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## Effect of Modified Therapeutic Work Program (MTWP) on Work status in Chronic Rheumatoid Arthritis (RA)

Jeetendra Mohapatra

### ABSTRACT

**OBJECTIVE:** 1. To study whether MTWP addressed to enhance the work skills in RA., 2. To evaluate if the program is successful for the client return to work, level of work satisfaction & self-performance level., **METHODS:** **Design-** Single group pre test post test experimental design followed by descriptive analysis with questionnaire., A different subject prospective, experimental, flexible design has been used for the purpose of this study. MTWP has 6 phases with treatment plan based on client capabilities, deficits, interest, work history and goals., **Setting-** Out-patient and in-patient based clinical services at NIOH., **Outcome Measure-** 1 Minnesota Manual Dexterity Test, 2, Hand Dynamometer, 3, Pinch gauge, 4, Short Form-36(version 1) – subjective outcome assessment for functional/ work status., **RESULTS:** The result which was analyzed by using paired t-test, found to be significant ( $p < 0.05$ ) improve in work skill post MTWP., **CONCLUSION:** The MTWP addresses the range of needs demonstrated by RA clients, from traditional therapy to prevocational and vocational intervention. The evaluation of the program indicates that the program was successful with RA working age adult. 72% clients who completed the program returned to work and switched over to different position and different type of work. 44% clients return to competitive employment with same work type, work situation, having work satisfaction and 80-100% work skills in compare to pre-MTWP work situation.

**Keywords** –Therapeutic Work Program, Work status, Rheumatoid Arthritis.

### INTRODUCTION

Rheumatoid arthritis (RA) is a chronic, systemic inflammatory disorder that may affect many tissues and organs, but principally attacks the joints producing an inflammatory synovitis that often progresses to destruction of the articular cartilage and ankylosis of the joints.

About 1% of the world's population is afflicted by rheumatoid arthritis, women three times more often than men. Onset is most frequent between the ages of 40 and 50, but no age is immune. It can be a disabling and painful condition, which

can lead to substantial loss of functioning and mobility (2).

The arthritis of joints known as synovitis, is inflammation of the synovial membrane that lines joints and tendon sheaths. Joints become swollen, tender and warm, and stiffness limits their movement. Most commonly, small joints of the hands, feet and cervical spine are affected, but larger joints like the shoulder and knee can also be involved, differing per individual. Synovitis can lead to tethering of tissue with loss of movement and erosion of the joint surface, causing deformity and loss of function (1).

The non-pharmacological treatment for RA includes physical therapy, orthosis and occupational therapy. Regular exercise is important for maintaining joint mobility and making the joint muscles stronger. The occupational therapist provides hand splint and assistive & adaptive devices to improve hand function (3).

Daily living activities are impaired in most individuals having rheumatoid arthritis. After 5

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years of disease, approximately 33% of sufferers will not be working. After 10 years; approximately half will have substantial functional disability (2).

Several references can be located in the literature mentioning about the work hardening program essentially aimed at improving the productivity, safety, and physical tolerance of the worker having disability (4, 8). Through work hardening program, Occupational Therapy can provide the vital link between the workers functional capacity and specific demands of a job. This link is in the form of a realistic simulation of job tasks and/or by simulation of physical demands of the job, which allow occupational therapist to determine if the worker; can return to the same job, can return to the same job with modification or requires retraining for a different job (6, 7).

Lyons & Morse (1988) developed a Therapeutic Work Program (TWP) to address client's prevocational & vocational needs, with prevocational and vocational intervention to facilitate return to work. As reported by Lyons and Morse, the TWP was originally developed in 1982 at the New England Rehabilitation Hospital by Patricia Harris Minnasian. The program was further developed and refined by Janet Kenig, Maureen Flaherty, and Sharon Engelhardt (5).

The current study is primarily based on the concept of TWP. However it is intended for use on the rheumatoid arthritis clients in combination with traditional therapies.

Traditionally the client having arthritis go through the rehabilitation program without emphasis on the client's ability to return to work. The original Therapeutic Work Program (TWP) has 8 phases, where as in Modified Therapeutic Work Program (MTWP) has 6 phases and it does not include two phases namely; 1.vocational placement 2. Follow-up.

### **AIMS & OBJECTIVE**

To find out effect of the MTWP on work status by addressing subjects prevocational and vocational needs among Rheumatoid arthritis working age adult.

### **Hypothesis**

MTWP has a positive influence on return to work abilities for individuals having Rheumatoid arthritis.

### **Null Hypothesis**

There is no influence of MTWP on work status for individual with Rheumatoid arthritis.

## **METHODOLOGY**

**DESIGN** Single group pre test post test experimental design followed by descriptive analysis by questionnaire.

A different subject prospective, experimental, flexible design has been used for the purpose of this study. MTWP has 6 phases with treatment plan based on client capabilities, deficits, interest, work history and goals.

**SUBJECTS** A total number of 30 subjects affected by RA for more than 5 years having difficulties in performing work were selected for the study. Mean age was 42 years (range 30 to 56 years) having both male and female. Period of study from January 08 to September 08. Clients were explained the purpose of the study and were requested to participate in the study. Written consent obtained from each participant before study begins.

