality in compliance to the therapy session. Thus, these various studies indicate a need for a home therapy program in conjunction with a clinic or school based therapy program.

Home based settings allow for a family centered approach demonstrating significant improvement in fine motor and gross motor skills in children with cerebral palsy.<sup>12</sup> In the article by Rostami, the home program made attempts to involve the child, the parent, and the therapist through selecting activities that meet common goals.<sup>10</sup> However, this study indicated that mCIMT is better for isolated functions of the affected arm compared to BIT which displayed more effectiveness of spontaneous hand use in real life situations.<sup>13</sup>

### **Frequency**

When reviewing duration of treatment using the QUEST, there was really no apparent difference in results. In the studies conducted by Zafer providing treatment over two weeks and a study completed by Facchin providing treatment over a ten week period, there was no substantial differences in the overall outcome.<sup>2,6</sup> Both studies used QUEST scores when looking at dissociated movements and protective extension. After reviewing another common outcome measure, Assisting Hand Assessment, no specific treatment duration demonstrated one as superior to another.

### **Age**

In the study conducted by Facchin, although the results were not statistically significant, the data appeared to show that the younger children made greater improvements in

ADLs when using the BIT approach.<sup>7</sup> A study conducted by Geerdink with a duration of 6 weeks of CIMT and 2 weeks of BIT found that children five years or younger were able to reach maximum potential by the sixth week with modified constraint induced movement therapy (mCIMT).<sup>11</sup> Children five years or older took longer to reach their maximum gain not reaching this level until the seventh or eighth week. This study suggests that children five years and older may benefit from a longer period of mCIMT. Although, other studies concluded that age was not a significant contributor to the results.<sup>11</sup>

### **Limitations**

When conducting the preliminary article search for this study, many articles did not utilize a control group limiting the ability to observe the effect of the intervention. There were few articles that looked at a comparison between the environmental settings of treatment. Some of the contributing factors such as environment, frequency, and age were not well researched, and that made it difficult to draw comparisons. When these contributing factors were researched, there were often occasions of conflicting data, even though some of this conflicting data was not statistically significant. Of the articles included in this study, many were comprised of a small sample size which could limit the external validity of this study.

A promising pilot study was found, and the researchers were contacted to obtain further information regarding the study.<sup>14</sup> Time restraints and lack of communication prevented the utilization of the pilot study results in this study, however important findings were included in Appendix A.

### **Strengths**

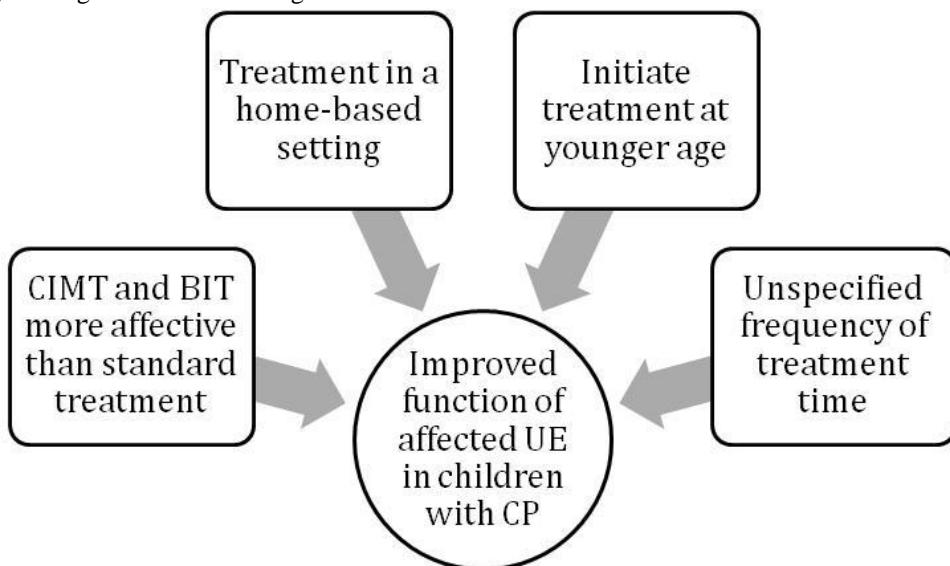
According to Gordon et al, it is important and somewhat necessary to create individualized programs for overall well being of the participant.<sup>8</sup> A strength discovered in this review method was the individualized care and therapeutic treatment of participants in the studies with small sample sizes which allowed for a more individualized outcome. Another strength of this study was the ample amount of articles available on the topic of pediatric cerebral palsy, and therefore it was possible to analyze each article to find factors which can influence therapeutic efficacy.

### **CONCLUSION**

In conclusion, as a result of this systematic review, it appears that the best therapeutic approach is home-based therapy

utilizing either CIMT or BIT at a younger age, with an unspecified frequency (summarized in Figure 4). Future research may be necessary to fully understand the effects of environment, frequency and age. When examining the overall

outcomes of CIMT versus BIT, evidence indicates that CIMT is superior when treating unilateral conditions. Conversely, BIT is indicated when treating patients with bilateral conditions.<sup>2</sup>



**Figure 4. Factors Contributing to Improvements of Affected UE Function**

## ACKNOWLEDGMENTS

We would like to extend our sincerest appreciation to Misericordia University's Physical Therapy Department for allowing us the opportunity to complete research.

## CLINICAL APPLICATIONS

This information helps identify the appropriate environment, frequency, and age that CIMT and BIT can be effective. Understanding the interaction between the aforementioned factors can help guide clinicians toward the most time and cost effective treatment techniques in order to improve the functional outcome of children with cerebral palsy. This knowledge may be useful in developing future modifications to existing practice to improve the overall quality of life during the developmental years of this population.

## REFERENCES

1. Sakzewski L, Carlon S, Shields N, Ziviani J, Ware RS, Boyd RN. Impact of intensive upper limb rehabilitation on quality of life: A randomized trial in children with unilateral cerebral palsy. *Dev Med Child Neurol.* 2012 May;54(5):415-423.
2. Zafer H, Amjad I, Malik AN, Shaukat E. Effectiveness of constraint induced movement therapy as compared to bimanual therapy in upper motor function outcome in child with hemiplegic cerebral palsy. *Pakistan Journal of Medical Sciences.* 2016 Jan-Feb;32(1):181-184.
3. de Brito Brandão, Gordon AM, Cotta Mancini M. Functional impact of constraint therapy and bimanual training in children with cerebral palsy: A randomized controlled trial. *Am J Occup Ther.* 2012 Nov- Dec;66(6):672-681.
4. Sackett DL, Strauss SE, Richardson WS, et al. *Evidence-Based Medicine: How to Practice and Teach EBM.* Philadelphia, PA: Churchill-Livingstone; 2000.
5. The George Institute. PEDro scale. PEDro. <http://www.pedro.org.au/english/downloads/pedro-scale/>. Published June 21, 1999. Updated September 5, 2016. Accessed March-September 2016.
6. Aarts PB, Jongerius PH, Geerdink YA, van Limbeek J, Geurts AC. Modified constraint-induced movement therapy combined with bimanual training (mCIMT-BiT) in children with unilateral spastic cerebral palsy: How are improvements in arm-hand use established? *Res Dev Disabil.* 2011 Jan- Feb;32(1):271-279.
7. Facchin P, Rosa-Rizzotto M, Visonà DP, et al. Multisite trial comparing the efficacy of constraint-induced movement therapy with that of bimanual intensive training in children with hemiplegic cerebral palsy: Postintervention results. *Am J Phys Med*

- Rehabil. 2011 July;90(7):539-553.
- 8. Gordon AM, Hung Y, Brandao M, et al. Bimanual training and constraint-induced movement therapy in children with hemiplegic cerebral palsy: A randomized trial. Neurorehabil Neural Repair. 2011 Oct;25(8):692-702 11p.
  - 9. Gelkop N, Burshtein DG, Lahav A, et al. Efficacy of constraint-induced movement therapy and bimanual training in children with hemiplegic cerebral palsy in an educational setting. Phys Occup Ther Pediatr. 2015 Feb;35(1):24-39 16p.
  - 10. Rostami H, Malamiri R. Effect of treatment environment on modified constraint-induced movement therapy results in children with spastic hemiplegic cerebral palsy: a randomized controlled trial. DisabilRehabil.2012;34(1):40-44.
  - 11. Geerdink Y, Aarts P, Geurts AC. Motor learning curve and long-term effectiveness of modified constraint-induced movement therapy in children with unilateral cerebral palsy: A randomized controlled trial. Res Dev Disabil. 2013 Mar;34(3):923-931.
  - 12. Shetty R, Joshi A, Shibila J. The magical pouch program: A case study of modified constraint induced movement therapy with bimanual training on a child with unilateral spastic cerebral palsy. Indian Journal of Occupational Therapy. 2014 Jan-Apr;46(1):3-9.
  - 13. Deppe W, Thuemmler K, Fleischer J, Berger C, Meyer S, Wiedemann B. Modified constraint-induced movement therapy versus intensive bimanual training for children with hemiplegia - a randomized controlled trial. Clin Rehabil. 2013 Oct;27(10):909-920.
  - 14. Lowes LP, Mayhan M, Orr T, et al. Pilot study of the efficacy of constraint-induced movement therapy for infants and toddlers with cerebral palsy. Phys Occup Ther Pediatr. 2014 Feb;34(1):4-21.

**Appendix A**

Question: What is the effect of CIMT and BIT for treating an affected UE in children with Cerebral Palsy?								
Citation	Study		Methods			Reviewer Comments		
	Study Type (LOER)	Pedro Score	Subject # and groups	Intervention	Assessment Tool	Outcomes	Limitations	Conclusion
Gelkop 2015	*Randomized controlled trial (1)	8	*12 children between the ages of 1.5 and 7 years with hemiplegic CP *6 children receive CIMT *6 children receive BIT	*administered during the children's normal school day *Each child received 2 hours of therapy 6 days a week for 8 weeks <b>CIMT group-</b> children wore custom gloves on the unaffected UE and performed fine motor and gross motor tasks using affected UE <b>BIT group-</b> fine and gross motor bimanual tasks were completed	*AHA measures effectiveness of using affected hand in bimanual activity *QUEST classifies UE function-reach, grasp, manipulation, and releasing activities. *MACS classifies children into 1 of 5 levels based on how they handle objects of daily activities	*Both improved the quality of bimanual hand use and UE function *participants significantly improved following intensive training	*No control group *Small sample size *A 6 month follow up would have been preferred (rather than the 2 month), but the school year did not allow for that to happen	*CIMT may be more beneficial when one to one supervision is not possible- decreases the likelihood of compensation of the unaffected UE
Gordon 2011	*Randomized controlled trial (1)	7	*44 participants randomly assigned to 2 groups- 1 from each group dropped out * Between 3.5 and 10 years of age with hemiplegic CP	* 6 hours a day for 15 consecutive weekdays <b>CIMT group-</b> less affected UE was placed in a sling and then performed fine and gross motor tasks <b>BIT group-</b> no restraints. Children participated in fine and gross motor tasks	*AHA *JTTHF assesses the time it takes to complete a battery of unimanual activities *3 secondary measurements were also used	*Both CIMT and BIT resulted in similar improvements on the AHA and JTTHF *There were significant changes in hand function in both groups *Improvements were achieved in 3 weeks and maintained at the 6 month follow up	*No control group *Shorter treatment duration	*CIMT solely focuses on the use of the affected UE, but it limits the child's ability to do meaningful bimanual tasks
de Brito Brandão 2012	*Randomized controlled trial (1)	6	*16 children with hemiplegic CP *8 in each group- CIMT and BIT	*6 hours a day for 15 days (totaling 90 hours) <b>CIMT group-</b> unaffected arm was put in a sling and motor tasks were preformed with the affected UE <b>BIT group-</b> no restraints were used and children participated in bimanual tasks	*MACS *PEDI scores child's ability to perform ADLs- like self care *Self care was a main focus *COPM defines functional problems that the client feels are relevant and addresses them as goals	*Improvements in functional skills and independence in self-care activities seen in both groups *The BIT group showed greater improvement than the CIMT group only on the functional goal performance scale	*Lack of follow ups to examine retention of acquired skills *Parents weren't blinded to which groups their children were assigned and that could have led to biased functional goals *Goals were only based off of parents' perception of	*Whether using CIMT or BIT, children should practice the functional goals that are deemed important

							important functional goals *Shorter treatment duration	
Deppe 2013	*Randomized controlled trial (1)	7	*47 children with hemiplegic CP or other non-progressive hemiplegia *ages 3 to 12 years were included	*4- 60 minute sessions daily, 5 days a week for a total of 4 weeks <b>*kid-CIMT group-</b> Used elastic bandages to restrain unaffected UE. This program is an integrative approach that targets 3 major elements: sensation, mobilization, and activity <b>*BIT group-</b> targets the same 3 elements that CIMT targets. Addresses ADLs	*MelbAss evaluates the quality and precision of isolate movement of paretic UE *AHA *PEDI	*Both interventions led to significant improvements of hand function	*Inclusion of non-congenital hemiplegia *Sample size *Lack of long term follow up	*Children with more impairment of the UE may benefit from CIMT
Facchin 2011	*Randomized controlled trial (1)	4	*105 children with hemiplegic CP assigned to 3 groups: 39 children in the mCIMT, 33 in the BIT, and 33 in the standard treatment group (ST) *Children between the age of 2 to 8 years old	*10 week treatment period with a 3,6, and 12 month follow up	*QUEST *Besta Scale assesses the quality of grasp and spontaneous hand use	*Significant differences between the three groups were found on the QUEST Scale as well as the Besta Scale *Both mCIMT and BIT showed improvements in UE function *ST group had minimal improvements *Fine grasp had greater improvement in the mCIMT group vs. the BIT group	*There was a difference between the BIT group and mCIMT group but it was not statistically significant	*BIT may be more useful in developing abilities to complete ADLs
Sakzewski 2013	*Randomized controlled trial (1)	7	*72 children- 36 in each group	*6 hours a day for 2 weeks <b>*CIMT group-</b> wore a tailor made glove and wore it for all tasks <b>*BIT group-</b> a strategy was adopted from Gordon's study	*CPQOL evaluates the well being of children with CP	*There were improvements, but minimal differences between the two groups	*No control group *Shorter treatment duration	*Both training techniques increased children's perception of well-being

Aarts 2011	*Randomized controlled trial (1)	6	<ul style="list-style-type: none"> <li>*50 Children with unilateral CP</li> <li>*28 children in the CIMT and BIT group (pirate group)</li> <li>*22 children in the usual care group (UC)</li> <li>*children were between the age of 2.5 and 8 years</li> </ul>	<ul style="list-style-type: none"> <li>*3 hours a week, 3 days a week, for 8 weeks</li> <li>*During the first 6 weeks, children in the Pirate group received CIMT</li> <li>*The last 2 weeks, the Pirate group underwent BIT and completed bimanual tasks</li> </ul>	<ul style="list-style-type: none"> <li>*ROM of the wrist and elbow</li> <li>*VOAA-DDD assessed developmental disregard as well as the capacity and performance of the affected UE</li> </ul>	<ul style="list-style-type: none"> <li>*Study found that improvements may be due to better utilization of motor function rather than muscle strength restoration</li> </ul>	<ul style="list-style-type: none"> <li>*ROM measurements were not taken at the shoulder or trunk, and those measurements may have gone undetected</li> </ul>	<ul style="list-style-type: none"> <li>*Study found that CIMT-BIT group showed improvements</li> </ul>
Geerdink 2013	*Randomized controlled trial (1)	6	<ul style="list-style-type: none"> <li>*50 Children with unilateral CP</li> <li>*28 children in the CIMT and BIT group (pirate group)</li> <li>*22 children in the usual care group (UC)</li> <li>*children were between the age of 2.5 and 8 years</li> </ul>	<ul style="list-style-type: none"> <li>*3 hours a week, 3 days a week, for 8 weeks</li> <li>*During the first 6 weeks, children in the Pirate group received CIMT</li> <li>*The last 2 weeks, the Pirate group underwent BIT and completed bimanual tasks</li> </ul>	<ul style="list-style-type: none"> <li>*Box and Block Test assess manual dexterity</li> <li>*AHA</li> <li>*ABILHAND-Kids is a parent questionnaire evaluating manual skills</li> </ul>	<ul style="list-style-type: none"> <li>*Age had the greatest effect on the speed of dexterity gained during the CIMT period</li> <li>*Children younger than 5 had a 2.3 times greater chance of reaching maximum performance on the Box and Block assessment</li> <li>*Outcomes from the study remained stable at the 6 month follow up</li> </ul>	<ul style="list-style-type: none"> <li>*Learning curve data was based on a small sample size</li> </ul>	<ul style="list-style-type: none"> <li>*Age was found to significantly affect the learning curve</li> </ul>
Zafer 2016	*Randomized controlled trial (1)	5	<ul style="list-style-type: none"> <li>*Started with 20 children, study conducted with 18 children with spastic hemiplegic CP</li> <li>*9 children in CIMT group</li> <li>*9 children in BMT group</li> </ul>	<ul style="list-style-type: none"> <li>*Both groups received 2 hours a day 6 days a week for 2 weeks</li> <li>*CIMT group- children used mitt and sling</li> <li>*BMT group- no restraints used.</li> <li>*Both groups received personalized ADL task training</li> </ul>	<ul style="list-style-type: none"> <li>*QUEST</li> </ul>	<ul style="list-style-type: none"> <li>*Dissociation movements and grasp were significantly improved in the CIMT group compared to BMT.</li> <li>*No difference in weight-bearing and protective extension between both groups</li> </ul>	<ul style="list-style-type: none"> <li>*Small sample size</li> <li>*Shorter treatment duration</li> </ul>	<ul style="list-style-type: none"> <li>*CIMT is considered an appropriate treatment approach for unilateral conditions while BMT for bilateral conditions.</li> </ul>
Rostami 2012	*Randomized controlled trial (1)	5	<ul style="list-style-type: none"> <li>*14 Children with Spastic Hemiplegic CP</li> <li>*7 children randomly assigned to home group</li> <li>*7 children randomly assigned to clinic group</li> </ul>	<ul style="list-style-type: none"> <li>* Both groups received 15 hours of m-CIMT 3 times a week, for 10 sessions every other day.</li> <li>*Sessions lasted 1 and a half hours</li> <li>*Interventions for both groups were the same, but the environment differed.</li> </ul>	<ul style="list-style-type: none"> <li>*Pre-test, post-test design, and 3 months post treatment</li> <li>*Pediatrics Motor Activity Log</li> <li>*8 (upper limb speed and dexterity) of Bruininks-Oseretsky</li> </ul>	<ul style="list-style-type: none"> <li>*Home environment provided more improvement with m-CIMT.</li> <li>*M-CIMT is effective in improving upper limb function in children with spastic hemiplegic CP.</li> <li>*Home environment provided a more natural context</li> </ul>	<ul style="list-style-type: none"> <li>*Small sample size</li> <li>*Low cooperation of parents and children outside of the research laboratories</li> <li>*Shorter treatment duration</li> </ul>	<ul style="list-style-type: none"> <li>*Home environment provides a more natural setting to administer m-CIMT</li> </ul>

Shetty 2014	*Case Study (3b)	5	*1 participant, 4 y/o girl with unilateral spastic CP	*8 weeks of both interventions for 1 hr. 2 times a week *Child received early intervention since 6 months old. (Freq.- 2 hrs a day, 2 times a week, for 8 weeks)	*Canadian Occupational Performance Measure *Beery Developmental Test of Visual Motor Integration *Bruininks-Oseretsky *Hand Awareness Scale	*No overall change in PROM *Child was able to complete some ADLs	*Because this was a case study, there were no control groups to compare	*While there was no change in PROM the child was able to complete some ADLs *Child was able to stabilize book while writing and erasing, she was able to play with affected limb during fine motor activities, and she was able to pull her pants to mid-thigh with affected limb.
Lowes 2014	*Cohort Study (2b)	4	*5 participants completed treatment protocol	*Usual care treatment for 1 hr a week for 4 weeks *CIMT treatment- casted 24/7 for 23 days 2 hrs of therapy per day *CIMT was followed by 4 days without casting	*Bayley Scale- Gross and Fine motor subscales *Infant Motor Activity Log	*Study indicated the feasibility of infant home based therapy *During CIMT intervention phase, infants demonstrated significant improvement in fine and gross motor, which was maintained at follow up	*Used non-standardized measures *Lack of blinding *Lack of control group *Further research should be completed with more participants	*Findings suggest positive effects for children with unilateral CP

AHA- Assisting Hand Assessment

MACS- Manual Ability Classification System

PEDI- Pediatric Evaluation of Disability Inventory

CPQOL- Cerebral Palsy Quality of Life Assessment for Children

MelbAss-Melbourne Assessment

VOA-DDD- Video Observations Aarts and Aarts module Determined Developmental Disregard

Permission to use granted by: Mary Hastings, PT, DPT, ATC and Washington University Program in Physical Therapy, updated last in 2009

## ATTITUDE AND PERCEPTIONS OF PHYSIOTHERAPY STUDENTS TOWARDS THEIR CHOSEN CAREER

**NAFISA SHABBIR MOTIWALA<sup>1</sup>, SEEMI RETHAREKAR<sup>2</sup>, SAVITA RAIRIKAR<sup>3</sup>,  
ASHOK SHYAM<sup>4</sup>**

1. Intern (BPTh) Sancheti Healthcare Academy, Shivajinagar , Pune
2. Associate Professor, Sancheti Healthcare Academy, Shivajinagar , Pune
3. Professor & Director, Principal, Sancheti Healthcare Academy, Shivajinagar , Pune
4. M.S. Ortho, Research Office, Sancheti Institute of Orthopedics and Rehabilitation. Pune

### **ABSTRACT**

**Background:** Physiotherapy is a physical medicine and rehabilitation specialty that remediates impairments and promotes mobility, function and quality of life through examination, diagnosis, prognosis, and physical intervention. In this study, attitudes & perceptions of students pursuing their Bachelors in Physiotherapy in two urban cities of Maharashtra have been studied and their views regarding choosing physiotherapy as a career highlighted; as they are the best ones to judge this rather than other professionals doing it for them. There is no doubt that Physiotherapy as a course, career and even as a profession is scaling new heights & reaching peaks.

**Aims & Objectives:** This study sought to assess the attitude and beliefs of Bachelors of PT students regarding the future of their profession in India.

**Study design:** Questionnaire based survey

**Methodology:** A self prepared questionnaire & Google docs format of the questionnaire was distributed to 9Physiotherapy colleges in Pune & Mumbai. The sample size was 737. The questionnaire consisted of 14 single best response MCQs.

**Results:** After analyzing the data received, it was seen that 87% students decided to study physiotherapy after their low medical entrance exam scores. 76% also sought advice from professional career counselors before choosing PT. Students also believed that this field has its disadvantages and not many were aware about the job opportunities in & around their state. Students appeared to have a mixed opinion about whether licensing exam should be compulsory before practicing physiotherapy in India.

**Conclusion:** Awareness about physiotherapy as a career is increasing but still needs to be worked upon mainly at school levels and amongst the general population. Job opportunities in the private, as well as the government sectors, needs a boost. The disadvantages of this field have to be considered and rectified.

**KEYWORDS:** attitude; physiotherapy students; perception; career

## INTRODUCTION

The history of physiotherapy or physical therapy can be traced back to ancient Greece in the era of Hippocrates<sup>1</sup>.

'Physiotherapy' is a branch of modern medical science which includes examination, assessment, interpretation, physical diagnosis, planning and execution of treatment and advice to any person for the purpose of preventing, correcting, alleviating and limiting dysfunction, including life saving measures via chest physiotherapy in the intensive care unit, curing physical disorders or disability, promoting physical fitness, facilitating healing and pain relief using physical agents, and devices including exercise, mobilization, manipulations, therapeutic ultrasound, electrical and thermal agents and electrotherapy for diagnosis, treatment and prevention<sup>2</sup>.

'Physiotherapist' is a qualified professional who has acquired all the above mentioned knowledge and skills for entry into

practice after being awarded a bachelor degree in the subject of "Physiotherapy"<sup>2</sup>. In the modern world, due to mechanization and sedentary lifestyles, people are facing a variety of muscular, skeletal, neurological and cardiovascular problems.

Physiotherapy works wonderfully & efficiently in managing the above problems & rehabilitating people back to their functional status.

Physiotherapy is a health profession, concerned with maximization of mobility and quality of life by implementing clinical reasoning<sup>3</sup>.

As various health centers, fitness centers, wellness centers, etc are coming up big way, prospects of careers in physiotherapy seem positive<sup>3</sup>.

Making a career in physiotherapy is a wise decision as the scope it covers is widening up and expected to offer numerous jobs options<sup>3</sup>. Most of the future physiotherapists, seem to be unsure of why they took up this course and aren't even aware of the extent of scope ahead of them in this chosen field. Research is, therefore, required in this arena so as to explore & bring to

For Correspondence: Nafisa S. Motiwala:  
Email-id: nafshabbir@gmail.com

light the attitude of the future generation of physiotherapists about their career of choice which is the need of the hour.

## MATERIALS AND METHODS

A self prepared, questionnaire that had 14 MCQs was made & Institutional Ethical committee approval obtained for the research design. Hard copies & a Google docs. format of this questionnaire was circulated to 9 Physiotherapy colleges in Pune & Mumbai. The total number of respondents was 737, making this the sample size. Informed written consent was taken from the students & were asked to select the single best option while answering the questions

**Selection and description of participants:** Selection of the participants was done by purposive sampling. The inclusion criterion was students pursuing their Bachelor's of Physiotherapy (including Interns).

**Statistical methods:** Descriptive analysis was done of the data received in Microsoft excel 2007.

## RESULTS

Q1) When did you decide to take up Physiotherapy?	87.6% decided to take it up after giving their entrance exams and 0.1% decided in their secondary school
Q2) Why did you decide to take up Physiotherapy?	84.6% decided after they did not get into other medical fields and 0.4% thought it was a lucrative profession.
Q3) Did you seek advice before taking up Physiotherapy?	98% replied positively
Q4) Did you seek advice about which college to go to?	98% said yes
Q5) Whom did u seek advice from regarding taking up Physiotherapy?	76% consulted professional counselors and 0.68% the internet.
Q6) Are you familiar with employment opportunities in your country?	41% were and 58% weren't aware.
Q7) According to you, work of a physiotherapist is...	53% believed PT is not appreciated in our country and only 1.2% considered it rewarding.
Q8) What can be achieved by working as a Physiotherapist?	21% believed it will give them social prestige and an equal no. hoped for a stable job.
Q9)What is the greatest disadvantage of working as a physiotherapist?	34% this to the disrespect by other medical professionals.
Q10) Finding a job would be easier if.....	38% believed a prestigious college would help and 23% thought that a masters degree is must
Q11) Future plans after finishing B.P.Th.?	24% wished to work in a polyclinic and 21% planned to work and study, simultaneously.
Q12) I believe that finding work as physiotherapist in my	63% disagreed

city is difficult.	
Q13) I believe that finding work as physiotherapist in other states of India is difficult.	57% disagreed
Q14) Should Licensing exam be started in every state in India?	43% gave a positive response as opposed to the 57% , who said NO.

## DISCUSSION

Physiotherapy is a non surgical, non pharmacological way of pain management, where various techniques are employed to provide instant or gradual relief to the patients by total rehabilitation of body tissues and strengthening the muscles and joints<sup>3</sup>.

Job opportunities are also not as adequate as most hospitals don't employ qualified physiotherapists with specialization though patients requiring specific treatment protocols are in plenty. Further, job prospects in the government departments are also very poor for physiotherapists. Physiotherapists are much needed in the field of medical health as they can, in some cases, treat patients in a non-surgical way. But unfortunately awareness about physiotherapy is rather poor, especially in developing countries like India<sup>4</sup>.

The authors did not come across any survey analyzing the attitudes of physiotherapy students in the state of Maharashtra, the discussion in this paper will, therefore, mainly consist of a detailed analysis of the attitude of physiotherapy students in two urban cities in the state of Maharashtra towards their chosen career pertaining to practice of physiotherapy.

The State Universities accept scores of minimum 50% in the entrance tests as eligibility for admissions in the field of physiotherapy, and so students who do not score high enough to enter other medical fields, considered this as the last option, and they choose Physiotherapy after their entrance exam results.

Students when asked about when did they decide to take up physiotherapy, majority of students (i.e. 87%) decided on the basis of the scores of their entrance exams & when they (84%) did not score high enough for their field of choice. Very few (0.1%) students actually considered to take up physiotherapy as a career during their high school. This could probably be due to the lack of awareness of physiotherapy, a vocational option at school level.

Majority of the students (75%) did seek professional advice about choosing physiotherapy before giving their entrance tests and also about which college to go to and the remaining sought advice from their parents, relatives, doctors, practicing therapists and some even from the internet.

41% of the students in the present study were aware of the job opportunities in India but a good 58% weren't.

The students were asked what they thought Physiotherapy was, a shocking revelation was when 53% answered that it is a field not appreciated by all, although 20% did know that it is rehabilitative in nature. A mere 1.2% called the profession fashionable & rewarding.

The students were asked to pick an option as to which life's value did a physiotherapist achieve. There was a mixed bag of responses from the students. An equal number believed it helped the therapist in achieving social prestige & would provide them with a stable job, giving them financial stability; a few (12%) hoped that the profession will help them expand their knowledge.

Most of the students (34%) considered not being respected by the other healthcare professionals as a major disadvantage of the profession, another 18% considered the profession as time consuming as well as suffering from lack of awareness.

According to a survey done in 2014, 95.5% of doctors did refer their patients to physiotherapist, suggesting they do appreciate the profession and its need<sup>3</sup>.

When students were asked regarding what would increase their job opportunities, 38% felt that a degree from a prestigious college would help, 15% felt, if one has the required knowledge and skills, it is sufficient enough to obtain a job, 23% believed that a post graduate degree would boost their careers.

Future plans after doing bachelors of physiotherapy has also obtained a mixed review from working in a polyclinic (25%), to studying further (22%), as well as working in a hospital (17%)and working along with studying (17%).

63% believed that obtaining a job as a physiotherapist in their hometown was difficult whereas 36% thought otherwise.

When asked about their views on job opportunities in different states of India other than their parent state, 42% believed it was easy to get jobs whereas 57% thought differently, which most likely could be due to lack of awareness of employment options across the country.

The students responded apprehensively to the question of starting licensing exam in the various states of India. Probably this was the reason why 49% of population said yes and 51% did not want to have any such entry level exams.

So overall from the present data, the fact that comes forth is that students need to be made aware about the immense scope that physiotherapy has to offer & that it is gaining

importance exponentially. This might help in decreasing the non-favourable view points of the future generations towards Physiotherapy as a future career. The government may need to intervene so as to change this attitudes & perceptions.

## CONCLUSION

Awareness about physiotherapy as a career is increasing but still needs to be worked upon starting at the school level.

Awareness is also required in the general population as well the different Healthcare professionals as they also influence the stakeholders of physiotherapy, our dear students.

Job opportunities in private as well as government sectors needs a boost which will definitely help minimize the disadvantages in the field as perceived by the future generations

## FUTURE SCOPE

Creating awareness among school & college going students is the need of the hour. As well as assessing the students' mindset in colleges in surrounding states.

**Limitations of the study:** Students of Physiotherapy colleges in interior areas of Maharashtra were not assessed.

## ACKNOWLEDGEMENTS

I would like to thank Dr. Rachana D. (PT), Dr. Ashok Shyam and Dr. Parag Sancheti for their guidance and support. I would also like to thank the Principals of different colleges and their students who cooperated with me in my study and helped me make it possible.

## REFERENCES

1. <http://www.jagranjosh.com/careers/physiotherapy-1288157397-1> (last viewed on 12/2/2016)
2. MUHS syllabus, [www.muhs.ac.in](http://www.muhs.ac.in)
3. <http://www.jagranjosh.com/careers/physiotherapy-1288157397-1>, last viewed on 6/2/2016
4. Sulagna Mehta (sept 11, 2013) - <http://timesofindia.indiatimes.com/city/visakhapatnam/Poor-awareness-hampering-physiotherapy-prospects/articleshow/22475689.cms> (last viewed on 10/5/16)
5. Shimpi A, Writer H, Shyam A, Dabaghav R. Role of physiotherapy in India—A cross-sectional survey to study the awareness and perspective among referring doctors. Journal of Medical Thesis. 2014 May;2(2):11-5.

## ASSESSMENT OF PHYSICAL ACTIVITY AMONG COLLEGE GOING STUDENTS IN PUNE CITY USING GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ)

SIDDHIKA KORE<sup>1</sup> SUROSHREE MITRA<sup>2</sup> RACHANA DABADGHAV<sup>3</sup>

1. *BPTs Sancheti Institute of College of Physiotherapy, Pune, India*
2. *Assistant Professor, Community Physiotherapy, Sancheti Institute College Of Physiotherapy*
3. *Research Coordinator, Sancheti Institute College of Physiotherapy*

### **Abstract:**

**Background:** The prevalence of obesity among children and adolescents is increasing at an alarming rate. Lifestyle characterized by lack of physical activity might cause obesity in children. Childhood obesity is a proven risk factor for adult obesity. Therefore, we wanted to find out physical activity levels in this population. **Objective:** This cross sectional study intends to find out levels of physical activity and also to find out gender specific differences among college going students in Pune. **Methods:** Study was carried out among 500 adolescents between the age group 17-21 years. Global physical activity questionnaire was administered to assess the physical activity levels. **Results:** The overall physical activity among the age group 17-21 years with the mean age group 19 was 2022.82 METS. It was also found out that males were more physically active as compared to females with P value 0.01 in the age group 21 years. **Conclusion:** The results show that Participants among the age group 17-21 years are physically active and males are more physically active as compared to females.

**Keywords:** Physical activity; childhood obesity; Adolescents; Students

## INTRODUCTION

Physical inactivity is one of the ten leading causes of death globally<sup>1</sup>. According to the author Deepak Kumar Gupta, there has been a significant increase in prevalence of adolescent obesity in India since the past three years. In addition, male gender and higher socioeconomic status is associated with significant risk of both being overweight and obese<sup>2</sup>.

Insufficient physical activity can be a risk factor for non-communicable diseases<sup>3</sup>. This can lead to various health problems such as hyperlipidemia, hypertension, glucose intolerance and orthopedic complications<sup>3</sup>. Further risk factors that contribute to obesity in adolescents are unhealthy food habits, watching TV, insufficient sleep duration, high BMI in parents and high birth weight<sup>4</sup>.

Global Physical Activity questionnaire (GPAQ) was developed by World Health Organization (WHO) in the year 2006. It is validated in nine countries. Around 50 countries use GPAQ for physical activity data collection and it is a suitable physical activity surveillance instrument for developing countries and can be used in all age groups. Metabolic equivalents (METS) are used for the analysis of GPAQ data. MET is the ratio of a person's working metabolic rate relative to the resting metabolic rate. One MET is defined as the energy cost of sitting quietly, and is equivalent to a caloric consumption of one kcal/kg/hour<sup>5-7</sup>.

Siddhika kore  
siddhika1993kore@gmail.com

Adolescence is the age where lifestyle as well as physiological changes occurs in the body<sup>8</sup>. Therefore by doing this study, we can check their physical activity levels and come to a conclusion about the lifestyle among adolescents in Pune. By analyzing the current health risks faced by the young generation, we can prevent further derogatory effects of ill health and loss to personal and national wealth in terms of both productivity and money.

## AIMS & OBJECTIVES

**Aim:** Assessment of physical activity among college going students in Pune city using Global Physical Activity Questionnaire (GPAQ).

### **Objectives:**

- To find the level of Physical Activity in the age group 17-21 years
- To find Gender specific level of Physical Activity.

## METHODOLOGY

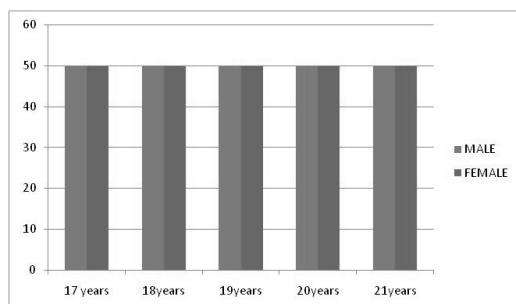
This cross-sectional study was carried out among college going students across different streams (Medical, Engineering, MBA) in the city of Pune during the period October-December 2015. It included about 500 college students aged 17-21 years using purposive sampling technique. Study participants were undergraduates. Of the total 500 students, 250 were females and 250 males. Institutional ethical committee clearance was obtained followed by a written informed consent signed by participants. The sample size was scientifically calculated.

GPAQ questionnaire was administered to the participants. Self evaluation of each participant's physical activity (PA) level was found out using GPAQ analysis guide and Microsoft Excel. The questionnaire contains three main domains: Activities at work, transportation and recreational activities. As per the guidelines for interpreting GPAQ version 2.0, individual were classified as active, if throughout a week (including activity for work, during transport and recreational activities), they were involved in at least 150 minutes of moderate-intensity physical activity OR 75 minutes of vigorous-physical activities OR an equivalent combination of moderate and vigorous-intensity physical activity achieving at least 600 MET-minutes<sup>5-7</sup>.

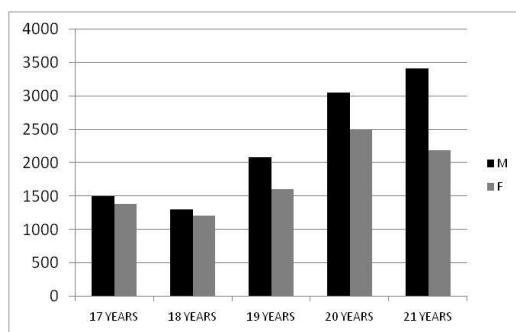
### Statistical analysis

GPAQ analysis guidelines and Microsoft Office Excel version 2007 was used for analysis of data collected. Mean was calculated and data was represented in graphical form. Unpaired t-test was to compare between males and females. In all calculations, P value less than equal to 0.05 was considered to be significant.

## RESULTS



Graph 1: No of males and females



Graph 2: Physical activity levels in all and age groups and comparison among males and females

Table 1: Unpaired t-test to compare mean of physical activity between males and females.

AGE GROUPS	MEAN	P VALUE
17 YEARS	1507.6	0.71
18 YEARS	1302.4	0.76
19 YEARS	2082.8	0.23
20 YEARS	3050	0.12
21 YEARS	3421.6	0.01*

## DISCUSSION

The objective of the study was to find out levels of physical activity using GPAQ questionnaire among college going students. The age group under inclusion was 17 years to 21 years. As shown in graph one, there were 100 students each under each age group. Out of which 50 were males and 50 females in each age group. Although we tried to match equal number of males and females in each age group but BMI matching could not be done due to time and resource constraints, in contrast with the study done by Ranjit M Anjana et al in which they tried to correlate BMI and physical activity<sup>16</sup>.

The overall mean score of physical activity in all the age group was 2022.82 METS which is more than the recommended value by GPAQ guidelines<sup>5-7</sup>. This shows that students from all the age group are physically active. The biggest contributors to this value were brisk walking/cycling (>10 minutes/day), moderate intensity activities at work/college, occasional vigorous intensity activities. The reason for this might be development and evaluation of intervention to promote physical activity in young people, access to sports, gymnastic and other recreational facilities at college/work, increased awareness of PA, social support in community settings and an increased need to be physically fit due to social considerations<sup>9-12</sup>. This contradicts with number of studies carried out in developed nations, which claim that there is high prevalence of physical inactivity. The behavioral Risk Factor Surveillance published in 2003 showed that 52.8% of U.S. citizens were inactive (50.2% men and 55.4% women)<sup>13</sup>. In a study done using the International Physical Activity Questionnaire (IPAQ) in Sweden in 2002-03 on 1470 adults aged 18-74 years, 31% of the population was found to be inactive<sup>14</sup>. While the Health survey for England reported a 63% prevalence of inactivity for men and 76% prevalence for women<sup>15</sup>. The reason for this might be that these studies were carried out in the last decade and there is a difference in lifestyle habits among Indians, Europeans and Americans. Also a study conducted in 2013 compared physical activity among people more than 20 years of age in four different states showed poor physical activity<sup>16</sup> which could be due to poor

resources in rural India and more use of technology in urban India.