### **Inclusion Criteria**

1. Subject diagnosed as RA by physician.
2. Subject had complained of change in job type or loss of job or difficulties in performing job.
3. Supervised functional mobility in the wheel chair or self ambulatory level.
4. Manageable social behavior.
5. Attention span of 30 minutes in an institutional environment with minimal distraction.
6. Ability to establish goals with guidance.
7. Stanford Arthritis Self-efficacy Function Scale above 5.

### Exclusion Criteria

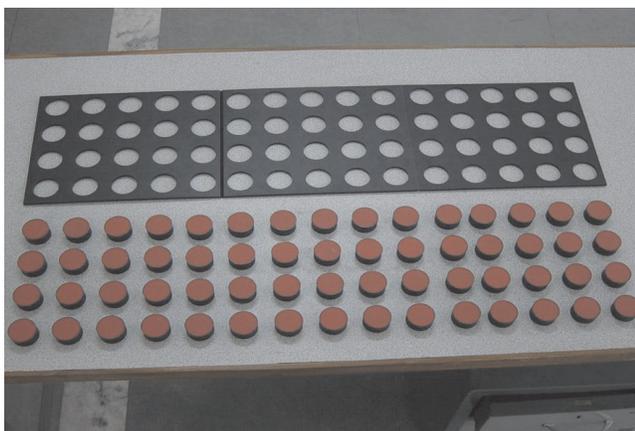
1. Dependent on others in mobility
2. Problematic behavior & Interpersonal skills

### Outcome measure used for work skill assessment

1. Minnesota Manual Dexterity Test, 2. Hand Dynamometer, 3. Pinch gauge, 4. Short Form-36(version 1) – subjective outcome assessment for functional/ work status.

**MMDT:** Minnesota Manual Dexterity Test is a standardized test that measures eye hand coordination and manual dexterity of the arm and

#### Placing Test (PT)



professional societies, the Jamar dynamometer has been shown to be a reliable test instrument, provided calibration is maintained and standard positioning of test subject is followed. This dynamometer has five adjustable spacing at 1, 1.5, 2, 2.5 and 3 inches. The client is shown how to grasp the dynamometer and is requested to grasp it with his or her maximal force. The grip test position should be standardized. The forearm should be in neutral rotation and the elbow flexed 90 degree. The shoulder should be adducted. The wrist should be between 0 and 30 degree of extension and 0 and 15 degree of ulnar deviation. The grip can measure at each of the five-handle spacing.

The right and left hands are tested alternately and the force of each is recorded. The test is placed at a rate to eliminate fatigue. There are 30 brands new dynamometer available in the market and 80% met the correlation criterion of + 0.9994. In

hand for manipulative work. It requires unilateral and bilateral movements while utilizing a broad range of shoulder motion. The Minnesota Manual Dexterity Test incorporates two test batteries namely-Placing Test (PT), Turning Test (TT).The tests include 60 two-colored wooden cylinders, plastic board, record forms, norms and manual with test battery instructions.

#### Hand Dynamometer & Pinch meter

The Hydraulic Jamar grip dynamometer with five adjustable handle spacing provides an accurate evaluation of the force of grip. Developed by Bechtol C. (1954) and recommended by

#### Turning Test (TT)



1978 and 1983, the ASSH recommended that the second handle position be used and average of 3-trials be recorded.

There are three basic type of pinch: (1) Chuck or three finger pinch (Pulp of the thumb to pulp of the index and middle finger) (2) Lateral or key pinch (Prehension of thumb pulp to the lateral aspect of the index middle phalanx) (3) Tip pinch (thumb tip to the tip of the index finger). These 3 types of pinch are usually assessed and can be tested with a pinch meter. As with grip measurement, the mean of 3 trials is recorded and comparisons are made with the opposite hand. Reliability of pinch meter needs investigation. Hydraulic pinch instruments are more accurate than spring loaded.

#### Sf-36(version 1)

SF-36 (John E. Ware, Jr., 1992) is a multi-purpose, short-form health survey with only 36

### Pinch meter



### Hand dynamometer



questions. It yields an 8-scale profile of functional health and well-being scores. The four scales Physical Functioning (PF), Role Physical (RP), Role Emotional (RE) & Social Functioning (SF) correlate most highly with the functional/work status. It is a generic measure, as opposed to one that targets a specific age, disease, or treatment group. Accordingly, the SF-36 has proven useful in surveys of general and specific populations, comparing the relative burden of diseases, and in differentiating the health benefits produced by a wide range of different treatments.

More recently, the SF-36 was judged to be the most widely evaluated generic patient assessed health outcome measure in a bibliographic study of the growth of "quality of life" measures published in the British Medical Journal (Garratt, Schmidt, Mackintosh, & Fitzpatrick, 2002).

### Program discription

The program is designed to help an individual to make a gradual, progressive transition from a medical setting to work placement and community reentry. MTWP has 6 phases. The client functional status and progress were monitored on an ongoing basis, and transition to new phases was determined by the Occupational Therapist and based on the client needs. Not all clients went through each phase or follow the sequence. Client continues with individual

occupational therapy throughout their involvement in the MTWP.

### MTWP Six Phases

**Phase 1-** *Individual assessment and treatment in OT department.*

Individualized assessment by occupational therapist were obtained from Initial general OT assessment format, which includes-

1. Date of onset, participation in MTWP
2. About previous job specification / demand which based on information from Canadian Classification and Dictionary of Occupations.
3. Obtaining background information pertinent to work.
4. FIM for ADL.
5. OT intervention includes joint protection, splinting and remedial activity etc.

### Phase 2- Group treatment

1. In this phase as client progress to higher level of functioning they participate in group treatment.
2. Groups are led by occupational therapist.
3. Emphasis is on interaction and interpersonal skills.

4. Groups are functionally based and focus on area such as functional living skills, energy conservation, debate and effective communication and family education.

### Phase 3 - Prevocational assessment

1. The first two sessions are devoted to a prevocational assessment. These assessments establish a baseline performance level and guides appropriate task selection.

3. The outcome measure as mentioned earlier is used here.

4. It guides appropriate secretarial task, and assembling task to be chosen as per the need of an individual client.

### Phase 4 - Therapeutic work groups

1. All Initial transition from role of client to the role of worker.

2. Client received 5 days per week for 30-minutes daily for 4 weeks.

3. The group structure includes sign an attendance register in and out, a daily routine, involved in variety of secretarial and assembly tasks.

4. Emphasis is on developing prevocational and work readiness skills, not on training for specific job.

### Assembling Task

#### Phase 5 - Work placement within the institute

1. Supervised work placements within the institute are available on block printing, appliqué & computer programming.

2. If only client show interest to participate then posted under vocational counselor for further guidance and training.

*Phase 6 - Back to previous job or supervised placement in community or further education and training.*

### Nut & bolt assembling



### Electric switch assembling



### Pen assembling



### Tightening screw

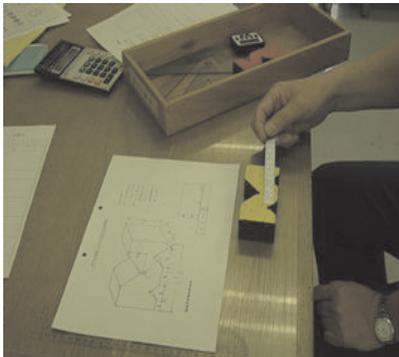


### Toys assembling



### SECRETARIAL TASK

#### Drawing & Designing



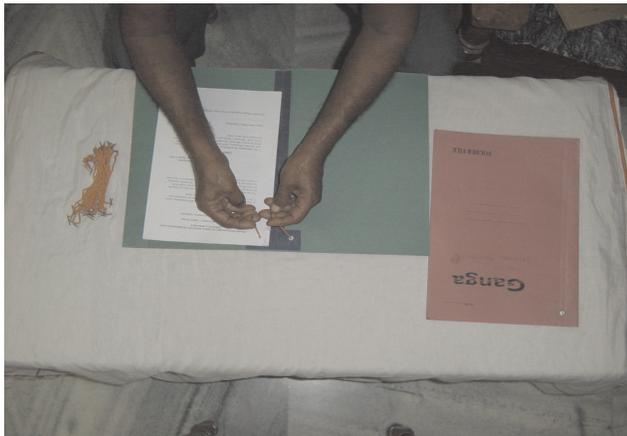
#### Inserting letter



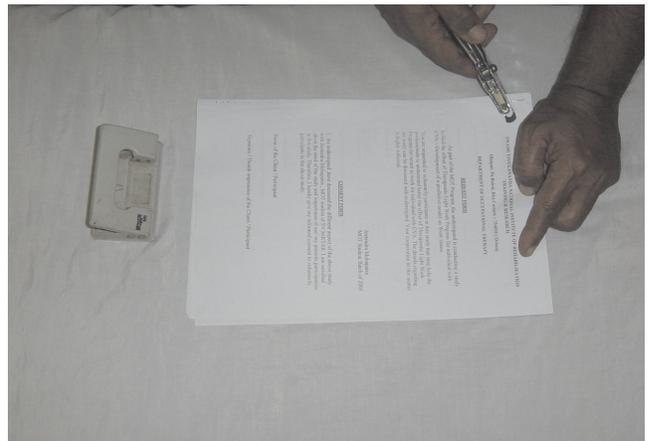
#### Applying stamp



#### Tie and Filling



#### Use Punching Plia



3. Previously employed client go back to their respective job.
4. Supervised placement in community
5. Clients engage in further education and training.

### Data collection evaluation

To evaluate the sustained impact of the MTWP, all clients with RA who have been discharge from it were requested to fill up the questionnaire. Out of the 30 identified, 3 could not be contacted, leaving a total of 27 clients. Information about the clients background, including dates of participation in the MTWP, year of impact by RA were obtained from initial general OT assessment format.

Questionnaire filled up by letter of post/ by email/ by telephone which consist of 21 open

ended and yes/no questions about vocational status, premorbid work history, and work attitudes and problems.