The study also shows that males were more active than females from all the age group<sup>17,18</sup>. The reason for this might be in girls, the onset of secondary sexual characteristic may contribute to perceptions of discomfort and lower self-esteem, which can lead to decrease level of physical activity. In boys, the age of the early peak height velocity (PHV) can positively influence the behavior of PA due to increased muscle mass and strength, which tends to occur after the peak height velocity (PHV). These changes in body composition and physical fitness promote better sports performance in boys. Another reason for this might be that historically, girls receive more conservative education from family and society. It can also be due to social, religion perceptions, environmental factors and cultural reasons<sup>19</sup>.

Further the study shows that students from age group 20 and 21 years were physically more active as compared to age group 17 to 19 years. The reason for this might be that 17, 18 and 19 years is an age group where students are mentally burdened with academics as compared to 20, 21 years. Since, high school is very important period in adolescents' life because, it is the period to enter a graduation college from high school and should obtain higher grades to join universities, thus students tend to quit a lot of their activities and become less physical active. It has also been found out that in the age group 20 & 21 males are more physically active as compared to females. The reason for this might be that individuals who regularly participate in sports during adolescence tend to perform more daily PA, and are more likely to perform PA in their adulthood. Another reason for girls being less physically active as compared to boys in the age group 20 & 21 years is that in this age group there are behavioral changes, the increasing obligations in daily tasks, work at home and/or the transition from school to work can facilitate the reduction of PA. In contrast, the physical changes that occur in boys such as a gain in height, body weight, higher proportion of lean mass and the widening of shoulders, are beneficial for participation in PA, as they result in a more appropriate physical build for success in many types of PA, particularly those that emphasize speed, power and strength. Furthermore, late-maturing boys tend to perform more PA involving sports and games<sup>18,19</sup>.

Strength of this study is GPAQ was used as an outcome measure which is designed by WHO, good number of sample size was included to collect the data and it is first study done in Pune, Maharashtra. Limitation of this study is that we have not included BMI and other

physical variables in our study. Perception of parents regarding physical activity was also not considered and also it was a time bound study. Future scope of study might be that a similar study can be done in adult and elderly age group. Also a comparison between physical variables like BMI and physical activity can be done. There can also be a study comparing PA among different cultures of different states in India and in Asia.

## CONCLUSION

Our study shows that students from age group 17-21 years are physically active and males are more physically active as compared to females.

## CLINICAL IMPLICATION

Colleges can take numerous steps to shape a health –promoting environment, like establishing policies that foster and allow better participation in more physical activity behaviors for both boys and girls, with a special focus on the latter group. For e.g. Colleges can continue to increase opportunities for physical activity, they can adopt and enforce more physical education classes, provide variety of physical activities to encourage students participation and increase students awareness about benefit of being active. Colleges and education authorities can broaden their association with organizations including sports and recreational clubs. Using this evidence in practice, such programs can be started in various other states and cities.

## ACKNOWLEDGEMENT

The author wishes to acknowledge all the participants in this study and would like to express their gratitude to Dr. Parag Sancheti, Dr. Ashok Shyam, Dr. Apurv Shimpi, Dr. Savita Rairikar for their valuable support.

## CONFLICTS OF INTEREST

None

## REFERENCES

1. <http://www.who.int/mediacentre/factsheets/f385/en/> (Last accessed on date 4th February 2016)
2. Gupta DK, Shah P, Misra A, Bharadwaj S, Gulati S, Gupta N, Sharma R, Pandey RM, Goel K. Secular trends in prevalence of overweight and obesity from 2006 to 2009 in urban asian Indian adolescents aged 14-17

- years. PloS one. 2011 Feb 23;6(2):e17221.
3. Trost SG, Kerr LM, Ward DS, Pate RR. Physical activity and determinants of physical activity in obese and non-obese children. International journal of obesity. 2001 Jun 1;25(6):822.
  4. Ghavamzadeh S, Khalkhali HR, Alizadeh M. TV viewing, independent of physical activity and obesogenic foods, increases overweight and obesity in adolescents. Journal of health, population, and nutrition. 2013 Sep;31(3):334.
  5. Armstrong T, Bull F. Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). J Public Health. 2006;14(2):66-70.
  6. Bull FC, Maslin TS, Armstrong T. Global physical activity questionnaire (GPAQ): nine country reliability and validity study. Journal of Physical Activity and health. 2009 Nov;6(6):790-804.
  7. www.who.int/chp/steps/resources/GPAQ\_Analysis\_Guide.pdf (accessed on date 8th September)
  8. Riddell MC. The endocrine response and substrate utilization during exercise in children and adolescents. Journal of Applied Physiology. 2008 Aug 1;105(2):725-33.
  9. Foster C, Hillsdon M, Thorogood M, Kaur A, Wedatilake T. Interventions for promoting physical activity. The Cochrane Library. 2005 Jan.
  10. Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, Stone EJ, Rajab MW, Corso P. The effectiveness of interventions to increase physical activity: A systematic review American journal of preventive medicine. 2002 May 31;22(4):73-107.
  11. Smith BJ. Promotion of physical activity in primary health care: update of the evidence on interventions. Journal of Science and Medicine in Sport. 2004 Apr 1;7(1):67-73.
  12. Van Sluijs EM, McMinn AM, Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. Bmj. 2007 Oct 4;335(7622):703.
  13. Behavioral Risk Factor Surveillance system (BRFSS) 2003. (Website-[http://www.cdc.gov/brfss/annual\\_data/annual\\_2003.htm](http://www.cdc.gov/brfss/annual_data/annual_2003.htm)).
  14. Bergman P, Grjibovski AM, Hagströmer M, Bauman A, Sjöström M. Adherence to physical activity recommendations and the influence of socio-demographic correlates—a population-based cross-sectional study. BMC Public Health. 2008 Oct 22;8(1):367.
  15. Blake M, Chaudhury M, Deverill C, Doyle C, Erens B, Falaschetti E, et al. In: Health Survey for England 2003, Volume 2. Sproston K, Primatesta P, editor. London: The Stationery Office; 2004. Risk factors for cardiovascular disease.
  16. Anjana RM, Pradeepa R, Das AK, Deepa M, Bhansali A, Joshi SR. Physical activity and inactivity patterns in India—results from the ICMR-INDIAB study (Phase-1) [ICMR-INDIAB-5]. Int J Behav Nutr Phys Act. 2014; 11:26.
  17. Dr Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: Surveillance progress, pitfalls, and prospects. 2012;380(9838):247-257.
  18. Caspersen CJ, Pereira MA and Curran KM. Changes physical activity patterns United States, by sex and cross-sectional age.
  19. Araujo Bacil ED, Mazzardo O, Rech CR, Santos Legnani RF, Campos W. Physical activity and biological maturation: a systematic review. Rev Paul Pediatr. 2015;33(1):114-121.

## CORRELATION OF UPPER EXTREMITY MUSCLE STRENGTH AND REACTION TIME IN COMPETITIVE BADMINTON PLAYERS

JAGRUTI KHARE<sup>1</sup>, PRAJAKTA SAHASRABUDHE<sup>2</sup>, ASHOK SHYAM<sup>3</sup>, PARAG SANCHETI<sup>4</sup>

1. BPTh. Sancheti Institute College of Physiotherapy
2. MPT, Assistant Professor, Sancheti Institute College of Physiotherapy
3. MS (Ortho) Research Officer, Sancheti Institute for Orthopaedics and Rehabilitation
4. MS (Ortho) and Chairman, Sancheti Institute for Orthopaedics and Rehabilitation

### Abstract:

**Introduction:** Badminton is a racquet sport. At a higher level game, being a fast paced sport Badminton demands excellent fitness, aerobic stamina, strength, speed and precision. Playing Badminton also requires good agility, cardiovascular endurance, strength and reaction time. Reaction time is the amount of time taken to respond to a stimulus. It can be improved by practice as it affects the quality of game. Every player and healthcare professionals need to analyze the technique and requirement of the sport in order to modulate the coaching accordingly.

**Aim:** To find if there is a correlation between upper extremity muscles strength of dominant hand and reaction time in competitive badminton players.

**Material and Method:** Isometric muscle strength of pectoralis major, shoulder rotators, triceps, deltoid, wrist flexors and extensor were assessed using the hand-held dynamometer (FET3) and the reaction time was assessed by audio-visual reaction time machine for competitive badminton players. The average age was 18.77 ( $\pm 2.75$ ) years. Both the parameters were correlated by the Pearson's correlation coefficient test using Microsoft Excel 2007.

**Result:** A negative moderate correlation was found between the upper extremity muscle strength and reaction time. This shows that when the strength of an individual is greater, then, the reaction time is lesser.

**Conclusion:** This study concludes that muscle strength, may affect the reaction time to some extent, i.e. strength and reaction time of the dominant upper extremity muscles are directly proportional.

**Keywords:** racquet sport; dominant hand; FET3 dynamometer; audio-visual reaction time machine.

## INTRODUCTION

Badminton is a racquet sport, played by either two opposing players or two opposing pairs. At a higher level game, the sport demands excellent fitness, aerobic stamina, strength, speed and precision. As it is also a technical sport it requires good motor coordination<sup>1</sup>. Badminton is a fast-paced sport. Players need to get trained with resistance exercises for the muscles which are involved actively while playing badminton. Strength training is often acknowledged as a beneficial thing for optimal health in every player which helps in training the important muscles in badminton<sup>2</sup>. Strength improves power which is required to hit the shuttle coming from the opposite side.

Strength training helps in maintaining and increasing the flexibility, helps to manage and reduce pain, improves brain function and coordination, improves balance<sup>2</sup>. Badminton requires good agility, endurance, strength and reaction time. Reaction time is the amount of time taken to respond to a stimulus<sup>3</sup>. The average reaction time for humans is 0.26 seconds to a visual stimulus, 0.17 for an audio stimulus, and 0.15 seconds for a touch stimulus<sup>1</sup>. Reaction time

is important in every sport as it affects the quality of the game<sup>3</sup>. Reaction time can be improved by practice. Every player and healthcare professionals need to analyze the technique and requirement of the sport in order to modulate the coaching accordingly.

### Need for Study

Playing badminton demands optimum strength of upper limb muscles. It also expects the player to react quickly to the shuttle cock heading towards the player which expects shorter reaction time. A Study performed by Salonikidis K, Zafeiridis A on 64 novice tennis players concluded that the plyometric training and like squat jump, lateral jumps, power skipping, tuck jumps, alternate leg bounding, etc., training helped to improve the strength and reaction time in the players<sup>4</sup>. Hence this study aimed to find if there is a correlation between the two health related entities strength and reaction time of the dominant upper extremity.

## METHOD & METHODOLOGY

### Procedure

The study was performed on 37 competitive badminton players between the age group of 16 to 25 years of age selected randomly

For Correspondence: Prajakta Sahasrabudhe  
Assistant Professor, Sancheti Institute College of  
Physiotherapy.  
Email: doc.ashokshyam@gmail.com

from sports clubs and badminton courts in Pune city. Players with any recent injuries were excluded.

The strength and reaction time of competitive badminton players was assessed of which 7 were males and 30 females. The average age was 18.77 ( $\pm 2.75$ ) years.

Approval from the ethical committee was taken before commencement of the research.

A correlation study was performed. Written consent was taken from the participants/parents before carrying out the study. Isometric muscle strength<sup>5</sup> of pectorals, rotators, triceps, deltoid, wrist flexors and wrist extensors was assessed using a handheld dynamometer (FET 3)<sup>6</sup> with the patient in sitting position for deltoid, triceps, rotators, wrist flexors and extensors and supine position for pectoral muscles; wherein the patient was asked to perform maximal isometric muscle contraction while the examiner placed the dynamometer on the forearm of the dominant hand. Best result out of three attempts was chosen for the study.

Reaction time was assessed by using the audio-visual reaction time machine<sup>3</sup>. The visual reaction times of the subject were assessed. The machine had two visual stimuli (red and green light). Each subject was exposed to these stimuli.

Best out of three readings were chosen for the study.

The correlation was calculated by using the Pearson's correlation coefficient test.

## RESULTS

The correlation coefficient of strength and reaction time of dominant upper extremity in competitive badminton players were as follows:

MUSCLES	CORRELATION COEFFICIENT
Triceps	-0.6137
Pectoralis major	-0.5932
Internal rotators	-0.61349
External rotators	-0.55342
Deltoid(anterior fibers)	-0.56342
Deltoid(middle fibers)	-0.55555
Deltoid(posterior fibers)	-0.64232
Wrist Flexors	-0.60666
Wrist Extensors	-0.55873

## DISCUSSION

The above study supports its hypothesis showing a negative correlation between the upper extremity muscles of dominant side and visual reaction time as it shows a significant decrease in the reaction time when the strength is greater. This correlation is a moderate correlation. If the muscle is stronger then the stimulus carried by the sensory receptors and sensory neurons to the central nervous system takes place faster due to which the relay neurons

and the motor neurons carry the motor response/action more quickly. This means that change in the strength changes motor response<sup>7,8</sup>. Hence there is a negative correlation between the strength and reaction time of dominant upper extremity. This shows that when the strength of an individual is greater, then the reaction time is lesser.

This study was in agreement with a study done by Salnikidis K, et al, on effect of plyometriclike squat jump, lateral jumps, power skipping, tuck jumps, alternate leg bounding, etc., tennis-drills, and on reaction time, lateral and linear speed, power and strength in novice tennis players which showed that, there was a significant difference in the speed and reaction time in the players after plyometrics like squat jump, lateral jumps, power skipping, tuck jumps, alternate leg bounding, etc. and tennis-specific drill training of 9 weeks (3 times/week)<sup>4</sup>. Badminton players go through similar training and coaching and hence such changes can be expected in the badminton players. The above study is also supported by another study done by T McMorris, S Delves, J Sproule, et al, which had similar finding of negative correlation between muscle strength and reaction time in normal male population who were medically fit<sup>9</sup>.

A study performed by Kelly L. Gao, et al, on stroke survivors also had a similar finding of negative correlation between strength of the muscles and reaction time<sup>10</sup>. Another study performed by Fusako Yokochi, et al, on Parkinson's patients and the study concluded that the reaction time of the Parkinson's patients is affected to a certain extent due to loss of power in the muscles<sup>11</sup>.

All these studies establish a connection between strength and reaction time in various populations with negative correlation suggesting some role of muscle strength on reaction time of the players, but the extent of it needs to be further analyzed.

## CONCLUSION

This study concludes that there is a negative moderate correlation between the upper extremity muscles and visual reaction time in competitive badminton players, which means that muscle strength, can affect the reaction time to some extent, i.e. strength and reaction time of the dominant upper extremity muscles are directly proportional.

## ACKNOWLEDGEMENTS

Sincere thanks to Dr. Rachana Dabagav and Dr. Apurv Shimpi for their guidance and support throughout; and thanks to

the ethical committee for granting me permission for carrying out this project.

I would also like to thank all the participants of this study.

#### **CONFLICT OF INTEREST**

Nil

#### **SOURCES OF FUNDING**

Nil

#### **REFERENCES**

1. Kosinski Robert J. A literature review of reaction time. 2010. Weblog. Available from: <http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/biae.clemson.edu/bpc/bp/Lab/110/reaction.htm> [Accessed 17th march 2016]
2. Michie Fraser. Effective strength training for Badminton. Weblog. Available from: <http://www.badmintonscotland.org.uk/index.php/latest-news-a-publications/1493-effective-strength-training-for-badminton> [Accessed on 17th march 2016]
3. Tonnessen, Haugen Espen, Shalfawi Thomas, A.I Shaher. Reaction Time Aspects of Elite Sprinters in Athletic World Championships. Journal of Strength & Conditioning Research. April 2013; 27(4):885–892.
4. K Saloni kidis, A Zafeiridis. The effects of plyometric, tennis-drills, and combined training on reaction, lateral and linear speed, power, and strength in novice tennis players. Journal of Strength and Conditioning Research. 2008 January; 22(1):182-91.
5. S. Lee, Caldwell, Chaffin Don B, Dukes-Dobos Francis N, K.H.E. Kromer, J Lloyd, Laubach, et al. A Proposed Standard Procedure for Static Muscle Strength Testing. American Industrial Hygiene Association Journal. 1974;34(7):201-206
6. CM Arnold, KD Warkentin, PD Chilibeck and CRAMagnus. The Reliability and Validity of Handheld Dynamometry for the Measurement of Lower Extremity Muscle Strength in Older Adults. Journal of Strength and Conditioning Research .2010; 24(3): 815-824.
7. Cabral Borges Luis Paulo Nogueira, Leitao Wilson Cesar de Vasconcelos, Ferreira Jailson Oliveira, Carvalho Luis Carlos. Measurement of motor nerve conduction velocity in three different sports. Brazilian journal of sports medicine. 2013 september-october; 19 (5).
8. The Reflex Arc. Weblog. [https://www.asu.edu/courses/pgs461/Reflexes%20Arcs\\_PGS%20461.pdf](https://www.asu.edu/courses/pgs461/Reflexes%20Arcs_PGS%20461.pdf) [Accessed on 12th august 2016]
9. T McMorris, S Delves, J Sproule, M Lauder, B Hale. Effect of incremental exercise on initiation and movement times in a choice response, whole body psychomotor task. British Journal of Sports Medicine. 2005; 39:537–54. Available from doi: 10.1136/bjsm.2004.014456 [Accessed on 10th august 2016]
10. Gao Kelly L, Ng Shamay S. M, Kwok Joey W. Y, Chow Ray T. K and Tsang William W. N. Eye-hand coordination and its relationship with sensorimotor impairments in stroke survivors. Journal of Rehabilitative Medicine. 2010; 42:368–373
11. Yokochi Fusako, Nakamura Ryuichi, Narabayashi Hirotaro. Reaction time of patients with Parkinson's disease with reference to asymmetry of neurological signs. Journal of Neurology, Neurosurgery, and Psychiatry 1985;48:702-705

## CURRENT USE OF PHYSIOTHERAPY PRACTICES IN THE INTENSIVE CARE UNITS OF PUNE CITY

JENISA DOSHI<sup>1</sup>, RAZIA NAGARWALA<sup>2</sup>, ASHOK SHYAM<sup>3</sup>, PARAG SANCHETI<sup>4</sup>,  
SAVITA RAIRIKAR<sup>5</sup>

1. Bachelor of physiotherapy, Sancheti healthcare academy
2. Masters in cardiovascular and pulmonary sciences, Head of department and Professor in cardiovascular and pulmonary sciences, Sancheti institute college of physiotherapy.
3. Research head, Sancheti institute of orthopedic rehabilitation
4. Research chairman, Sancheti institute of orthopedic rehabilitation
5. Dean and Professor, Sancheti institute college of physiotherapy

### ABSTRACT

**Background:** An intensive care unit (ICU) is a specialized hospital ward which is dedicated to the management of critically ill patients. Physiotherapists are an important part of the medical team providing rehabilitation to the patients with life threatening illnesses with recovery and majorly preventing the ICU related complications like muscle weakness, lung collapse, bed sore formation and functional disability. The outcome of rehabilitation depends on the knowledge and skills of the physiotherapist and hence it is vital to analyze the current physiotherapy techniques put to use in the ICU.

**Aim:** To study the current use of physiotherapy techniques in the intensive care units of Pune city.

**Method:** a cross sectional questionnaire survey was conducted among 63 physiotherapists working in the ICU of various multispecialty hospitals across Pune city.

**Results:** Descriptive statistics were used for analyzing the responses. Overall in this survey, diversities were noticed in the physiotherapy practices among hospitals across pune city, India. It was seen that 100% respondents were always monitoring all the investigation parameters like blood reports, X rays and ABG during the rehabilitation. Conventional physiotherapy techniques were more commonly notices in comparison to devices like acapella which were seen to be used only by 41% of the respondents. Only 44% of the respondents were involved in bed sore management.