The research question to be evaluated-

1. Whether MTWP addressed, to enhance the OT work skills assessment for RA?
2. To evaluate if the program is successful for the client return to work, level of work satisfaction & self-performance level?

### Data analysis

Calculation was performed in SPSS (version 10). Statistical tests were carried with the level of significance set at  $p < 0.05$ . The independent t-test was used to compare the work skills result between the groups. The change in work skills within pre test and post test were analyzed using the paired t-test.

## DATA COLLECTION

Pre-test	Therapeutic work program Session	Post-test	Follow-up by Questionnaire based on return to work abilities
Pre therapeutic work skills measurement of each dependant variable for 30 clients.	Client engaged for 4 weeks in Therapeutic work group (20 sessions, 1 hour daily).	Work skills measurement of each dependent variable for same 30 clients after the completion of therapeutic work group session.	Questionnaire was used after 3 months since discharge from MTWP to find out work status.

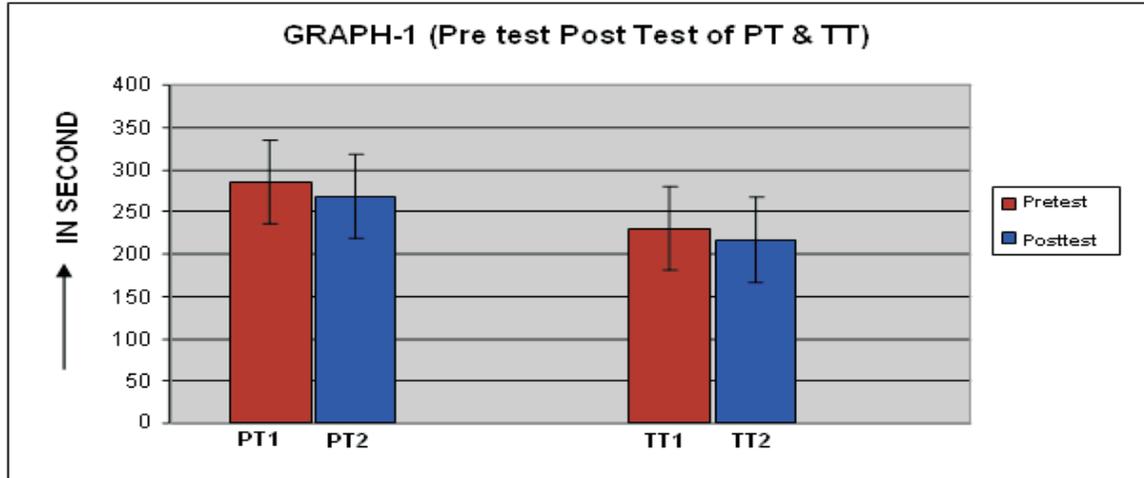
## RESULT & DISCUSSION

Graph 1to 4 shows, the mean pre-therapeutic work skills in compare to mean post therapeutic work skills after 4 weeks during MTWP .

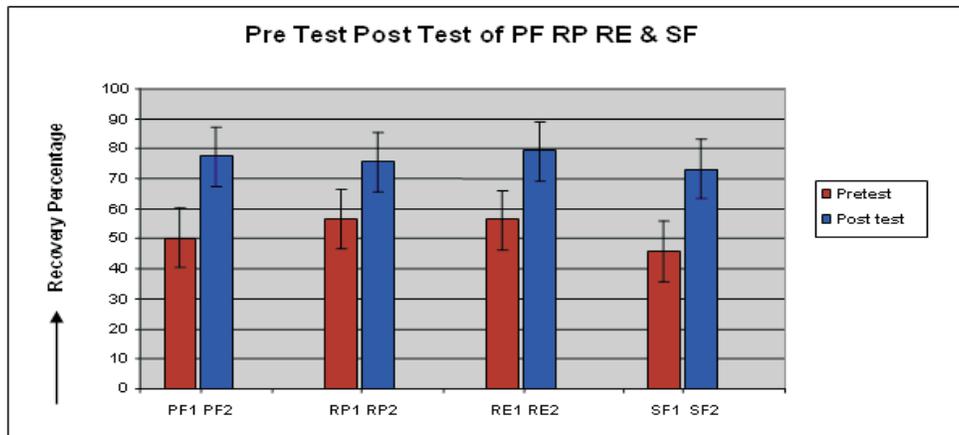
**Table 1 (Demographic Data)**

Sl.No.	Characteristic	Groups
01	No. of Subjects	30
02	Age range	30-56 yrs.
03	Mean age	42
04	Male/Female	15/15
05	Affected by Arthritis in Years	>5 yrs.