**Conclusion:** All the physiotherapists posted on the intensive care units were observed very commonly using chest expansion techniques, positioning and active mobilization for rehabilitation of patients in the ICU. Conventional chest physiotherapy practices were more commonly used in comparison to adjunct devices. The physiotherapists treat patients on the basis of physician referral more commonly as compared to self assessment and routine treatment. The posting of the physiotherapists on overnight shifts and on public holiday is not seen in most of the hospitals.

**Keywords:** intensive care unit; critical; current techniques

## INTRODUCTION

Rehabilitative programs which restore human function, maximizes motor functioning, help in pain relief, prevent and treat physical challenges because of injuries and diseases are planned and implemented by physiotherapists<sup>1</sup>.

An intensive care unit is a specialized hospital ward which is heavily equipped and highly staffed which is dedicated in the management of critically ill patients with life threatening diseases or injuries and other complications. A physiotherapist is an important member of the entire medical team which provides the holistic spectrum of care to patients with acute respiratory illnesses and other impairments in a dynamic environment like the intensive care units.

Complications of the pulmonary, circulatory, musculoskeletal and integumentary systems are prevented and treated by physiotherapists working in the intensive care

units by gradual mobilization, active movements, proper positioning and chest physiotherapy<sup>2</sup>.

A high mortality rate is prevalent in the critically ill patients in the intensive care units despite of the documented recent advancements in medical treatment and mechanical ventilation. Also the patients in the intensive care units may suffer from cognitive impairments, muscle weaknesses and functional disability which may be prevalent for at least 1 to 3 years. Complications like hospital acquired pneumonia; lung collapse and severe weakness are long term whereas muscle atrophy is seen in a time span less than 7 days of the ICU stay<sup>3</sup>.

Improvement in the patient's quality of life and prevention of complications related to the ICU like physical de conditioning, respiratory complications and inability to wean from ventilator are the main of the physiotherapists working in the ICU. Functional debility is seen in at least 50% of the patients in the ICU<sup>4</sup>.

Knowledge of the physiotherapists about various techniques, education about the use

of appropriate skills and modalities, availability of apparatus, ratio between patient and physiotherapist, presence of chest physiotherapists and the medical treatment of the patient are different factors which affect the physiotherapy practice in the ICU.

Physiotherapy is the most critical part in the management of ill patients and when used at the correct time, ICU complications can be prevented in many patients<sup>5</sup>.

The physiotherapy techniques, devices and adjuncts used in the ICU may differ depending upon the patient co-operation, illness, injury, impairments and diseases.

There is no information about the physiotherapy practices in the ICUs of Pune city. The purpose of this study is to find what practices physiotherapists perform in the ICUs.

## AIM AND OBJECTIVES

### AIM

The aim of this study is to obtain data on current physiotherapy practices in intensive care units of Pune city.

### OBJECTIVES

- To find out which physiotherapy practices are currently in use most commonly in the intensive care units in Pune.
- To study if conventional physiotherapy is used in combination with other adjuncts to airway clearance
- To study about the availability of devices to deliver physiotherapy in intensive care units
- To find out if physiotherapists are involved in practices like weaning, suctioning, mechanical ventilation etc.
- To find out the physiotherapy protocol in the intensive care units to prevent complications during ICU recovery and speedy recovery of the critically ill patients.

## METHOD AND METHODOLOGY

Study design is a cross sectional survey which was carried across the multispecialty hospitals across Pune city.

Participants were the physiotherapists working in the intensive care units, PG students. All physiotherapists working in a time span of 1 month to 11 years were included. Under graduate interns and students were excluded from the study.

75 questionnaires were personally handed over to the head of departments of physiotherapy of the concerned hospitals.

## PROCEDURE

After obtaining approval from the ethical committee of Sancheti healthcare academy. All multi-specialty hospitals across Pune city with intensive care units were shortlisted. Informed written consents were obtained from them for conducting research. A questionnaire based on their qualification profile of the physiotherapists, availability of equipment in the ICU and the physical therapy protocol was handed personally to the head of department of the intensive care unit. Aim and objective of the study was clearly stated in the cover letter attached to the questionnaire. Physiotherapists working in the intensive care unit were asked to fill the questionnaire. The respondents were made clear that their identity will not be revealed. A period of 1 week was given to them for the completion of the questionnaire.

## RESULT

**Gender:** Out of 63 physiotherapists working in the ICU it was noted that 64% were females and 36% were males.

**Qualification:** The qualification of the responding physiotherapists was as follows: 53% were BPTH 3% were PG students, 42% were MPTH and 1% were PhD.

**Work experience:** 39% of the physiotherapists worked in the concerned hospitals for a period between 1 to 5 years. 30% of the respondents were practicing for less than a year and 2% of the respondents for a period of more than 10 years and 29% of the respondents for a period between 5 to 10 years.

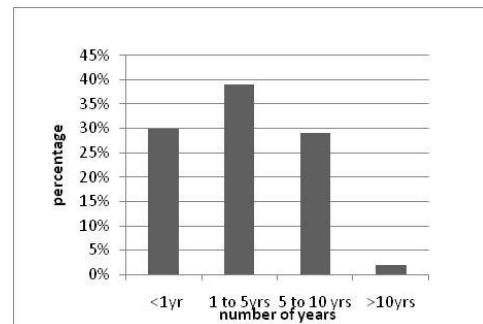


Figure 1: Work Experience

**Trained in CPR:** Out of 63 physiotherapists, 47 were trained in cardio pulmonary resuscitation

**Patients seen are on:** Out of 63 physiotherapists, 49 see patients on physician reference and 14 see patients on routine assessments

**Posting schedule:** Out of 63 physiotherapists, 19 are posted permanently in icu and 44 are posted on rotation from wards

**Overnight shifts:** Out of 63 physiotherapists, 39 physiotherapists work on over night shifts

**Sunday duties:** Out of 63 physiotherapists, 34 worked on Sundays and public holidays

### Monitors

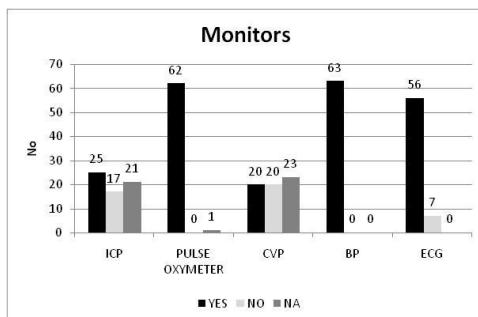


Figure 2: Monitors

Intracranial pressure monitoring, when available, was utilized by 25 respondents; 21 respondents had reported that ICP monitoring was not available. Oxygen saturation monitoring was appreciated by 62 respondents. The graph provides description about the usage of others parameters that are monitored and investigations looked for in planning the physiotherapy.

**Investigation studies:** Monitoring and clinical investigations used by physiotherapists in the neurological ICU as part of their assessment. All the 63 physiotherapists are involved in monitoring all necessary parameters before, during and after the treatment sessions.

**Positioning:** Out of 63 physiotherapists, 45 are involved in positioning as a priority in the treatment.

### Treatment techniques in intubated and non-intubated patients:

#### Airway clearance techniques:

The use of airway clearance techniques is depicted in the graph below. Suctioning is regularly practiced by all the respondents. Clapping and vibration is practices by 80% and 93% of the respondents' respectively. It is observed that 58% of the physiotherapists are always involved in giving proprioceptive neuromuscular facilitation for respiratory muscles and 63% are always involved in postural drainage depending upon the condition of the patient all the physiotherapists use this technique with proper positioning to achieve removal of secretions. Over 98% of the physiotherapists are involved in postural drainage.

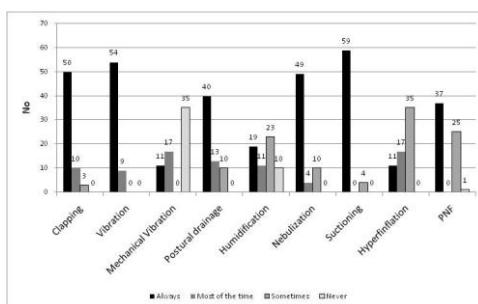


Figure 3: Airway clearance techniques

#### Lung expansion therapy:

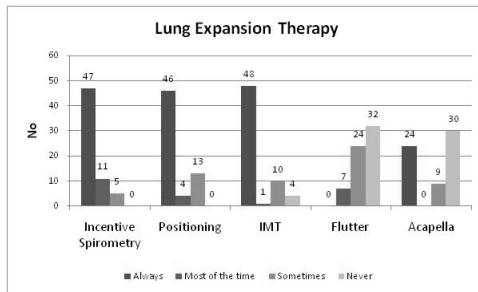


Figure 4: Lung expansion techniques

The graph provides the information about the frequency of usage of lung expansion therapy used by the respondents. Inspiratory muscle training (IMT) was used by nearly 94% physiotherapists on patients with respiratory muscle weakness. Only 76% of the physiotherapists used it more frequently. Use of conventional as well as adjunct devices for treatment is seen within the respondents but the use of adjunct devices like acapella is seen as less as 41% on routine basis.

#### Specific treatment in non-intubated patients:

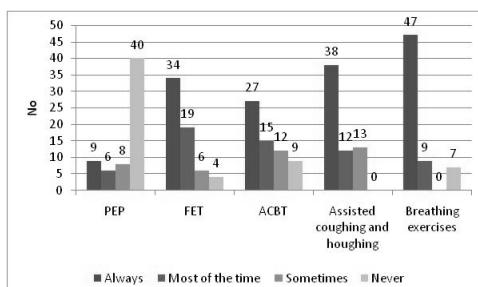
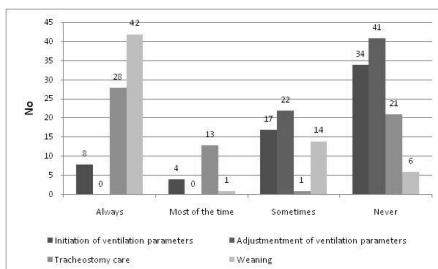


Figure 5: Specific treatment in non intubated patients

It was observed that active cycle of breathing technique (ACBT) (85%), forced expiratory technique (94%) and autogenic drainage (100%) are being used more by the physiotherapists compared to standard positive expiratory pressure (PEP) device (39%) and Flutter/Acapella device (38%). Though some techniques are used less frequently and only when appropriate to the patients, the graph above

depicts the usage of the specific techniques by the physiotherapists for treatment of non-intubated patients.

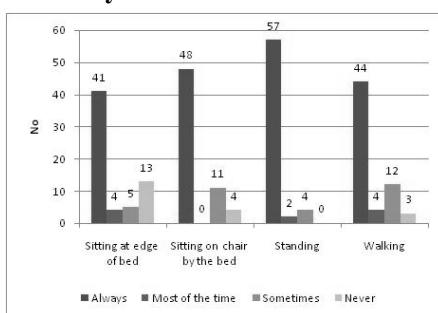
#### Involvement in other methods



**Figure 6: Involvements in other methods**

Only 12% of the physiotherapists were always informed with the initiation of ventilator settings whereas 66% of them adjusted the parameters as and when required during the treatment. Only 44% of the respondents were routinely involved in tracheostomy care and 63% were regularly involved in weaning from ventilator.

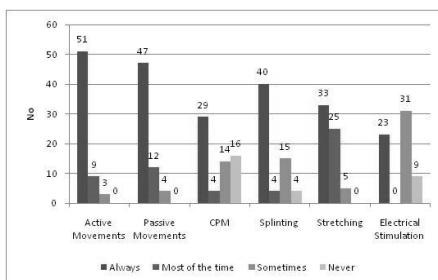
#### Early mobilization



**Figure 7: Other methods**

The above graph depicts the different methods of mobilization and the frequency of their usage in the intensive care units across Pune. Sitting at the edge of the bed was less frequently seen as compared to sitting in the chair by the bed. Standing and walking are routinely practiced by the physiotherapists for better and speedy functional recovery of the patients suffering from critical and life threatening conditions.

#### Exercises of the extremities



**Figure 8: Exercises of the extremities**

Exercises to extremities are given maximum importance in the intensive care units across Pune as seen by 51 therapists who use active movements, all the 63 who employ passive movements, 59 who use splints and 58 who provide stretching for the extremities. However, only 23 therapists use electrical stimulation in the intensive care units. Continuous passive movements are routinely employed by 44% of the respondents depending upon the motor function and condition of the patient.

#### Bed sore management:

This study shows that 46% of the responding physiotherapists were not frequently involved in bed sore management and 44% were routinely involved.

## DISCUSSION

75 questionnaires were handed personally to the head of departments of physiotherapy of hospitals across Pune out of which 63 were received back with a wonderful response rate of 84%.

This study was done to analyze the ongoing physiotherapy practices in the most required unit of the hospital that is the intensive care unit. There was a variation seen in the qualifications, work experience, training, skills and techniques. It was observed that 53% of the respondents were qualified as bachelors in physiotherapy and 42% were masters in physiotherapy. In a study done by Ujwal Yeole et al, in 2015 it was noted that only 15% were masters in physiotherapy which contradicts the findings here<sup>9</sup>.

It was observed in this study that 77% of the physiotherapists saw patients on basis of "physician reference" and 22% of the respondents treated patients on the basis of routine assessment which goes hand in hand with the findings observed by Bhatt et al. in which the majority of physiotherapists (73.2%) required neurologists/neurosurgeon's referral to treat the neurological ICU patients, whereas 23.2% treated patients on routine assessment<sup>5</sup>. Also a survey conducted by Yeole et al. recorded that 58% of the respondents treated patients on physician reference and 39% of them initiated patient treatment based on routine assessments. From the observation of this finding it is clear that the treatment in the ICU is largely physician referred whereas it should be for the physiotherapist to diagnose and treat each and every patient in the unit based on daily assessment<sup>9</sup>.

Training in cardiopulmonary resuscitation (CPR) is an important part for all the physiotherapists handling such critical

patients. It is noted that 78% of the respondents in this study are trained in CPR whereas according to the survey conducted by Bhatt et al. only 60% of the therapists are certified in CPR<sup>5</sup>.

Monitoring of parameters is critical in treatment of patients and in this survey it was recorded that only 38% of the respondents took a look at intra cranial pressure while treating as it is seen inFigure 2. The oxygen saturation of the patient is a useful indicator of the metabolic requirements of the brain when the intracranial pressure monitoring is unavailable and it was recorded that a good percentage of 95% were aware of monitoring SpO<sub>2</sub> before, during and after the treatment sessions but the central venous pressure monitoring has a bad response in that it is monitored only by 31% of the participants.

This study noted that all the respondents were monitoring the blood pressure, oxygen saturation, mechanical ventilator parameters and echocardiography during, before and after the physiotherapy treatment sessions. The physiotherapists working in the intensive care units were involved in the monitoring of the X ray and the ABG in order to plan a proper rehabilitation program for the patients. Complete blood count gives an approximate about the hemoglobin, total leucocyte count, platelet levels, coagulation status and the erythrocyte sedimentation rate which plays an important role in the physiotherapy to the patients.

Conventional chest physiotherapy techniques are routinely practiced in ICU. Nearly 98% of the respondents reported that they provide postural drainage to the patients in the ICU as seen in Figure 3. However, this survey did not assess the details of modifications made in the postural drainage positions for the patients. From this study, it is evident that nearly 99% of the physiotherapists were involved in suctioning procedures seen in Figure 3. Tracheostomy care is crucial part of bronchial hygiene therapy. This study revealed that only 44% of the physiotherapists provided tracheostomy care for the patients in the ICU. This survey revealed that most of the physiotherapists practiced ACBT and autogenic drainage technique. However, the results should be interpreted with caution as these techniques cannot be easily administered in head injured or in patients with altered sensorium.

In patients who are unable to obey commands, proprioceptive neuromuscular facilitation (PNF) techniques may be of value in increasing air entry and help propel the secretions toward trachea. According to this survey, only 58% of physiotherapists practiced PNF techniques in the ICU patients for lung expansion therapy when appropriate (Figure 3).

During this survey, it was observed that majority of physiotherapists (90%) always performed chest wall techniques. The role of the physiotherapist in weaning a patient from a ventilation circuit to spontaneously breathing includes numerous techniques that are based on skill and knowledge. These roles involve the decision-making such as when weaning should begin, weaning strategies, mode of ventilation, and whether use of noninvasive ventilation (NIV) is appropriate.

It was observed that 12% of the respondents were always involved in setting ventilator parameters while 53% opinions were always taken before weaning a patient from the mechanical ventilator. 66% respondents were involved in decision-making in extubation. Yeole et al. reported that 10% of respondents were involved in setting ventilator parameters and 18% were involved in weaning<sup>9</sup>.

From this survey, use of devices for AC such as Acapella/Flutter device and PEP were reported by about 35-45% of the physiotherapists for suitable patients which is less as compared to use of manual techniques of physiotherapy for the concerned patients (Figure 4).

Bed sores are very commonly seen in bed ridden patients. Since the patients In the ICU suffer from critical conditions they can remain on bed for a long period of time and bed sore management is very crucial but only 44% of the total respondents show active participation in bed sore prevention as a part of their rehabilitation.

Overall in this survey, variations were observed in physiotherapy practices within hospitals across Pune city, India. This diversity needs to be explored by future study for variables such as physiotherapist's qualification, years of experience, attendance of seminars, type of hospital, referral system, availability of physiotherapist during night and preferred physiotherapy techniques.

## CONCLUSION

All the physiotherapists posted on the intensive care units were observed very commonly using chest expansion techniques, positioning and active mobilization for rehabilitation of patients in the ICU. Conventional chest physiotherapy practices were more commonly used in comparison to adjunct devices. The physiotherapists treat patients on the basis of physician referral more commonly as compared to self assessment and routine treatment. The posting of the physiotherapists on overnight shifts and on public holiday is not seen in most of the hospitals. More experience, knowledge and skill are required among the physiotherapists. The response rate low and

hence there is need to carry out this study on a larger scale with higher response rate. The use of physiotherapy in the ICU must be thoroughly evaluated in terms of effectiveness after proper consideration of the patient condition.

## REFERENCES

1. Classification of Health Workforce Statistics, World Health Organization. Available from: [http://www.who.int/hrh/statistics/health\\_workers\\_classification.pdf](http://www.who.int/hrh/statistics/health_workers_classification.pdf)
2. Stiller K. Physiotherapy in intensive care: Towards an evidence based practice. *Chest*. 2000;118:1801-13.pubmed.
3. Herridge MS, Tansey CM, Matteaos N, et al. Functional disability 5 years after acute respiratory distress syndrome. *N Engl J Med*. 2011; 364.:1293-130.
4. Stevens RD, Dowdy DW, Michaels RK, Mendez-Tellez PA, Pronovost PJ, Needham DM Neuromuscular dysfunction dysfunction acquired in critical illness: A systematic review. *Int Care Med* 2007; 33(11): 1876-1891.
5. Bhat A, Chakravarthy K, Rao BK. Chest physiotherapy techniques in neurological intensive care units of India: A survey. *Indian J Crit Care Med*. 2014; 18:363-8.
6. NicolinoAmbrosino, MD, and Dewi N. Makhabah MD. Physiotherapist in the ICU. *RT magazine*. 2014. Rtmagazine.com.
7. Gosselink R, Bott J, Johnson M, Dean E, Nava S, Norrenberg M, et al. Physiotherapy for adult patients with critical illness: Recommendations of the European respiratory society of intensive care medicine task force on physiotherapy for critically ill patients. *Intensive Care Med*. 2008; 34: 1188-99.
8. Clin E, Ambrosino N. Early physiotherapy practice in intensive care units in Australia, the UK and Hong Kong. *Physiotherapy theory Pract*. 1992; 8: 39-47.
9. Ujwal Y, Ankita R, Roshan G. Physiotherapy practices in intensive care units across Maharashtra. *Indian J Crit Care Med*. 2015 Nov; 19(11): 669-673.

## A STUDY TO FIND OUT EFFECT OF CERVICAL TRACTION ON SOLEUS MUSCLE H - REFLEX IN AMBULATORY STROKE PATIENTS - AN EXPERIMENTAL STUDY

**SNEHA CHAUHAN<sup>1</sup>, RENUKA DAFDA<sup>2</sup>**

1. MPT Student in Neurological condition Shree K.K Sheth Physiotherapy College, Rajkot
2. Assistant professor Shree K.K Sheth Physiotherapy College, Rajkot

### **ABSTRACT**

**Context:** There are limited studies on effect of cervical traction in inhibition of the soleus H reflex amplitude in ambulatory stroke patients.

**Aim:** To find out effect of cervical traction on soleus H-reflex in ambulatory stroke patients.

**Settings and Design:** The interventional study was carried out in Shree K.K Sheth physiotherapy college, Rajkot.

**Method and Material:** Static Cervical traction (C.T) has been given to total 15 subjects (13 males and 2 females) for 1 min with 4 kg weight. Soleus muscle H reflex amplitude was measured before C.T and after 3 min of C.T.

**Statistical analysis:** Data was analyzed by using SPSS Version 20. Paired t-test was used to find out effect of cervical traction on soleus muscle H reflex in ambulatory stroke patients.

**Results:** Statistically not significant ( $p>0.05$ ) effect of cervical traction on soleus muscle on H reflex in ambulatory stroke patients.

**Conclusion:** This study concludes that there is no significant effect of cervical traction on soleus muscle H reflex in ambulatory stroke patients.

**KEYWORDS:** Cervical traction (C.T); H reflex; ambulatory stroke patients

## INTRODUCTION

The term Stroke or brain attack is defined as the sudden loss of neurological function caused by an interruption of the blood flow to the brain<sup>1</sup>. This cut off the supply of oxygen and nutrients, causing damage to the brain tissue<sup>2</sup>. The most common symptom of a stroke is sudden weakness or numbness of the face, arm, or leg, most often on one side of the body, occurring in 90% of the strokes<sup>2</sup>.

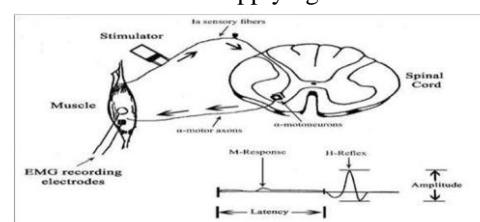
In India, the overall prevalence rate for stroke is lies between 84 – 262 per 100,000 in rural area and between 334 – 424 per 100,000 in urban areas. Mean age for onset of stroke for men in India ranges from 63-65 years and for women 57-68 years. Indian studies have shown that about 10-15% of strokes occur in people below age of 40 years<sup>3</sup>.

Performing late response tests, such as the H-reflex, can provide valuable information helpful in understanding the pathophysiology of various central nervous system abnormalities.

H-reflex was described by Johann Hoffmann in 1918, hence called H-reflex.<sup>4</sup> It is a mono synaptic reflex elicited by submaximal stimulation of the nerve. It is analogous to the mechanically induced spinal stretch reflex. The primary difference between the H-reflex and the spinal stretch reflex is that the H-reflex bypasses

the muscle spindle and therefore, is a valuable tool in assessing modulation of monosynaptic reflex activity in the spinal cord.

The H-wave is a good indicator of the strength and distribution of the stimulus input from muscle spindle to the motor neuron pool, which lies at the site of the anterior horn of the spinal cord and hence is an objective method for the measurement of spasticity<sup>4</sup>. The reflex arc of H-reflex includes, i) large fast conducting group 1a sensory fibers, ii) spinal cord where afferent fibers synapse with alpha motor neurons and iii) efferent motor fibers supplying the muscle.



**Figure 1: The reflex arc for H-reflex**

The H reflex amplitude is a parameter of the excitability of the monosynaptic reflex and increase in excitability of that reflex increases spasticity<sup>5-8</sup>. Through clinical observations, it has been reported that triceps surae is a muscle in which spasticity is predominantly present in patients with central nervous system dysfunctions such as stroke or cerebral palsy<sup>9-10</sup>.

Accordingly, longitudinal cervical traction, which induces mechanical stimulation of the cervical region, is also expected to have an effect on the soleus H reflex. In healthy subjects,

Corresponding author: Sneha Chauhan  
2nd M.P.T student, Shree K.K Sheth physiotherapy college, Rajkot  
Email id: chauhansneha73@gmail.com

cervical traction with intensity of 3kg depressed the soleus H reflex amplitude after traction and the degrees of the depression were 6% in the first minute, 7% in the second minute, and 10% in the third minute<sup>11</sup>.

## NEED OF THE STUDY

There are limited studies on effect of cervical traction in inhibition of the soleus H reflex amplitude in ambulatory stroke patients.

If there is any significant effect of C.T on soleus H reflex amplitude and  $\alpha$  motor neuron excitability then C.T can be used as treatment tool in combination with other spasticity reduction methods in stroke patients.

So the need of the study is to find out effect of cervical traction on soleus H reflex in ambulatory stroke patients.

## AIM OF THE STUDY

To find out effect of cervical traction on soleus muscle H- reflex in ambulatory stroke patients.

## OBJECTIVES

- To measure soleus H reflex amplitude prior to cervical traction in ambulatory stroke patients.
- To measure soleus H reflex amplitude after 3 min of cervical traction in ambulatory stroke patients.
- To find out difference between soleus muscle H reflex amplitude prior to cervical traction and after 3 minor cervical traction in ambulatory stroke patients.

## MATERIAL AND METHODS

**STUDY SETTING:** Shri K.K. Sheth Physiotherapy Centers, Rajkot

**STUDY DESIGN:** An experimental study

**METHOD OF COLLECTION OF DATA:**

Source of data collection: Shree K. K. Sheth Physiotherapy center, Rajkot

Study population: Ambulatory stroke patients

Sampling method: Purposive sampling

Sample size: 15 subjects

### MATERIALS TO BE USED

- EMG-NCV Instrument (RMS EMG EP MK-II, Version 1.1)
- Stop Watch
- Gel & cotton
- Cervical Traction apparatus
- Pen – Paper & pencil
- Consent form
- Assessment form



Figure 2: Materials to be used



Figure 3: Patient's Position during cervical traction



Figure 4: EMG-NCV Instrument (RMS Ep Mk-II, Version 1.1)



Figure 4: EMG-NCV Instrument (RMS Ep Mk-II, Version 1.1)

## CRITERIA FOR SELECTION

### *Inclusion Criteria*

- Gender: both males and females
- Modified Ashworth scale (1-3)
- Subjects with normal cognitive function (MMSE >23 )
- Ischemic and hemorrhagic types of stroke
- A score of 2-4 on Brunnstrom stages of recovery for the lower limb
- Patients with acute, sub acute and chronic stages of stroke

- Independent ambulatory patients with and without assistive device

#### **Exclusion Criteria**

- Patients with history of any recent surgeries in low back and lower limbs
- Patients with history of any recent musculoskeletal injuries like fractures, dislocation, joint instability or any soft tissue injuries
- Patients with other form of neurological impairments
- Patients with severe contractures due to spasticity in lower limbs
- Hemodynamically unstable patients
- Uncooperative patients or patient who is not willing to participate

#### **MEASUREMENT PROCEDURE**

The patients have been selected on the basis of inclusion and exclusion criteria.

Before starting the study, brief assessment has been done by Mini Mental State Examination and written consent was taken from the patients.

Position for soleus H reflex: Patient lied in prone position with leg and thigh firmly supported. The feet hanged freely with dorsum at right angle to tibia. Recording: The active surface electrode was placed at the distal edge of calf muscle, the reference electrode was placed on Achilles tendon and stimulating electrode was placed in the popliteal fossa. A square pulse of 1 ms duration was used for preferential stimulation

of large sensory fibers. The cathode was kept proximal to anode to avoid anodal block. The amplitude was measured from peak to peak. Five H responses were studied for analysis and maximum H wave amplitude was taken<sup>12</sup>.

#### *Instrumentation Parameters for H-reflex measurement:*

- Sweep speed: 10ms/div
- Sensitivity: 200-500  $\mu$ V/div
- Filter setting: 3 KHz

Cervical traction mode was static for 1 minute, with 4 kg weight given to the patient. Then soleus H – reflex was measured before cervical traction and after 3 and 5 minutes of cervical traction.

#### **RESULTS**

Data was analyzed by using SPSS Version 20. Paired t- test was used to find out effect of cervical traction on soleus muscle H reflex in 15 (Male-13 and Female-2) ambulatory stroke patients. In this test t value is 0.478 and level of significance is 0.640 that is more than 0.05.

**Table 1: Age and gender group distribution**

Age group	Male	Female	Total
30-40	2	0	2
41-50	1	1	2
51-60	2	1	3
61-70	8	0	8

**Table 2: Paired t test for pre and 3 min post H reflex amplitude**

	Paired Differences					t	df	Sig. (2-tailed)			
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference							
				Lower	Upper						
Pre and 3 min Post H reflex	0.122	0.989	0.25538	-0.42574	0.669	0.478	14	0.64			

**Table 3: Paired t test for pre and post 5 min H reflex amplitude**

	Paired Differences					T	df	Sig. (2-tailed)			
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference							
				Lower	Upper						
Pre and 5 min Post H reflex	-0.2	1.59227	0.41112	-1.082	0.6811	-0.488	14	0.633			

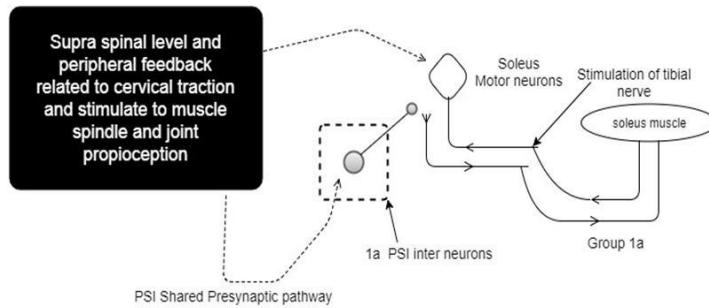
**Table 4: Mean and Standard Deviation for pre and 3 min post H reflex amplitude**

	Pre H reflex amplitude	Post H reflex amplitude
Mean	2.34	2.21
SD	2.82	2.99

Interpretation: The above table shows the mean value of pre H reflex amplitude 2.34+ or – 2.82 and post H reflex amplitude 2.21 + or – 2.99

#### **DISCUSSION**

Aim of the study was to find out effect of cervical traction on soleus muscle H- reflex in ambulatory stroke patients. This study concludes that there is no significant effect of cervical traction on soleus muscle H reflex in ambulatory stroke patients.



**Figure 6: Mechanism for Effect of cervical traction on soleus muscle H reflex**

Koichi Hiraoka et al, (1998) conducted a study to find the effects of cervical traction on the soleus H reflex in stroke patients in Japan. There was inhibition of the soleus H reflex amplitude several minutes after cervical traction. The result implied the possible usefulness of cervical traction for inhibiting excitability of the monosynaptic reflex in stroke patients<sup>21 13</sup>.

Olyaei et al (2017) conducted a study to the effect of cervical traction on soleus H reflex in healthy men and concluded showed that traction with 3 Kg force can increase motor neuron excitability of soleus muscle<sup>22 14</sup>. In 2003, Alain Frigon et al. conducted a study to find out effect of rhythmic arm movement on reflexes in the legs: Modulation of Soleus H Reflexes and Somatosensory Conditioning, concluded that, rhythmic arm swing contributes to the pattern of H-reflex modulation reported during human walking and running<sup>23 15</sup>.

In study noticed that Position of the patients in proper prone are most important for taking soleus H reflex. Two subjects dropped out because of fear of cervical traction.

It was also observed that the effect of cervical traction to reduce a neuro motor excitability or changes in H reflex were continued even after 5 minutes of cervical traction but that changes are not clinical significant so according to result of present study cervical traction cannot be used as treatment tool to reduce spasticity.

#### **Limitation of the study**

Small sample size, specific age criteria and duration after onset of stroke was not taken in to consideration.

#### **FURTHER RECOMMENDATIONS**

The effect of cervical traction on motor neuron excitability needs to be evaluated in other neurological conditions and other C.T parameter can be used.

#### **ACKNOWLEDGEMENT**

I am first thankful to Almighty God and my family for blessings. I extend my sincere thanks to my respected guide Dr. Rajesh Padnani. I am also thankful to Prayag Parekh and my friends for their support and help in this study.

#### **CONCLUSION**

There is no significant effect of cervical traction on soleus muscle H reflex in ambulatory stroke patients. Therefore, cervical traction cannot be used as treatment tool to reduce spasticity in stroke patients.

#### **Conflict of Interest:**

Nil.

#### **Source of Fund:**

No fund was needed.

#### **Ethical Clearance:**

From Shree K.K. Sheth Physiotherapy College, Rajkot.

#### **REFERENCE**

1. Susan B O’ Sullivan, Thomas J Schmitz; Physical rehabilitation; 5th Edition; Jaypee Brothers 2007.
2. Manjari Tripathi and Deepti Vibha: Review Article Stroke in Young India. Hindawi Access to Research Stroke Research and Treatment 2010; Volume 2011.
3. Jeyaraj Durai Pandian, Paulin Sudhanb, Stroke Epidemiology and Stroke Care Services in India. Journal of Stroke 2013;15(3):128-134.
4. Kai S, Nakabayashi K. Evoked EMG Makes Measurement of Muscle Tone Possible by Analysis of the H/M Ratio.

- Electrodiagnosis in New Frontiers of Clinical Research: 195-212.
5. Angel RW, Hoffman WW: The H reflex in normal, spastic and rigid subjects. *Arch Neurol* 8: 591-596, 1963.
  6. Lance JW: Symposium synopsis. In: Feldman RG, Young RR, Koella WP(eds) Spasticity: Disordered Motor Control. Chicago, Yearbook Publishers, 1980, pp. 485-494.
  7. Harburn KL, Hill KM, et al.: Spasticity measurement in stroke: A pilot study. *Can J Public Health* 83(S2): S41-S45, 1992.
  8. Katz RT, Rymer WZ: Spastic hypertonia: Mechanisms and measurement. *Arch Phys Med Rehabil* 70: 144-155, 1989.
  9. Bobath B: Adult Hemiplegia: Evaluation and Treatment, 2nded, Heinemann, London, 1978.
  10. Bobath K: The Motor Deficit in Patients with Cerebral Palsy. Heinemann, London, 1975.
  11. Hiraoka K, Nagata A: The effects of cervical traction on the soleus H reflex amplitude in man. *Jap J Phys Fitness Sports Med* 1998, 47.
  12. Wilson VJ, Ezure K, et al.: Tonic neck reflex of the decerebrate cat: Response of spinal interneurons to natural stimulation of neck and vestibular receptors. *J Neurophysiol* 1984, 51: 567-577.
  13. Koichi Hiraoka, et al. The Effects of Cervical Traction on the Soleus H Reflex in Stroke Patients 1998, JJpnPhyTherAssoc 1: 25-27.
  14. Olyaei GR et al. The effect of cervical traction on soleus H reflex in healthy men, 2017, Journals.tums.ac.ir
  15. Alain Frigon, et al. Effect of Rhythmic Arm Movement on Reflexes in the Legs: Modulation of Soleus H-Reflexes and Somatosensory Conditioning, 2004, *J Neurophysiol* 91: 1516–1523.

## PREVALENCE OF NECK PAIN, PERCEIVED STRESS FACTORS AND OTHER ASSOCIATED FACTORS ON THE FUNCTIONAL DISABILITY IN SURGEONS AT HALDWANI –RUDRAPUR REGION

**DEPTEE WARIKOO<sup>1</sup>, MEENAKSHI RAWAT<sup>2</sup>, P.S. MONDAL<sup>3</sup>, SAURABH AGNIHOTRI<sup>4</sup>, ANKITA SRIVASTAVA<sup>5</sup>**

1. Head of Department, Department of Physiotherapy, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, UK, India
2. Research Student, MPT (Musculoskeletal disorders), Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, UK, India
3. MPT (Musculoskeletal), Haldwani
4. MPT (Musculoskeletal disorders), Assistant Professor, TMU, Moradabad
5. MPT(Cardio), Assistant Professor, TMU, Moradabad

### ABSTRACT:

The work of surgeons can involve high level of mental concentration and very precise movements that can be categorized as mild to moderate physical demands. The present study aims to investigate prevalence of chronic non-specific neck pain among surgeons in Haldwani and Rudrapur regions along this the aim is also to investigate prevalence of non-specific neck pain on the functional disability, and to analyze that how much perceived stress and other associated factors contributes on the functional disabilities in surgeons with non-specific neck pain.

**Methods:** A survey was conducted amongst surgeons working in various hospitals and nursing homes of Haldwani and Rudrapur regions. 60 surgeons completed the survey successfully (response rate 51.7%). Questionnaire included NPRS, Cohen PSS, NPDS and Associated factors among surgeons. The relationship among these factors with neck pain was examined.

**Results:** The study indicated high prevalence rate of non-specific chronic neck pain (51.7%). Neck pain was strongly associated with functional disability in surgeons ( $p= 0.000$ ). Stress factors were associated with functional disabilities in surgeons ( $p=0.000$ ).

**Conclusion:** These results indicate that non-specific chronic neck pain does affect the functional disability in surgeons. Strong association of stress factors on the functional disabilities in surgeons was confirmed, while associated factors don't contribute to the functional disabilities in surgeons. There is high recommendation of urgent ergonomic attention and physiotherapeutic awareness for the future.

**Keywords:** non-specific chronic neck pain; perceived stress; functional disability

## INTRODUCTION

In Industrialized countries neck pain is a significant musculoskeletal disorder with high medical costs, Social costs and low rate of complete recovery. Previous studies have discovered high prevalence of neck pain among the general population<sup>1</sup>. Prevalence and incidence rates of neck musculoskeletal disorders have shown an increasing trend. Work related neck pain is believed to have multidimensional etiologies<sup>2</sup>.

Surgeons are at a high risk group for developing work related musculoskeletal disorders, with prevalence rates as high as 80 % reported for neck pain among surgeons in Europe and in Hong Kong<sup>3</sup>.

The work of surgeons can involve high levels of mental concentration and very precise movements that can be categorized as mild to moderate physical demands<sup>4</sup>.

One of the most recognized physical

stress factors in the surgeons work is the long duration of maintaining a static posture during surgery. The physical strains of performing surgical tasks with very fine manual dexterity and high precision must contribute to muscular fatigue and exhaustion in the surgeons<sup>3</sup>.

In the field of surgical research although it is commonly recognized that maintaining a static posture is a major physical demand on surgeons, it is not clear that what parameters are appropriate to quantify this problem<sup>3</sup>.

Surgeon's awkward body posture, increased muscle activity, repetitive movements of the upper extremities, and prolonged static head and back postures during surgical procedures are main problems, which cause work related musculoskeletal disorders.<sup>5</sup>

Because of the position of the patient during open surgery, surgeons tend to lean forward and this results in increased extension muscle activity to balance the body. In addition to these problems, surgeons also have to deal with problems related to inappropriate operating table height due to the different height of the surgeons in the surgical team<sup>5</sup>.

For correspondence: Deeptee Warikoo  
Email: dep tee.pt@gmail.com

Furthermore, past studies have mostly attempted to examine the surgeon's physical workload in performing simulated and standardized surgical tasks<sup>3</sup>.

A recent study in Hong Kong also found alarmingly high prevalence rates of neck and back musculoskeletal symptoms among general surgeons working in public hospitals<sup>16</sup>.

Negative stress and prolonged pain are health risks with adverse long – term health effects<sup>7</sup>. Work related neck and upper limb symptoms are still prevalent. In the Netherlands, yearly sick leave due to work related neck and upper limb problems are estimated to be 2% to 4 % of all workers<sup>8</sup>.

Neck symptoms are also common in Dutch general practice<sup>8</sup>. Possible risk factors are of a physical psychosocial or personal region.<sup>8</sup> Wauben et al. reported that over 80% of surgeons had experienced discomfort and pain in the neck after surgery<sup>5</sup>. Kant et al, conducted a study and reported that surgeons performed repeated static postures with forward bending of the head and twisting at the back. These positions were described as "distinctly harmful" by the subjects<sup>5</sup>.