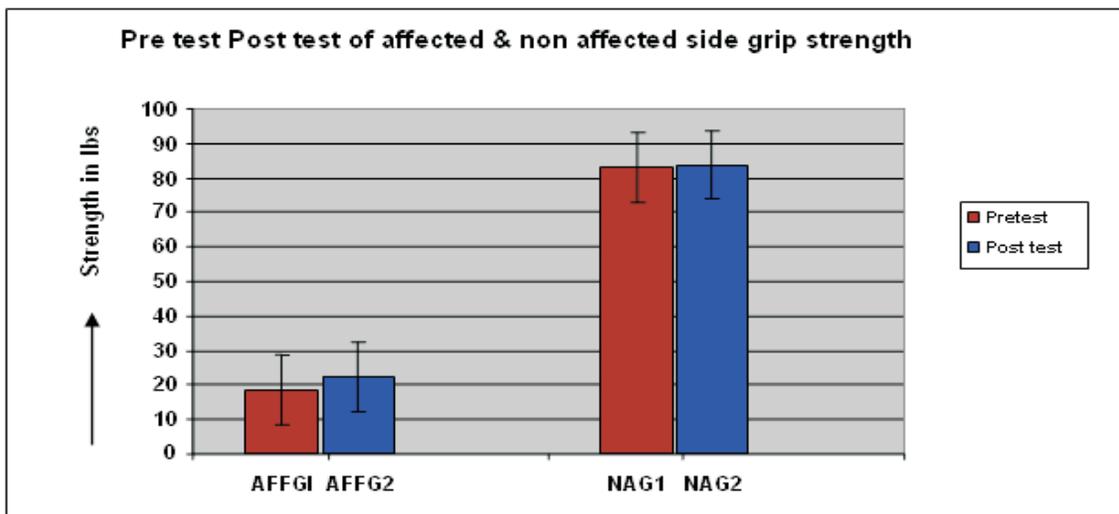
Graph 1



Graph 2



Graph 3



Graph 4

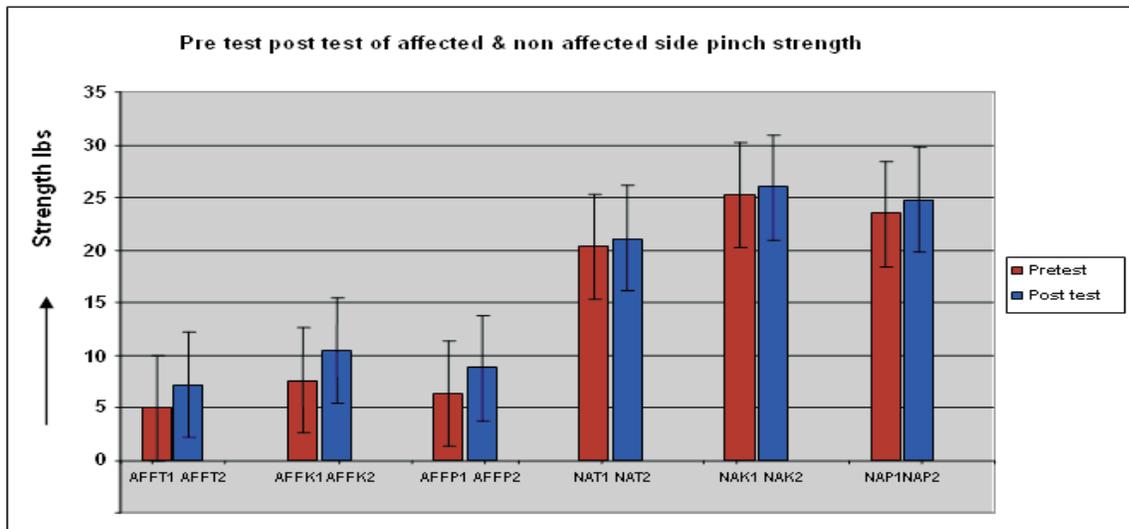


Table 2 (Paired Sample Test)

GROUP	Mean	SD	SE Mean	t	p
Placing Test(PT1-PT2)	15.38	6.34	1.31	12.78	0.01
Turning Test(TT1-TT2)	13.35	6.42	1.16	11.22	0.01
Physical functioning(PF1-PF2)	-24.87	6.46	1.14	-18.11	0.00
Role limitation to Physical Problems(RP1-RP2)	-18.00	7.22	1.50	-12.12	0.00
Role limitation to Emotional Problems(RE1-RE2)	-20.96	7.11	1.35	-14.66	0.00
Social functioning(SF1-SF2)	-22.41	10.21	1.75	-12.78	0.00
Grip strength Rt.( AFFG1-AFFG2)	-3.60	2.48	0.44	-6.92	0.01
Grip strength Lt.( NAG1-NAG2)	-0.62	0.52	0.14	-4.09	0.01
Tip to tip pinch Rt.( AFFTP1-AFFTP2)	-2.10	0.85	0.15	-12.20	0.00
Tip to tip pinch Lt.( NATP1-NATP2)	-0.72	0.66	0.12	-5.20	0.00
Key Pinch Rt.( AFFKP1-AFFKP2)	-2.66	1.22	0.18	-12.36	0.00
Key Pinch Lt.( NAKP1-NAKP2)	-0.62	0.72	0.12	-4.60	0.00
Palmar Pinch Rt.( AFFPP1-AFFPP2)	-2.40	1.02	0.18	-10.80	0.00
Palmar Pinch Lt.( NAPP1-NAPP2)	-1.20	1.62	0.30	-4.00	0.00

Table 2 shows the result which was analyzed by using paired t-test, found to be significant ( $p < 0.05$ ). The result of the analysis shows that there is significant improve in work skill post MTWP.