Moreover, individual surgeons may have differences in muscle strength and endurance differences as well as different physical fitness levels. It is not known to what extent this factor may affect their ability to handle the sustained physical workload, especially in surgeries of long duration hour and high complexity. In particular research on female surgeons is sparse and it is not known whether they may be disadvantaged in any way for those with smaller physique and weaker muscles<sup>3</sup>.

One study by Person et al. has attempted this approach by attaching sterilized marker arrays on to the surgeon's torso and dominant arm and used an optical tracking system to record the three dimensional co-ordinates of reflection markers with infrared cameras at 15 Hz. This was intended to study the body movements during different phases of laparoscopic cholecystectomy. However, in an actual operation the surgeons' movements can be easily blocked from the cameras and missing markers can be a major source of measurement errors.<sup>3</sup>

The head – neck posture is actually a combined result of movements of upper cervical spine on the head and the lower cervical spine movements.<sup>3</sup>

On the other hand the disadvantages for the surgeons and the operating team also are becoming increasingly known<sup>9</sup>.

Ergonomic research strives to improve the working conditions in the operating room. The work ergonomics originates from the Greek

words "ergon" means labor and "nomos" means law, which indicates knowledge concerning the law of human labor. Combined with product development and product evaluation, this leads to the working principle that the operating room designers should adapt the environment to the workers instead of adapting the workers to the environment.<sup>9</sup>

Surgeons in our opinion have always been an example of an individual who is determined, professional being able to control himself under adverse circumstances and willing to work extra hours beyond any schedule or program<sup>10</sup>

Stress related problems have been the area of investigations for many scientists, but surgeons were one of the last to take this matter seriously.<sup>10</sup>

Previous study analyzed the prevalence of work related musculoskeletal disorder in Ophthalmologists practicing in Navi Mumbai and Mumbai by using a self-reported method of outcome measurement with the help of a validated questionnaire. Various methods of assessment have been described to estimate the prevalence rates such as self-report, interview and clinical examination with some differences.<sup>11</sup>

The present study aims to investigate the prevalence of chronic non-specific neck pain among surgeons in various hospitals and nursing homes of Haldwani and Rudrapur region and to investigate the prevalence of non-specific neck pain on the functional disability in surgeons of Haldwani and Rudrapur region, also to analyze that how much perceived stress factors and other associated factors contributes on the functional disabilities in surgeons with non-specific neck pain.

## METHODS

The study examined self cross-sectional survey of non-specific neck pain among surgeons working in hospitals and nursing homes of Haldwani and Rudrapur regions. Altogether over 60 Surgeons completed surveys successfully with response rate of 51.7%. This survey study was conducted by simple interview method and e-mails to all participants. Informed consent forms were obtained from the subjects.

### The Survey Design

The survey contained information on four major categories:

1. Numeric pain rating scale questionnaire (NPRS) for neck pain.
2. Cohen perceived stress scale questionnaire (PSS) 10 – items for stress factors.

3. Evaluation of functional disability by neck pain and disability scale questionnaire (NPDS).
4. Associated factors (age, gender, BMI).

Assessment of non-specific chronic neck pain done by numeric pain rating scale. It is a valid and reliable measure of chronic pain intensity. An 11 – point numeric scale with 0 representing non pain and 10 represents the extreme pain. The NPRS was administered verbally and graphically for self-completion. The respondents were asked to indicate the numeric value on the segmented scale that best describes their pain intensity as current best and worst pain and their average are taken to describe their pain.

The number that the patients indicates on the scale to rate their pain intensity was recorded scores range from 0 – 10 higher score indicate greater pain intensity. Assessment of perceived stress factors is done by Cohen's (PSS) 10 items scale. PSS will be administered in all subjects to evaluate perceived stress factors. Patient will be in comfortable seated position. Questionnaire (10 – items) scored by e-mail or by simple interview method. It is an (10 – items) measure that tests five areas of stress factors.

- 0 - never
- 1 – Almost never
- 2 – Sometimes
- 3 – Fairly often
- 4 – Very often

Functional disability was assessed by neck pain and disability scale which consists of 20 – items questions that measures five areas of function. Items score ranges from 0 to 5 and the total score is a total of the items scores. Completion of the NPDS usually requires less than 5 minutes. The authors suggest that a total score of 0 – 22 indicates none problems minimal problems.

- 23 – 40: indicates mild problems.
- 41-57: indicates moderate problems.
- 58-74: moderate - severe problems.
- 75-92: indicates severe problems.
- 93-100: indicates extreme pain, suffering and disability.

Associated factors age, gender, BMI done by simple interview method.

## DATA ANALYSES

The data was analyzed for 60 subjects. Descriptive statistics was used to analyze the data. Correlation of data was done by "Karl Pearson Test". Data analysis was done using SPSS 20.0 version. Descriptive analysis was done to calculate the mean for age, BMI, NPRS score, PSS score, neck pain and disability scale for functional disabilities in subjects.

Repeated measure Karl Pearson was applied to correlate the data age, BMI, NPRS score, PSS score with NPDS score. The

statistical significance was set at 95 % confidence interval with p value <0.01 considered highly significant and p value <0.05 considered to be significant.

## RESULTS

Sixty surgeons which included Laparoscopic surgeons, Orthopaedic surgeons, General surgeons, Gynaecologists, Paediatrician, Dental surgeons, Cardiac surgeons, E.N.T. surgeons, Ophthalmologists, Plastic surgeons, and Neuro surgeons completed the survey successfully with all items completed with both male and female equally of age groups between 40-60 yrs. With respect to the inclusion and exclusion criteria of the study. Descriptive analysis was completed with the various variables included in the study (n=60). It shows that the age group of n=60 surgeons having the mean 51.11 with 6.81 standard deviation. For numeric pain rating score (NPRS) the mean is 5.64 with 3.61 standard deviation (n=60). For BMI (weight/height) the mean is 26.41 with 2.53 standard deviation. For perceived stress scale (PSS – 10 item score) the mean is 22.15 with 3.45 standard deviation. For the neck pain and disability scale (NPDS) score the mean is 51.20 with 28.32 standard deviation. It has shown that prevalence of chronic non-specific neck pain in surgeons was 51.7% at Haldwani and Rudrapur regions. Gender is not significantly associated with NPDS score as p> 0.958 greater than 0.05. Correlation between age and NPDS score is p >0.0057 with correlation coefficients r = 0.247 which is non-significant, so there is no association between age of the surgeons on the functional disabilities. Correlation between BMI and NPDS score is p> 0.139 with correlation coefficients r = 0.193 which is non-significant. Correlation between NPRS score and NPDS score is p< 0.000 which is significant. Correlation between PSS score and NPDS score is p<0.000 which is significant so it is interpreted that there is high positive correlation between perceived stress factors on the functional disabilities in surgeons.

## DISCUSSION

Prevalence and incidence rates of neck musculoskeletal disorders have shown an increasing trend<sup>2</sup>. Work related neck pain is believed to have multidimensional etiologies<sup>2</sup>. Surgeons' awkward postures increased muscles activity, repetitive movements of the upper extremities, and prolonged static head and back postures during surgical procedures are main problems, which cause work related musculoskeletal disorders<sup>5</sup>. Wauben et al. reported

that over 80% of surgeons had experienced discomfort and pain in neck after surgeries<sup>5</sup>. Previous study analyzed the prevalence of work related musculoskeletal problems in ophthalmologists practicing in Navi Mumbai and Mumbai by using a self-reported method of outcome measurement with the help of validated questionnaire<sup>11</sup>. In this study results showed that chronic non-specific neck pain is prevalent among the surgeons of Haldwani and Rudrapur regions.

In this study the prevalence was 51% in chronic non-specific neck pain among surgeons. In 2015 by Dabohlker T<sup>11</sup> in Navi Mumbai and Mumbai the prevalence rate of neck pain was 51% in the Ophthalmologists during surgery hours and 27% of them complain during O.P.D hours, as compared to back pain which was 46% during surgical hours and 51% during O.P.D hours while shoulder pain was 16% and 14% headache during and after O.P.D. hours. It was observed from this study that there is a strong positive correlation between the prevalence of non-specific neck pain on the functional disability in surgeons with ( $p<0.000$ ). There is also high positive correlation between the perceived stress factors on the functional disability in surgeons with ( $p<0.000$ ) value. While the associated factors such as age, shows correlation with functional disability in surgeons statistically non-significant result ( $p>0.057$ ) value. Correlation of gender with functional disability in surgeons showed non-significant result ( $p> 0.958$ ) as the p values greater than 0.05. Correlation of BMI (Height, Weight) with functional disability in surgeons showed on-significant result ( $p> 0.735$ ) as the p values greater than 0.05.

Neck pain has been found to be a major health problem for surgeons. This study reveals that chronic non-specific neck pain is prevalent highest among surgeons and showed positive relationship on the functional disabilities in surgeons. Other factors like perceived stress factors and other associated factors were included in this study. The study showed that there is major contribution of perceived stress factors on the functional disability in surgeons, but the other associated factors on functional disability in surgeons revealed non-significant results. So there is no contribution of the associated factors on the functional disability in surgeons.

The purpose of this study was to find the prevalence of non-specific neck pain in surgeons which was clearly seen in surgeons so that to suggest the better ergonomic attention and physiotherapeutic awareness in them.

## LIMITATIONS OF STUDY

The sample size of the present study was small. In addition there was time limitation while collecting the data from the surgeons due to the busy schedule of the surgeons. In future gender based study can be done. In addition ergonomics related study can be done for the surgeons, and also the same study can be done for the back pain and various musculoskeletal symptoms in the surgeons for the future research.

## CONCLUSION

In conclusion, the present survey study has shown high prevalence rates of chronic non-specific neck pain in surgeons of Haldwani and Rudrapur region. The results indicated that prevalence of non-specific neck pain in surgeons also contributes, and affects the functional disabilities in them. While stress factors perceived by them which could be psychological, physical, social also affects the functional disabilities in surgeons. But associated factors do not contribute positive results on functional disabilities in them. So it is clear that there is high prevalence of non-specific chronic neck pain in surgeons at Haldwani and Rudrapur cities. In addition prevalence of non-specific neck pain hampers their functional disabilities in their lifestyle stress factors also hampers their lifestyle (functional disability) severely. We recommend urgent ergonomic attention and postural awareness to the work set up and better ergonomic practices in surgeons for the future as well as to provide some physiotherapeutic awareness for the treatment of surgeons with non-specific neck pain.

## ACKNOWLEDGEMENTS

It has been a privilege and a great experience working on this topic with great support from Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun. I thank all my associates for constant help, support, encouragement & guiding my work in every step.

## REFERENCES

1. Xiaopeng Ning, Yuping Huang, Boyi Hu, Ashish D. Nimbarde. Neck Kinematics and muscle activity during mobile device operations. International journal of industrial ergonomics 48 (2015) 10-15.
2. Ashish D. Nimbarde, Suman Kanti Chowdhary, E David Cart Wright. Empirical evaluation of neck muscle fatigue generated

- by health care exertions. Safety science 57 (2013) 100-107.
3. Grece P.Y, Szeto, Ph.d, Stephan W.K Chang, M.D, Jensen T.C. Poon. M.D. Albert C.W. Ting M.D. Raymond C.C. Tsang M.Sc. and Pei Ho. M.D. Surgeons statics postures and movements repetitions in open and laparoscopic surgery. Journal of surgical research 172, E 19-E31 (2012).
  4. Grace P.Y Szeto, Pie Ho. Albert C.W. Ting M.D Jensen T.C. Poon. Stephen W.K. Chang Raymond C.C. Tsang . Joceup. Rehabilitation (2009) 19 ; 175-184.
  5. Nihan Karatas, Seda BICICI. The effect of Kinesiotape application on functional performance in surgeons who have musculoskeletal pain after performing surgery. 2011, 10.5137/1019-5149.
  6. Szeto GPY HOP, Ting ACW J.T.C. Poon RCCT Sang. SW.K.Cheng. A study of surgeons postural muscle activity during open, laparoscopic and endovascular surgery. Surg.Endosc(2010)24;1712-1721.
  7. Berit Osteras, Herundur sigmundrsson and Monika Hapa. Perceived stress and musculoskeletal pain are prevalent and significantly associated in adolescence. An epidemiological cross-sectional study. BMC public health (2015) 15;1081.
  8. P.M. Bonrgers S, Ijmker. S.Vanden Hevvel. B.M. Blatter. Epidemiological of work related neck and upper limb problems. Psychosocial and personal risk factors(part-I) and effective interventions from a behavioural perspective (part-II) J.occup. rehabi.(2006)16;279-302.
  9. L.S.G. L Wauben, MA Van Veelan D.Gossot, R.H.M. Goosens. Application of ergonomic guidelines during minimally invasive surgery. A questionnaire survey of 284 surgeons. (2002). Surgery endosco.16;635-639.
  10. Ioannis, Christakis, Morios T Pagkratis, Lisa, Varroigli, Christina Darviri, Geoge Chnussos. Measuring the stress of surgeons in training and use of a novel interventional programme to combat it. J. Korean Surg.Soc.2012,82;312-316.
  11. Dabholker T, Yardi, Dabholker YG, Nrayan prevalence of work related musculoskeletal problems in ophthalmologist practicing in Navi Mumbai and Mumbai . International Journal of medical research professionals. (2015)3;80-84

## EFFECT OF FOOTWEAR ON BALANCE AND GAIT IN MEN AGED BETWEEN 60 TO 80 YEARS

SALVI SHAH<sup>1</sup>, DISHA MONSARA<sup>2</sup>, JALAK SHAH<sup>3</sup>, CHELSI GABANI<sup>4</sup>

1. Assistant Professor, SPB Physiotherapy College, Ugat-Bhesan Road, Surat.
2. Clinical therapist, P.P. Savani heart institute and multispeciality hospital, Surat.
3. PG student, D.Y. Patil college of physiotherapy, Pune.
4. Clinical therapist, Shree Prannath Hospital, Surat.

### ABSTRACT

**Background & Purpose:** Decline in physical mobility is a major concern for many older people. Even small improvements in the areas of mobility, balance, and gait may contribute valuable benefits in terms of quality of life. Footwear, being at the interface between the body and the supporting surface, has the potential to affect balance and subsequently, the risk of falling. Hence the purpose of this study was to evaluate the balance & gait while wearing different type of footwear using functional reach test (FRT), time up and go test(TUG) and 10 meter walk test(10 MWT). **Subjects:** 50 older males aged between 60-80 years. **Method:** Demographic data, brief history and characteristics of different type of footwear were recorded. Each subjects performed FRT, TUG and MWT while barefoot, walking shoe and usual footwear (slipper). Each subject had performed all 3 tests without any difficulty. Three trials were given for each test and average of three trials was noted by therapist. One way repeated measure ANOVA and post-hoc analysis were done by SPSS. **Results:** One way repeated measure ANOVA showed that there was a significant difference between each footwear condition for all 3 tests. Post-hoc analysis revealed that walking shoes were having significant superior score than the barefoot & usual footwear for all 3 tests. **Conclusion:** Walking shoes improve balance and gait in older males. Walking shoes also provide shock absorption and allow people to walk faster without increasing the impact loading of the body. So Footwear intervention should be considered as a way of improving gait and balance in older males.

**Keywords:** Different footwear; Balance; Gait.

### INTRODUCTION

The balance is the ability to maintain an upright position in human being. It is more appropriately defined as postural stability<sup>1</sup>. Postural stability can be described as the ability of an individual to maintain own centre of gravity (COG) within the base of support. Balance is a complicated process that includes recognition and structuralization of sensory information to achieve a good standing posture, which is necessary for performance of Activity of daily livings (ADLs)<sup>2</sup>. When standing up and moving, the foot is the first point of contact between the body and the external environment, providing sensory information to the central nervous system for stability and locomotion.

Footwear may influence the quality of sensory feedback from the feet and may act as a sensory filter between the feet and the external environment<sup>3</sup>. Footwear, being at the interface between the body and the supporting surface, has the potential to affect balance and subsequently, the risk of falling<sup>4</sup>. Different components of shoes have been studied in relation to their requested functions<sup>5</sup>. Walking barefoot does not appear to be a safe alternative because it has been found that walking barefoot or in socks also increases the risk of falling<sup>6-8</sup>. Despite the

number of studies that have addressed the effects of footwear on balance<sup>9,10</sup>, there are still no evidence-based guidelines to assist older people with regard to which specific shoe features are optimal for balance<sup>4</sup>. Because older people most often fall in response to unexpected perturbations when walking<sup>11</sup>, it follows that the effects of footwear should be tested under such conditions<sup>12</sup>.

Inappropriate footwear has been identified as a contributor of up to 45% of falls<sup>13</sup>. Some authors have suggested that poorly fitting footwear and slippers or shoes with inadequate fixation may increase the risk of trip-related falls<sup>14-17</sup>. Wearing inappropriate footwear may also impair balance and alter gait patterns in the elderly<sup>18,19</sup>. Robbins<sup>20</sup> found that older men performed better with thin hard-soled shoes rather than running shoes with soft soles and hypothesized that soft midsoles induce a more unstable foot position; the deformable material alters plantar feedback and may induce a greater maximum supination angle that is underestimated by the wearer which may limit postural adaptations to maintain stability<sup>21</sup>.

Decline in physical mobility is a major concern for many older people. Even small improvements in the areas of mobility, balance, and gait may contribute valuable benefits in terms of quality of life<sup>22</sup>. Therefore, measures of balance and gait performance are critical in the field of aging and essential to help health care

For Correspondance: Salvi Shah  
E-mail: shahsalup@yahoo.com

professionals and researchers keep their focus on the real needs of the older population<sup>23,24</sup>.

Research on the effects of different types of footwear on balance and gait in the aging population is very limited<sup>25</sup>. Till now, in India, there are very few studies on the effect of footwear on balance and gait in elderly individual especially in males. So, that the present study was undertaken. The purpose of the study is to determine whether different types of footwear affect the balance and gait in elderly males.

## METHODOLOGY

A Convenient sample of 50 males, aged between 60 to 80 years were taken from charitable trust named by Mannmandir charitable trust, Katargam, Surat after receiving permission from administration. Participants were selected for study based on inclusion and exclusion criteria. Inclusion criteria of subjects were 60-80 years of age, male individuals, able to stand unsupported for 30 seconds or more, able to walk independently at least 20 meter and turn 180 degrees, able to follow simple instruction, able to do at least 90 degrees of shoulder flexion with dominant hand, at least have a one pair of shoes. Exclusion criteria of subjects were Female individual, < 60 years of age, could not stand independently, any inability to follow standardized test instructions, any known neurological condition, any known cardiovascular disorder which limits physical daily activities, any known musculoskeletal disorder (i.e. fracture, joint replacement, amputation, physically limited activities). All participants were asked to give & sign consent form prior to participate in the study.

Functional reach test, Time up and go test and 10 meter walk test were taken as an outcome measure. Reliability and validity of all the 3 tests were good<sup>26,27,28</sup>. Information on age, level of mobility, medications, use of spectacles, falls history of last one year, different type of footwear characteristics were determined. All the Subjects were assessed for the presence of foot abnormalities including hallux valgus, hallux rigidus, hammer toes, claw toes, overlapping or under riding toes, painful corns and ulcers. All the subject were assessed for balance and gait using the functional reach test, timed up and go test and 10 meter walk test with three different type of footwear (i.e. barefoot, walking shoes, usual footwear[slippers]).

All of the assessment tests were performed in morning. Subjects performed the FRT, TUG and 10 MWT in a randomized order. The tests were performed in the sequence in which the subjects drew their names from a hat at

the beginning of the testing period. The order of the footwear conditions was counterbalance among the subjects so that all possible sequences of footwear conditions were equally represented.

To avoid undue fatigue, subjects rested 3 minutes between different footwear conditions and 1 minute between different functional measurements. For the first footwear condition, one therapist had explained each test and demonstrated it in a standardized manner. For the 2 following footwear conditions, the therapist repeated the explanation but did not demonstrate the test. All subjects were received the same number of practice and test trials for all footwear conditions. Three trials were given for each test and average of three trials was noted by therapist for all footwear conditions. One way repeated measure ANOVA and post-hoc analysis were done by SPSS 20.

## RESULTS

**Table 1: Demographic and footwear characteristics of subjects**

		No. of Subject (n=50)
Living with family	Yes	50
	No	00
History of fall in one year	Yes	05
	No	45
Diabetes	Yes	16
	No	34
Hypertension	Yes	12
	No	38
Heart Problem	Yes	4
	No	46
Cholesterol	Yes	2
	No	48
Spectacles	Yes	13
	No	37
Cataract operation	Yes	28
	No	12
Presence of foot deformity	Yes	00
	No	50
Use of mobility aids	Yes	05
	No	45
Type of walking shoes:	Lace	02
	Velcro	05
	Shoes without lace & Velcro	43
Heel height(cm)	<2.5	11
	2.5-5	39
	>5	00
Shoe sole	Treaded	40
	Non Treaded	10
Usual footwear sole	Treaded	34
	Non Treaded	16
Usual footwear (slippers) sole characteristics	Soft sole	22
	Hard sole	28
Sole flexibility	>45 degree	18
	<45 degree	32

A total number of 50 older males participated in this study. All the subjects had completed all three tests without any difficulty. The mean age of all subjects was 70.8 and

standard deviation was 6.822. All the tests were performed by subjects with 3 different type of footwear condition (barefoot, walking shoes and usual footwear [slipper]) and results were noted by therapist. Details of Demographic and footwear characteristics of subjects are described in table 1. One way repeated measure ANOVA showed that there was a significant difference between each footwear condition for all 3 tests.

The descriptive statistics for the FRT, TUG and 10 MWT scores under the 3 footwear conditions are documented in Table 2. Results also showed that walking shoes ( $8.772 \pm 2.35$ ) were having superior score than the barefoot ( $8.312 \pm 2.30$ ) & usual footwear ( $8.356 \pm 2.17$ ) for FRT as well as for TUG (walking shoes  $10.72 \pm 1.898$ , barefoot  $11.54 \pm 2.213$  & usual footwear  $11.31 \pm 1.794$ ) and for 10 MWT (walking shoes  $5.234 \pm 0.746$ , barefoot ( $5.706 \pm 0.968$ ) & usual footwear  $5.534 \pm 0.759$ ). Post-hoc analysis was performed to determine which footwear condition resulted in significantly better scores than other two footwear conditions.

**Table 2: One way repeated measure ANOVA for the FRT, TUG and 10 MWT scores under the 3 footwear conditions**

	Mean (SD)	Lower 95% CI	Upper 95% CI	p value	F value
<b>Functional reach test(cm)</b>					
Bare foot walking	8.312 (2.298)	7.659	8.965	0.0146	4.415
Walking shoes	8.772 (2.345)	8.106	9.438		
Usual foot wear	8.356 (2.169)	7.740	8.972		
<b>Time up and go test(sec)</b>					
Bare foot walking	11.54 (2.213)	10.90	12.17	0.0008	7.680
Walking shoes	11.72 (1.898)	10.18	11.27		
Usual foot wear	11.31 (1.794)	10.80	11.83		
<b>10 meter walk test(sec)</b>					
Bare foot walking	5.706 (0.9684)	5.434	5.978	<0.0001	19.37
Walking shoes	5.234 (0.7466)	5.024	5.440		
Usual foot wear	5.534 (0.7596)	5.320	5.748		

In post hoc analysis for FRT, walking shoes ( $8.772 \pm 2.35$ ) were statistically better than barefoot ( $8.312 \pm 2.30$ ) ( $p<0.05$ ), walking shoes ( $8.772 \pm 2.35$ ) were statistically better than usual footwear (slippers) ( $8.356 \pm 2.17$ ) ( $p<0.05$ ) and no statistically significant difference was noted between barefoot and usual footwear (slippers) ( $p>0.05$ ). For TUG and 10 MWT lesser the score of mean greater the improvement in gait. For TUG and 10 MWT same results were found in post hoc analysis. (Walking shoes vs barefoot ( $p<0.05$ ); walking shoes vs usual foot wear

( $p<0.05$ ) and barefoot vs usual footwear ( $p>0.05$ )).

## DISCUSSION

The results of the present study showed that there was a significant difference between each footwear condition for all 3 tests (FRT, TUG and 10 MWT). Post-hoc analysis revealed that walking shoes were having significant superior score than the barefoot & usual footwear for all 3 tests.

Results from this study are consistent with previous studies<sup>1,29-31</sup>. Shoes were an important element in development of human posture<sup>29</sup>. An increase in stability whilst wearing shoes rather than in bare feet could be explained by three hypotheses<sup>30</sup>. First, the greater shoe ground contact area compared to bare feet could result in the measurement of an increase in the support base. Second, the increased sole width of shoes, compared to when barefoot could increase the base of support to avoid contact between feet. Third, shoes could act as a sensory filter by reducing proprioceptive feedback, and leading to posture modifications to improve stability<sup>31</sup>.

The better performance in walking shoes compared with barefoot is consistent with the results from Dobbs et al<sup>32</sup>, who reported faster self – selected walking speeds in shoes as compared with barefoot in subjects up to 89 years of age. The shock absorption provided by walking shoes may allow people to walk faster without increasing the impact loading of the body.

Results from this study are not consistent with previous studies<sup>33-35</sup>. Lord et al.<sup>33</sup> found that in a convenience sample of 30 elderly women (mainly recruited from a hostel for aged persons providing domestic care and with a mean age of 79 years), balance was best when barefoot. These studies suggest that the relationship between footwear and balance is more complex than previously suspected being affected by patient frailty, barefoot balance and type of balance tested. It is possible that patients with poorer balance have deficits in foot and ankle architecture that are compensated for by footwear, whereas more independent subjects have a reduction in balance due to reduced proprioception while wearing shoes, although this warrants further investigation.

Koepsell et al.<sup>34</sup> examined the risk of falls in a Washington state sample of community-dwelling older adults in relation to footwear in fallers and matched controls and found that fall risk was markedly increased when participants were not wearing shoes. While going barefoot was more common in those who had a gait abnormality and who used a gait aid, the

strong association of risk of fall persisted after controlling for these variables.

The results of this study have several implications for research and clinical practice. Authors assess individuals under three different footwear conditions that they typically encounter in their daily lives. In addition, footwear and testing surface should be described when reporting test results for research or clinical purpose.<sup>30</sup> Results of this study also provide information about the effect of footwear on balance and gait in older males.

Limitations of study were only males individual were recruited and small sample size. All the subjects in the present study were recruited from only one charitable trust. Small sample size limits the generalizability of the results. All subjects in our study were tested in their own walking shoes and usual footwear. Walking shoes and usual footwear characteristics were not specified that could affect the results. Test performance on different floor surfaces was not examined. Future study could also be done to see the effect of different types of walking shoes on balance and gait along with different floor surface considerations.

## CONCLUSION

Results from this study revealed that different footwear had a significant effect on balance and gait (FRT, TUG and 10 MWT) in male individuals. Subjects performed significantly better in the walking shoe condition as compared to the barefoot or usual footwear (slipper) conditions. Footwear intervention should be considered as a way of improving gait and balance in older male individuals.

## ACKNOWLEDGEMENT

Researchers would like to thank all the participants for their kind co-operation and valuable support required for the data collection.

## REFERENCES

1. Notarnicola A, Maccagnano G, Pesce V, Tafuri S, Mercadante M, Fiore A, Moretti B. Effect of different types of shoes on balance among soccer players. *Muscles, ligaments and tendons journal*. 2015 Jul;5(3):208.
2. Carr JH, Shepherd RB, Nordholm L, Lynne D. Investigation of a new motor assessment scale for stroke patients. *Physical therapy*. 1985 Feb 1;65(2):175-80.
3. Arnadottir SA, Mercer VS. Effects of footwear on measurements of balance and gait in women between the ages of 65 and 93 years. *Physical Therapy*. 2000 Jan 1;80(1):17-27.
4. Menant JC, Perry SD, Steele JR, Menz HB, Munro BJ, Lord SR. Effects of shoe characteristics on dynamic stability when walking on even and uneven surfaces in young and older people. *Archives of physical medicine and rehabilitation*. 2008 Oct 31;89(10):1970-6.
5. Lord SR, Bashford GM. Shoe characteristics and balance in older women. *J Am Geriatr Soc*. 1996;44:429–433.
6. Koepsell TD, Wolf ME, Buchner DM, Kukull WA, LaCroix AZ, Tencer AF, Frankenfeld CL, Tautvydas M, Larson EB. Footwear style and risk of falls in older adults. *Journal of the American Geriatrics Society*. 2004 Sep 1;52(9):1495-501.
7. Menz HB, Morris ME, Lord SR. Footwear characteristics and risk of indoor and outdoor falls in older people. *Gerontology*. 2006;52(3):174-80.
8. Larsen ER, Mosekilde L, Foldspang A. Correlates of falling during 24 h among elderly Danish community residents. *Preventive medicine*. 2004 Aug 31;39(2):389-98.
9. Menz HB, Lord SR. Footwear and postural stability in older people. *Journal of the American Podiatric Medical Association*. 1999 Jul;89 (7):346-57.
10. Hijmans JM, Geertzen JH, Dijkstra PU, Postema K. A systematic review of the effects of shoes and other ankle or foot appliances on balance in older people and people with peripheral nervous system disorders. *Gait & posture*. 2007 Feb 28; 25(2):316-23.
11. Lord SR, Sherrington C, Menz HB, Close JC. Falls in older people: risk factors and strategies for prevention. Cambridge University Press; 2007 Mar 1.
12. Robbins S, Gouw GJ, McClaran J. Shoe sole thickness and hardness influence balance in older men. *Journal of the American Geriatrics Society*. 1992 Nov 1;40(11):1089-94.
13. Finlay O. Footwear management in the elderly care program. *Physiotherapy* 1986; 72: 172–78.
14. Sherrington C, Menz HB. An evaluation of footwear worn at the time of fall-related hip fracture. *Age and ageing*. 2003 May 1;32(3):310-4
15. Barbieri EB. Patient falls are not patient accidents. *Journal of gerontological nursing*. 1983 Mar 1;9(3):164-73.
16. Gabell A, Simons MA, Nayak US. Falls in the healthy elderly: predisposing causes. *Ergonomics*. 1985 Jul 1;28(7):965-75.

17. Dyer CA, Watkins CL, Gould C, Rowe J. Risk-factor assessment for falls: from a written checklist to the penless clinic. *Age and ageing*. 1998 Sep 1;27(5):569-72.
18. Menz HB, Morris ME, Lord SR. Footwear characteristics and risk of indoor and outdoor falls in older people. *Gerontology*. 2006;52(3):174-80.
19. Menz HB, Lord SR. Footwear and postural stability in older people. *Journal of the American Podiatric Medical Association*. 1999 Jul;89(7):346-57.
20. Robbins S, Gouw GJ, McClaran J. Shoe sole thickness and hardness influence balance in older men. *Journal of the American Geriatrics Society*. 1992 Nov 1;40(11):1089-94.
21. Horgan NF, Crehan F, Bartlett E, Keogan F, O'grady AM, Moore AR, Donegan CF, Curran M. The effects of usual footwear on balance amongst elderly women attending a day hospital. *Age and ageing*. 2008 Nov 11;38(1):62-7.
22. Bloom S. The frail and institutionalized elderly. *Geriatric physical therapy*. 1993;391-403.
23. Kane RL. Beyond caring: the challenge to geriatrics. *Journal of the American Geriatrics Society*. 1988 May 1;36(5):467-72.
24. Lewis C, Bottomley J. Assessment instruments. In: Lewis C, Bottomley J, eds. *Geriatric Physical Therapy: A Clinical Approach*. East Norwalk, Conn: Appleton & Lange;1994:139-186
25. Arnadottir SA, Mercer VS. Effects of footwear on measurements of balance and gait in women between the ages of 65 and 93 years. *Physical Therapy*. 2000 Jan 1;80(1):17-27.
26. Weiner DK, Duncan PW, Chandler J, Studenski SA. Functional reach: a marker of physical frailty. *Journal of the American Geriatrics Society*. 1992 Mar 1; 40(3):203-7.
27. Schoppen T, Boonstra A, Groothoff JW, de Vries J, Göeken LN, Eisma WH. The Timed “up and go” test: reliability and validity in persons with unilateral lower limb amputation. *Archives of physical medicine and rehabilitation*. 1999 Jul 1; 80(7):825-8.
28. Peters DM, Fritz SL, Krotish DE. Assessing the reliability and validity of a shorter walk test compared with the 10-Meter Walk Test for measurements of gait speed in healthy, older adults. *Journal of geriatric physical therapy*. 2013 Jan 1;36(1):24-30.
29. Murphy K, Curry EJ, Matzkin EG. Barefoot running: does it prevent injuries?. *Sports Medicine*. 2013 Nov 1;43(11):1131-8.
30. Menant JC, Perry SD, Steele JR, Menz HB, Munro BJ, Lord SR. Effects of shoe characteristics on dynamic stability when walking on even and uneven surfaces in young and older people. *Archives of physical medicine and rehabilitation*. 2008 Oct 31;89(10):1970-6.
31. Lieberman DE, Venkadesan M, Werbel WA, Daoud AI, D'Andrea S, Davis IS, Mang'Eni RO, Pitsiladis Y. Foot strike patterns and collision forces in habitually barefoot versus shod runners. *Nature*. 2010 Jan 28; 463(7280):531-5.
32. Dobbs RJ, Charlett A, Bower SG et al. Is this walk normal? *Age Ageing*. 1993 22:27-30.
33. Lord SR. Shoe characteristics and balance in older women. *Journal of the American Geriatrics Society*. 1996 Apr 1;44 (4):429-33.
34. Koepsell TD, Wolf ME, Buchner DM, Kukull WA, LaCroix AZ, Tencer AF, Frankenfeld CL, Tautvydas M, Larson EB. Footwear style and risk of falls in older adults. *Journal of the American Geriatrics Society*. 2004 Sep 1;52(9):1495-501.
35. Shinohara J, Gribble P. Five-toed socks decrease static postural control among healthy individuals as measured with time-to-boundary analysis. In2009 American Society of Biomechanics Annual Meeting. State College, PA 2009.

## A STUDY TO FIND OUT RELIABILITY AND CONCURRENT VALIDITY OF FULLERTON ADVANCED BALANCE SCALE FOR ASSESSMENT OF FUNCTIONAL BALANCE IN INDEPENDENT OLDER ADULTS IN INDIA - AN OBSERVATIONAL STUDY

SNEHA CHAUHANI, RAJESH PADNANI<sup>2</sup>

1. M.PT Student in Neurological condition, Shree K.K Sheth Physiotherapy College, Rajkot
2. Assistant professor, Shree K.K Sheth Physiotherapy College, Rajkot

### ABSTRACT

**Context:** Falls are a common and often devastating problem among older people, causing a tremendous amount of morbidity, mortality and use of health care services including that most effective and cost-effective fall reduction programs have involved systematic fall risk assessment and targeted interventions, exercise programs and environmental-inspection and hazard-reduction programs.

**Aim:** The aim of the study was to find out reliability and con-current validity of Fullerton advance balance scale for assessment of functional balance in independent older adults.

**Settings and Design:** An observation study was carried out in Shree K.K Sheth physiotherapy college, Rajkot.

**Method and Material:** For measure reliability and validity of FAB Scale 40 (Male-24, Female-16) older adults should be taken. Intrarater reliability FAB Scale measured by rater A1 and after 24 hour by same rater A2. For concurrent validity of BBS score has been taken at first day by rater A1.

**Statistical analysis:** Data was analyzed by using SPSS Version 20. Intra rater reliability and concurrent validity of FAB Scale were assessed by Spearman's correlation coefficient.

**Results:** Spearman's correlation coefficient value for Intra rater reliability is 0.954 and concurrent validity is 0.847 which show moderately positive correlation of Intra rater reliability and concurrent validity of Fullerton Advanced Balance Scale with Berg Balance Scale.

**Conclusion:** The Fullerton Advanced Balance Scale appears to be reliable and valid test to independent older adults affect movement to walk over obstacles, anticipatory control, dynamic gait and reactive postural control in various directions. The FAB Scale is an easy-to-administer, less equipment use and less time consuming clinical test with concurrent validity, intra rater reliability for assessment of functional balance in independent older adults in India.

**Keywords:** Older adults; Intra rater reliability; Concurrent validity; Fullerton Advanced Balance Scale (FAB); Berg Balance Scale (BBS)

### INTRODUCTION

Definition of the Elder is the frequent presence of multiple pathology and the atypical way in which illness can present with confusion, falls and loss of mobility and day-to-day functioning<sup>1</sup>.

In three division of elder are; Young-old group consists of the population between 65 and 75, in Middle-old group consists between 75 and 85 and old-old group consists between older than 85 years of age<sup>1</sup>.

The number of persons above the age of 60 years is fast growing, especially in India. India as the second most populous country in the world has 76.6 million people at or over the age of 60 constituting above 7.7% of total population<sup>2</sup>.

Falls are an important cause of morbidity and mortality in the elderly. Most often the cause of fall is multifactorial. Falls and their sequel are potentially preventable and hence it is of importance to know the risk factors for falls in the elderly several promising strategies such as

exercise programs, environmental modification, and other educational opportunities for preventing falls and fractures exist<sup>2</sup>.

Fullerton Advanced Balance (FAB) Scale was developed by Debra Rose. FAB scale to develop a new balance assessment tool that could be used to identify balance problems of varying severity in functionally independent older adults and also evaluate more of the system (eg, sensory, musculoskeletal, neuromuscular) that might be contributing to balance problems. One of the advantages of the FAB scale is that it is quick to administer, requiring approximately 10 to 12 minutes. In contrast to the BBS, which is comprised of 14 test items, the FAB scale has only 10 test items. Each item is scored from 0-4. The maximum score is 40 points<sup>3</sup>.

Patrick D. Neuls et al, (2011), did a systemic review on usefulness of the Berg Balance Scale to predict falls in the elderly and concluded that The Berg Balance Scale is used to help identify and measure changes to elderly clients fall risk as a part of a total balance evaluation and used in conjunction with other tests or measures as a total balance assessment<sup>4</sup>. In BBS, a subject is assessed with 5 point ordinal scale ranging from 0 to 4 with higher scores

Corresponding author: Sneha Chauhan  
Email id: chauhansneha73@gmail.com

awarded on the basis of speed, stability or degree of assistance required for completion of the task<sup>5</sup>.

### NEED FOR THE STUDY

There are already many ways of measuring balance, but very less are suitable for use in the clinical setting to assess functional balance, the effects of individual rehabilitation interventions or to measure change over a short term.

The Fullerton Advanced Balance Scale is convenient, quick, more challenging, easy to access with periodically and simple to administer for functional balance evaluation in independent older adults in India.

There is no study which finds the reliability and con-current validity of Fullerton Advance Balance Scale with Berg balance Scale. So, the purpose of this study was to find concurrent validity and reliability of The Fullerton Advanced Balance Scale for assessment of functional balance in independent older adults in India.

### AIM OF THE STUDY

The aim of the study was to find out reliability and con-current validity of Fullerton advance balance scale for assessment of functional balance in independent older adults in India.

### OBJECTIVES OF THE STUDY

- To assess intra-rater reliability of the Fullerton advanced balance scale for assessment of functional balance in independent older adults in India.
- To assess concurrent validity of the Fullerton advanced balance scale for assessment of functional balance in independent older adults in India.