#### ACKNOWLEDGEMENT

First and foremost, I wish to express my sincere thanks and deepest gratitude to Dr. Ratnesh Kumar, Director, NIOH for his meticulous guidance, constant supervision and permission to carryout my study.

I also thank to Dr. Abhishek Biswas, Asst. Professor, NIOH, for his continuous support in review of literature .Finally I thank my friends, well wishers, occupational therapy students of NIOH and clients for trusting me during the course of my study.

**Table 3: Work status comparison of Pre MTWP and Post -MTWP Subjects (N - 27)**

Work Status	Pre- MTWP	Post -MTWP
Competitive employment	19	23
Homemaker	01	04
Trainee	01	00
Unemployed	06	00

As table-3 shows, out of 27 clients in pre-MTWP stage, 23 were competitively employed and 4 work as primary homemaker after participating in MTWP

**Table 4: Work type comparison of Pre-MTWP (N-21) and Post MTWP (N - 27) Subjects**

Work Type	Pre-MTWP	Present (Post-MTWP)
Managerial	02	07
Heavy labor	01	09
Light Labor	13	07
Student	01	00
Home maker	01	04
Others	03	00

Table-4 shows, the categories of post MTWP work vary from those prior to pre-MTWP. The clients did work that was different from the work they had done prior to the RA.

**Table 5: Work situation comparison preceding MTWP and following MTWP (N-27)**

Work Situation	Number of subjects (N -27)
Same company / Same position	08
Same company/ other position	10
Other company/same work type	02
Other company/other work type	07

Table-5 shows, the comparison of present job with former job. Return to the same or a different company was related to the length of time of prior employment

**Table 6: Number of jobs Held by Subjects since Discharge (N-27)**

Number of jobs	Number of Subjects
1( Full time)	19
2( 1Full time+ 1 Part time)	06
3& more( All Part time)	01
NR	01

Table-6 shows, 19 out of 27 subjects had one jobs, 06 had two jobs, 01 had three or more jobs since discharge from MTWP. The majority of respondent, 25 out of 27 were working 40 or more hours per week.

**Table 7: Subject Work Satisfaction (N=27)**

Liked their jobs	10
Job is challenging & look forward To going to work	08
Did not enjoy their work	05
Home makers want to be involved In competitive employment	03
No response	01

**Table 8: Subjective Work difficulty (N=27)**

Job required more physical demand	05
Job required high cognitive demand	10
Easiest job that repetitious, familiar & required few cognitive & physical demand	12

**Table 9: Self evaluation of job performance**

100 to 80 %of their prior level	08
80 to 65 % of their prior level	05
65 to 50 % of their prior level	08
50 % and below prior level	06

N= 27(comparing their present work skills with their skills prior to MTWP)

## CONCLUSION

The MTWP addresses the range of needs demonstrated by RA clients, from traditional therapy to prevocational and vocational intervention. The evaluation of the program indicates that the program was successful with RA working age adult. 72% clients who completed the program returned to same or modified work, and switched over to different position and different type of work. 44% clients return to competitive employment with same work type, work situation, having work satisfaction and 80-100% work skills in compare to pre-MTWP work situation.

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Happy are those who are concerned for the poor; the Lord will help them when they are in trouble. PS. 41:1

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**Educational Development:** Each child will enroll in school and receive tutoring.

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**Monthly sponsorship is just Rs.400/\$30** and every rupee/dollar you give goes to the Child Sponsorship Program to provide things like education, food, medical care, and spiritual nurturing for your sponsored child. Our general administrative and fund raising costs are covered through other donations.

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## Relationship between neuropathic pain, neurodynamics, sensory perception thresholds and quality of life in patients with painful diabetic peripheral neuropathy- a cross-sectional study., (UTRN 052343809-080920102668203)

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### ABSTRACT

**Background and purpose:** Neuropathic pain (NP) is the most disabling complaint in patients with painful diabetic peripheral neuropathy (PDPN). Neurodynamics (ND) is assessment and treatment of neural tissue mechanosensitivity (NTM). Vibration perception threshold (VPT) is a measure of large fiber function and thermal perception threshold (TPT) is a measure of small fiber function. Quality of life (QoL) is a subjective perception of well-being in a person's living. The purpose of this study was to assess the inter-relationship between NP, NTM, VPT, TPT and QoL in patients with PDPN., **Materials and methods:** Assessor-blinded cross-sectional study with random-order test method was carried out on 112 PDPN patients of either gender (67 female, 45 male) of age ... years with medically diagnosed distal symmetric polyneuropathy for at-least 3 years due to type-2 diabetes for greater than 5 years duration. The NP was assessed using neuropathic pain questionnaire (NPQ); ND assessment comprised of neurodynamic testing (range of motion in degrees) and nerve trunk palpation (presence of mechanical allodynia by clinical scoring) of sciatic, tibial and common peroneal nerves; VPT and TPT (which includes heat perception threshold- HPT and cold perception threshold- CPT) was assessed using biothesiometer; and QoL was measured using neuropathy-specific quality of life (NeuroQoL) instrument. The assessments were done only once per patient. Total assessment duration for each patient was one hour., **Data analysis and results:** All correlations were analyzed using Karl-Pearson's correlation co-efficient at 95% confidence interval using SPSS 11.5 for Windows., **Conclusion:** There was a statistically significant positive correlation found between neuropathic pain, neurodynamic testing, neuropathy-specific quality of life in patients with PDPN.

**Key words:** Diabetic neuropathy, clinical examination correlates, quantitative sensory testing, self-administered questionnaires, manual therapy examination

### INTRODUCTION

Neuropathic pain was defined by International Association for the Study of Pain as "pain caused

or arising from the lesion or dysfunction of the nervous system.<sup>1</sup>" Overall point prevalence estimates for neuropathic pain in general population was shown to be 8.2%.<sup>2</sup> Translating this prevalence to our Indian population of 10.28 billion<sup>3,4</sup> (according to 2001 census of Govt of India), it comes to .84 billion or 84 million people with neuropathic pain. Seven conditions were profoundly associated with disabling neuropathic pain, of which four were peripheral (chemotherapy-induced neuropathy, postsurgical neuropathic pain associated with breast and amputation surgery, post-herpetic neuralgia, and painful diabetic neuropathy) and three were central (post-stroke pain, spinal cord injury pain,

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multiple sclerosis pain).<sup>5</sup> The presence and severity of neuropathic pain was associated with a greater impairment in health-related quality of life of these patients.<sup>6</sup> The intense pain, other troublesome symptoms, limited efficacy and tolerability of available treatments, together with the impaired health and reduced work status, amount to a substantial burden for patients with peripheral neuropathic pain (PNP).<sup>7</sup>

Diabetic neuropathy is a descriptive term meaning a demonstrable disorder, either clinically evident or subclinical that occurs in a setting of diabetes mellitus without other causes of neuropathy. The neuropathic disorder includes manifestations in both somatic and/or autonomic parts of the nervous system.<sup>8</sup> Diabetic peripheral neuropathy is one of the leading peripheral nervous system diseases leading to PNP. Peripheral nervous system dysfunction clinically manifest as peripheral neuropathies in a large proportion of diabetic patients, presenting either as painful or painless neuropathies.<sup>9</sup> Peripheral neuropathic pain often presents as a combination of nerve trunk pain and dysesthetic pain.<sup>10</sup> Nerve trunk pain is typically described as a deep and aching sensation that has been attributed to increased activity from mechanically or chemically sensitized nociceptors in the connective tissue sheaths of the nervous system (i.e. *nervi nervorum* and *sinuvertebral nerves*).<sup>11</sup> Dysesthetic pain is often characterized as an unfamiliar or abnormal sensation such as burning, tingling, electric, searing, drawing, or crawling,<sup>8</sup> and it is thought to be the result of volleys of impulses originating from damaged or regenerating afferent fibers that have become hyperexcitable (i.e. abnormal impulse generating sites).<sup>12</sup>

Nerve trunk pain typically presents as pain or abnormal sensations along the course of the peripheral nerve that can be clinically tested using the concept of neurodynamics. Neurodynamics is the concept based on a close interaction of mechanics and physiology of the nervous system which is to be considered while assessing and treating patients via nervous system mobilization and manual therapy.<sup>13</sup> The foundation of knowledge behind neural tissue mechanosensitivity arose from the fact that peripheral nerve trunks in diabetic neuropathy exhibited mechanical allodynia<sup>14</sup> and mechanical

hyperalgesia in animal and human experimental models of neuropathic pain.<sup>15-18</sup>

Neurodynamic assessment involves neurodynamic testing<sup>19</sup> and nerve palpation.<sup>20</sup> Neural tissue mechanosensitivity was to be confirmed during neurodynamic testing by positive response to structural differentiation so as to identify neural from the non-neural sources of patient symptoms.<sup>13</sup> Presence of mechanical allodynia on nerve trunk palpation was another key diagnostic sign of neural tissue mechanosensitivity.<sup>11,21</sup>

There are a numerous clinical assessment tools to evaluate neuropathic pain in painful diabetic peripheral neuropathy (PDPN) patients.<sup>22</sup> Of these, the neuropathic pain scale developed by Galer and Jensen,<sup>23</sup> and neuropathic pain questionnaire developed by Krause and Backonja<sup>24</sup> were well validated for their use in diabetic neuropathic pain clinical trials.<sup>25</sup>