### MATERIAL AND METHODS

**STUDY SETTING:** Shri K.K. Sheth Physiotherapy Centers, Rajkot

**STUDY DESIGN:** An Observational study

**METHOD OF COLLECTION OF DATA:**

Source of data collection: Shree K. K. Sheth Physiotherapy center, Rajkot

Study population: Independent Older adults

Sampling method: Purposive sampling

Sample size: 40 subjects

Materials to be used: FIG: 1 (a - b)

- Consent form , Measurement form, Pencil and Pen
- 12 inch ruler
- 6 inch high stool
- Stop Watch

- Measure tape
- Chair
- Foam Surface
- Mini Mental Status Examination Scale
- Fullerton Advanced Balance Scale
- Berg Balance Scale

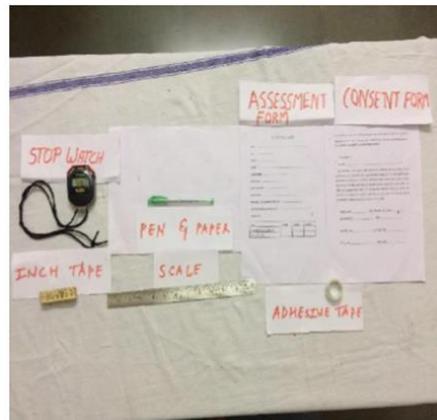


FIG: 1(a) Material used in the study



FIG: 1(b) Foam Surface and 6 inch High stool used in the study

### Criteria for selection

#### *Inclusion Criteria*

- Age - 66 to 85 years.<sup>1</sup>
- Gender: both males and females.
- Subjects with normal cognitive function (MMSE >23)
- Independently Ambulatory older without use of assistance device

#### *Exclusion Criteria*

- Subjects with history of any recent surgeries in low back and lower limbs.
- Subjects with history of any recent musculoskeletal injuries like fractures, dislocation, joint instability or any soft tissue injuries no with other form of neurological impairments.
- Hemodynamically unstable patients.

- Uncooperative patients or patient who is not willing to participate.

## MEASUREMENT PROCEDURE

- The subjects have been selected on the basis of inclusion and exclusion criteria.
- Before starting the study, brief assessment has been done by Mini Mental State Examination and written consent was taken from the subjects.
- Patients were then explained about the test and procedure to be conducted Fullerton Advanced Balance Scale conducted to check Functional balance in older adults. The FAB Scale was conducted twice by same rater (Rater A1 and Rater A2) at different time (after 24 hours of duration). BBS was taken to find out concurrent validity by rater A1.

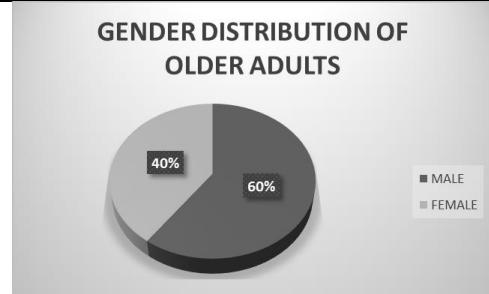
## RESULTS

All the statistical analysis was done by Statistical Package for the Social Sciences (SPSS) statistical software version 20.0 for windows.

Intra rater reliability and concurrent validity of FAB Scale were assessed by Spearman's correlation coefficient. Level of significance (p value) was set to 0.01 level.

**Table 1 - Age distribution of Older adults (years)**

AGE GROUP (YEARS )	NO OF SUBJECTS
66 - 70	29
71 - 75	7
76 - 80	4
81 - 85	0
TOTAL	40
MEAN±SD	69.675 ± 3.878



**Graph 1- Pie chart showing gender distribution of the older adults**

**Table 2:- Mean value and Standard Deviation of Fullerton Advanced Balance Scale and Berg Balance Scale in older adults**

Outcome Measure	Rater	Mean	Standard deviation
Fullerton Advanced Balance Scale	Rater A1	30.325	± 5.244
Fullerton Advanced Balance Scale	Rater A2	30.600	± 5.550
Berg Balance Scale	Rater A1	49.550	± 4.037

**Table 3:- Spearman correlation coefficient showing Intra rater reliability and concurrent validity of Fullerton Advanced Balance Scale with Berg Balance Scale of older adults**

Measure	Spearman Correlation Coefficient	P value
Intrarater Reliability	**0.954	0.000
Concurrent Validity	**0.847	0.000

\*\* Correlation is significant at the 0.01 level (p value <0.01)

Interpretation: table shows moderate positive correlation of Intra rater reliability and concurrent validity of Fullerton Advanced Balance Scale with Berg Balance Scale.

## DISCUSSION

This study was conducted to check reliability and con-current validity of the Fullerton advanced balance scale for assessment of functional balance in post independent older adults in India.

In the above study the results for intrarater reliability and concurrent validity suggested moderate positive correlation with Rater A1 and Rater A2 both which suggest that functional balance can reliably and validly be measured in independent older adults by using Fullerton Advanced Balance Scale.

Balance impairments increase fall risk, resulting in high economic costs and social problem. Decreased muscle strength, range of movement, abnormal muscle tone, motor coordination, sensory organization, cognition, and multisensory integration can contribute to balance disturbances at different levels<sup>6</sup>.

Result of present study suggested that Fullerton advanced Balance Scale is reliable and valid tool to asses balance in post stroke patients and this is supported by a study done by Debra J. Rose in 2006 et al; Development of a Multidimensional Balance Scale for Use With Functionally Independent Older Adults and concluded that Preliminary results suggest that the FAB scale is a valid and reliable assessment tool that is suitable for use with functionally independent older adults residing in the community<sup>7</sup>.

Item 10 (reactive postural control) was found to measure a balance-control mechanism different from that measured by the other nine FAB scale items. Item 10 is intended to measure an individual's ability to respond quickly to an unexpected loss of balance using a protective and involuntarily controlled righting response<sup>8</sup>.

During the study it was observed that in FAB Scale Item 4 (Step up over bench), Item 5 (Tandem walk), Item 6 (Stand on one leg) and Item 8 (Two footed jump) are more difficult in

subjects. It is more challengeable items to perform in older adults.

Penelope J. Klein et al, (2009), conducted a study on research analysis of the Fullerton advanced balance scale and concluded that the scale appears to be a reliable and valid tool to assess balance function in older adults. The test was found to discriminate among participants of varying balance abilities. It also determine the test is for diagnostic prescriptive utility<sup>8</sup>.

The present study finding suggests that Fullerton Advanced Balance scale is reliable and valid scale to measure Functional balance in independent older adults in India.

## LIMITATION OF THE STUDY

Small sample size, Inter-rater reliability, specific age criteria for independent older adults was not taken in to consideration.

## FURTHER RECOMMENDATION

Study can be performed in specific age criteria and Physiotherapist with different years of experience can be taken to check inter rater reliability.

## ACKNOWLEDGEMENT

I am first thankful to Almighty God and my family for blessings. I extend my sincere thanks to my respected teacher Dr. Renuka Dafda. I am also thankful to Prayag Parekh, Sarika Patel and friends for their support.

## CONCLUSION

The Fullerton Advanced Balance Scale appears to be reliable and valid test to independent older adults affect movement to walk over obstacles, anticipatory control, dynamic gait and reactive postural control in various directions. The FAB Scale is an easy-to-administer, less equipment use and less time consuming clinical test with concurrent validity, intra rater reliability for assessment of functional balance in independent older adults in India.

## CONFLICT OF INTEREST

Nil.

## SOURCE OF FUND

No fund was needed.

## ETHICAL CLEARANCE

From Shree K.K. Sheth Physiotherapy College, Rajkot.

## REFERENCES

1. Narinder Kaur Multani, Satish Kumar Verma; Principles of Geriatric Physiotherapy; First Eddition: Jaypee brothers; 2007
2. Dr. B. Krishnaswamy, Dr. Gnanasambandam Usha; Falls in older people national/ regional review india
3. Debra J. Rose, Nicole Lucchese, Lenny D. Wiersma ; Development of a Multidimensional Balance Scale for Use With Functionally Independent Older Adults, American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation 2006
4. Patrick D. Neuls et al. Usefulness of the Berg Balance Scale to Predict Falls in the Elderly J Geriatr Phys Ther 2011;34:3-10
5. Katherine Salter (cand.) et al. Outcome Measures in Stroke Rehabilitation chapter: 21, in October 2013.
6. Clarissa Barros de oliveria, Italo Roberto torres de Mdeiros, Norberto Anizio Ferreira Forta;Balance control in hemiparetic stroke patients: main tools for evaluation; journal of rehabilitation and research & development 2008;45(8):1215-26.
7. Debra J. Rose, Nicole Lucchese, Lenny D. Wiersma ; Development of a Multidimensional Balance Scale for Use With Functionally Independent Older Adults, American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation 2006
8. Penelope J. Klein, Roger C. Fiedler, Debra J. Rose Rasch Analysis of the Fullerton Advanced Balance (FAB) Scale Physiother Can. 2010;preprint, doi:10.3138/ptc.2009

## A STUDY TO FIND OUT EFFECTS OF NEURODEVELOPMENT THERAPY ON HEAD AND SEGMENTAL TRUNK CONTROL TRAINING IN CEREBRAL PALSY: AN INTERVENTIONAL STUDY

RAJESH PADNANI<sup>1</sup>, SNEHA CHAUHAN<sup>2</sup>

1. Associate professor, Shree K.K Sheth Physiotherapy College, Rajkot
2. M.P.T. Student in Neurological condition, Shree K.K Sheth Physiotherapy College, Rajkot

### ABSTRACT

**Context:** Neurodevelopmental treatments are an advanced therapeutic approach practiced by experienced occupational therapists for the rehabilitation of children with cerebral palsy. The primary challenge in children with cerebral palsy is gross motor dysfunction.

**Aim:** To find out effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

**Settings and Design:** The interventional study was carried out in Shree K.K Sheth physiotherapy college, Rajkot.

**Method and Material:** Neurodevelopment therapy (NDT) has been given to total 10 subjects (6 males and 4 females) with 2 to 6 years of age for treatments were scheduled for three- one-hour sessions per week for 3 months.

**Statistical analysis:** Data was analyzed by using SPSS Version 20. Paired t- test was used to find out effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

**Results:** Statistically is significant ( $p>0.05$ ) effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

**Conclusion:** There is significant effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy. Therefore, neurodevelopment therapy can be used with conventional therapy on head and segmental trunk control training in cerebral palsy.

**Keywords:** Cerebral Palsy (C.P); neurodevelopment therapy (NDT).

## INTRODUCTION

Cerebral palsy (CP) is defined as a non-progressive neurological disorder resulting in movement and posture disability. The treatment goal of CP is to improve the motor function through physical therapy, including muscle strengthening, endurance exercise, and range of joint motion exercise<sup>1</sup>.

CP is not a single disease but a name given to a wide variety of static neuromotor impairment syndromes occurring secondary to a lesion in the developing brain. The damage to the brain is permanent and cannot be cured but the consequences can be minimized. Progressive musculoskeletal pathology occurs in most affected children. The lesion in the brain may occur during the prenatal, perinatal, or postnatal periods. Any nonprogressive central nervous system (CNS) injury occurring during the first 2 years of life is considered to be CP. Cerebral Palsy is a common problem, the worldwide incidence being 2 to 2.5 per 1000 live births<sup>2</sup>.

Neurodevelopmental Treatment (NDT), originally known as Bobath Therapy, is a treatment approach which evolved out of the practice of Mrs. Beata and Dr. Karel Bobath.<sup>3</sup> NDT is an eclectic approach which has adapted its treatment emphasis over the years in response to increased knowledge of the pathophysiology of

neurological conditions and a growing understanding of therapeutic effects. However, the Bobath's underlying premise that treatment should always be aimed at improving function.

Various methods of physical therapy are known for CP children. Among these, neurodevelopmental treatment (NDT) has achieved global acceptance since 1940. Based on a reflex/hierarchical model, NDT inhibits the abnormal movements and promotes normal movements by stimulating key points of motion, and also emphasizes in developing automatic righting reaction. Nowadays, NDT is widely used to treat CP patients, and also has a positive effect in patients with developmental delay (DD) other than CP<sup>1</sup>.

The Gross Motor Function Measure (GMFM-88), Pediatric evaluation of disability Inventory (PEDI), Denver Developmental screening test (DDST) and Postural assessment scale (PAS) has been developed as an evaluative measure capable of detecting change in the gross motor function of children with cerebral palsy<sup>3</sup>.

The GMFM (GMFM-88) is a clinical measure designed to assess gross motor abilities of children with CP in five dimensions: (1) Lie and Roll, (2) Sit, (3) Crawl and Kneel, (4) Stand, and (5) Walk, Run and Jump (13). In children with CP, the GMFM has been shown to be sensitive to change during periods of therapy<sup>4</sup>.

According to Bobath, once the reflex patterns of abnormal tone are inhibited the child is said to have been prepared for movement.

Corresponding author: Dr. Rajesh Padnani  
Email id: rajeshgpadnani@yahoo.co.in

Reflex inhibitory patterns specifically selected to inhibit abnormal tone associated with abnormal movement patterns and abnormal posture.

Sensory motor experience – The reversal or break down of these abnormalities gives the child the sensation of more normal tone and movements.

The therapist tries to attempt to change the patterns of spasticity so that child is prepared for movement and mature postural reactions uses key-points of control.

The key-points are usually head & neck, shoulder & pelvic girdles, but there is also work from distal key- points.

## NEED FOR THE STUDY

Conventional physiotherapy techniques have been proved to be effective, but there are few studies available in India showing effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

So the need of the study is effects of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

## AIM OF THE STUDY

To find out effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

## OBJECTIVES

- To measure GMFM-88 score before 3 month of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.
- To measure GMFM-88 score after 3 month of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.
- To measure difference between GMFM-88 score before and after 3 month of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

## HYPOTHESIS

### *Null hypothesis*

There is no effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

### *Experimental Hypothesis*

There is a significant effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

## MATERIALS ANDMETHOD

Source of data collection: Shree K. K. Sheth Physiotherapy center, Rajkot

Study population: cerebral palsy

Sampling method: Purposive sampling

Study type: An interventional study

Sample size: 10 subjects

## CRITERIA FOR SELECTION

### *Inclusion Criteria*

- Diagnosis of cerebral palsy (patient's diagnosis of Cerebral Palsy confirmed by an expert paediatrician neurologist).
- Between 2–6 years of age
- Taking physiotherapy for last 3 months and indicated for further physiotherapy treatment.

### *Exclusion Criteria*

- subjects who have undergone medical procedures likely to affect motor function such as botulinum toxin injections
- Severe abnormalities such as seizure
- No participation in other therapeutic programs
- orthopedic surgery
- Learning disability<sup>4</sup>.

## MEASUREMENT PROCEDURE

The patients have been selected on the basis of inclusion and exclusion criteria.

Before starting the study consent was taken from the Parents.

Prior and after 3 month of NDT approach GMFM-88 Score has been taken in subjects.

In each session, Treatments were scheduled for three- one-hour sessions per week for 3 months. exercises should be included that sustaining themselves on their forearms and hands, sitting, crawling, semi-kneeling and in standing positions supported by the therapist until tone reduction has been achieved. Balance and corrective reactions were developed by using a vestibular ball and tilt board after the children had acquired the skill of maintaining exercise positions. Ambulation training, appropriate to the motor development level (crawling, creeping, walking while in a semi-kneeling position, and walking between parallel bars) was given. Additionally, the NDT program included passive stretching of the lower limb muscles (e.g. hamstrings, Calf)<sup>4</sup>.

## RESULTS

Data was analyzed by using SPSS Version 20. Paired t- test was used to find out effect of NDT in 10 (Male-6 and Female-4) CP patients. In this test t value is -3.934 and level of significance is 0.003 that is less than 0.05.

**Table 1: Age and gender group distribution**

Age group	Male	Female	Total
2-3	5	3	8
3.1-4	1	1	2

**Table 2: Paired t test for pre and post GMFM-88 Score**

	Paired Differences				t	df	Sig. (2-tailed)
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower			
pre	-18.5	14.87	4.70	-29.13	-7.86	-3.93	9
post							0.003

## DISCUSSION

Aim of the study was to find out effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy. This study concludes that there is significant effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy.

Arndt et al (2008) evaluated the efficacy of a neurodevelopmental treatment based sequenced trunk activation protocol for changes in the GMF of infants with posture and movement dysfunction, their results showed that the NDT-based protocol group made significantly more progress than the control group from pre-test to posttest<sup>5</sup>. This is supportive study for present study. Cbrrie Reye et al, (1968) conducted that Neuro-developmental approach to the treatment of Cerebral palsy and concluded that NDT is more effective in Cerebral palsy. An attempt has been made to assess the value of a neuro-developmental approach in the treatment of children with cerebral palsy. Some ‘facilitation’ techniques used to encourage automatic postural reactions are mentioned and it is emphasized that these patterns are more easily established in the very young before the increased tone or fluctuation of tone has become well established<sup>6</sup>.

Carolyn Ann et al, (1997) conducted that the effect of neurodevelopmental treatment on gross motor function and ambulation in children with cerebral palsy and conclusion that The results of this study indicated that NDT effected a trend of improved gross motor function for three of the four participants; this was statistically significant for two of the four children The gait analysis suggested that each participant improved on at least one gait variable<sup>3</sup>.

Heba M Youss El-Basatiny et al, (2015) conducted that Effect of Trunk Exercises on Trunk control, Balance and Mobility Function in Children with Hemiparetic Cerebral Palsy and concluded that Additional trunk exercises to conventional therapy had a beneficial effect in improving trunk control, balance and mobility function in children with spastic hemiparetic

cerebral palsy<sup>7</sup>. Julie Chung, BHK et al, (2008) concluded that Effectiveness of Adaptive Seating on Sitting Posture and Postural Control in Children with Cerebral concluded that s that no single intervention has been shown to be more effective than others in improving sitting posture and postural control. Furthermore, there is limited evidence to suggest whether improved sitting posture or postural control will lead to improved functional abilities<sup>8</sup>.

## LIMITATION OF THE STUDY

Small sample size, specific age criteria and duration after Cerebral Palsy was not taken in to consideration.

## FURTHER RECOMMENDATION

The effect of neurodevelopment therapy on head and segmental trunk control training in other neurological conditions.

## CONCLUSION

There is significant effect of neurodevelopment therapy on head and segmental trunk control training in cerebral palsy. Therefore, neurodevelopment therapy can be used with conventional therapy on head and segmental trunk control training in cerebral palsy.

## CONFLICT OF INTEREST

Nil.

## SOURCE OF FUND

No fund was needed.

## ETHICAL CLEARANCE

From Shree K.K. Sheth Physiotherapy College, Rajkot.

## REFERENCES

1. Kyoung Hwan Lee, Jin Woo Park, MD, Ho Jun Lee, Ki Yeun Nam; Efficacy of Intensive Neurodevelopmental Treatment for Children With Developmental Delay, With or Without Cerebral Palsy; Ann Rehabil Med 2017;41(1):90-96
2. Cerebral Palsy—Definition, Classification, Etiology and Early Diagnosis Chitra Sankar and Nandini Mundkur: Indian Journal of Pediatric 2005; 72 (10): 865-868
3. Carolyn an king; the effect of neurodevelopmental treatment on gross motor function and ambulation in children

- with cerebral palsy: a series of single-subject studies; a thesis submitted to the school of rehabilitation therapy in conformity with the requirements for the degree of Master of Science; 1997
4. Shamsoddini A, Hollisaz MT, Sobhani V, Shakibaee A; Effects of Neurodevelopmental Therapy on Gross Motor Function in Children with Cerebral Palsy. *Iran J Child Neurol.* Spring 2015; 9(1):36-41.
  5. Arndt SW, Chandler LS, Sweeney JK, Sharkey MA, McElroy JJ. Effects of a neurodevelopmental treatment-based trunk protocol for infants with posture and movement dysfunction. *Pediatr Phys Ther.* 2008; 20(1):11-22.
  6. Cbrrie reye; a neuro-developmental approach to the treatment of cerebral palsy a preliminary report. *Ausf. paediat. J.* (1968) 4: 73
  7. Heba M Youssr El-Basatiny, Amr Almaz Abdel-aziem; Effect of Trunk Exercises on Trunk control, Balance and Mobility Function in Children with Hemiparetic Cerebral Palsy; *International Journal of Therapies and Rehabilitation Research* 2015, 4: 5
  8. Julie Chung; Effectiveness of Adaptive Seating on Sitting Posture and Postural Control in Children with Cerebral; *Pediatric Physical Therapy*; 0898-5669/108/2004-0303