Of many laboratory assessment methods<sup>26</sup> in evaluation of patients with PDPN, electrophysiological testing<sup>27</sup> methods like nerve conduction studies<sup>28</sup> have been regarded as "gold standard" in diagnosis of peripheral neuropathy. Recently, evaluation and quantification of sensory function in neuropathic pain states led to the development of procedures collectively termed as the quantitative sensory testing (QST).<sup>27</sup> It comprises of assessment of light touch using Semmes Weinstein monofilaments or von Frey hairs; vibration testing using calibrated tuning forks; vibration perception thresholds testing using biothesiometer; thermal perception thresholds using a biothesiometer; current perception thresholds using a neurometer; pain thresholds testing using pressure algometer; and thermal pain thresholds testing.<sup>28</sup> Assessment of light touch and temperature sensation indicates small-fiber function whereas vibration sensation indicates large-fiber function.<sup>29</sup> The German Research network<sup>30</sup> on neuropathic pain had established standards and guidelines for use of quantitative sensory testing in patients with neuropathic pain conditions and studies report QST to be better able to detect abnormalities than nerve conduction studies in PDPN patients.<sup>31</sup>

Post-herpetic neuralgia and diabetic peripheral neuropathy have been shown to significantly quality of life in patients.<sup>32</sup> So far, only one

instrument, a self-report measure was shown to objectively assess the quality of life in patients with PDPN, the neuropathy and foot-ulcer specific quality of life instrument developed by Vileikyte et al.<sup>33</sup>

According to the World Health Organization's (WHO) International classification of functioning, disability and health (ICF-DH),<sup>34</sup> evaluation of impairments must be correlated to patient's activity limitations and participation restrictions to holistically address the clinical problem.<sup>35</sup> Hence, measures of impairment in PDPN namely neuropathic pain, neurodynamic findings and sensory findings and their relation to quality of life would enable the clinicians and researchers involved with such patients to understand the complexity of the clinical presentation and the underlying pathogenesis and clinical progression of the disabling condition. Studies relating these measures could not be found in our search thus necessitating current research. The objective of this study was to assess the relationship between neuropathic pain, neurodynamic assessment findings, quantitative sensory testing, and quality of life in PDPN patients.

## MATERIALS AND METHODS

**Study design:** Cross-sectional study with assessor-blinding and random-order testing method.

**Ethical clearance:** The study's protocol was approved by Institution Ethics Committee of Kasturba Medical College (Manipal University), Mangalore, India and the trial was registered at Clinical Trials Registry- India under universal trial registration number UTRN 052343809-080920102668203.

**Study location:** Out-patient treatment unit of department of physiotherapy in a multi-specialty teaching hospital.

**Patient selection:** Patients enrolled in diabetes clinic of the hospital were screened initially for the following inclusion criteria;<sup>36-40</sup>

Known case of type-2 diabetes, with stable glycemic levels (on HbA<sub>1c</sub>) for a minimum of six months.

Complaint of bilateral neuropathic pain in the legs and feet (screened using neuropathic pain scale) for a minimum of six months.

Insensitivity to 5-gm monofilament in bilateral feet.

Vibration perception thresholds greater than 25 volts in both feet when assessed using a biothesiometer.

Tested positive on structural differentiation during lower extremity neurodynamic testing on both sides lower limbs. Sciatic neurodynamic test, tibial neurodynamic test and common peroneal neurodynamic test were used for this purpose.

Mechanical allodynia to manual palpation of nerve trunks in bilateral legs and feet. Manual palpation of sciatic, tibial and common peroneal nerve trunks were done for this assessment.

Patients with comorbid musculoskeletal disorders, history of fractures, trauma and surgery to lower limbs, and inability to understand therapist's instructions were excluded.

## PATIENT RECRUITMENT

All patients were required to provide a written informed consent prior to their participation in the study. The consecutive patients were randomly assigned to receive either of seven test procedures first. The allocation method was concealed from the primary investigator using sequentially numbered sealed opaque envelopes, generated by computerized table of random numbers method.

## OUTCOME ASSESSMENT

### *Neuropathic pain questionnaire (NPQ)*

This self-administered questionnaire was developed by Krause and Backonja,<sup>24</sup> and it consisted of ten items (burning pain, overly sensitive to touch, shooting pain, numbness, electric pain, tingling pain, squeezing pain, freezing pain, unpleasantness and overwhelming nature) and the last two items (increased pain due to touch and increased pain due to weather changes) thus making it twelve items in total. Each of the items was to be scored on a eleven-point visual analogue scale (0-10) with anchors for no

pain and worst pain at both ends. The items with negative discriminant function score were electric pain, squeezing pain, overwhelming nature and influence of weather). The total discriminant function score below zero indicated non-neuropathic pain and score at or above zero indicated neuropathic pain. Of the eight items with positive discriminant function scores, a total score of 80 indicated the intensity or severity of neuropathic pain perceived by the patient.

### NEURODYNAMIC ASSESSMENT: NEURODYNAMIC TESTING (NDT)<sup>41</sup>:

*Sciatic neurodynamic test- straight leg raise (SLR)<sub>1</sub>*: The examiner passively lifts the tested lower extremity with knee maintained in full extension till the onset of perceived symptoms or a feel of resistance. At that point, structural differentiation maneuver of ankle dorsiflexion or plantarflexion was done to observe for alteration in symptoms. A positive structural differentiation indicated altered neural mobility of the sciatic nerve. *Tibial neurodynamic test- SLR<sub>2</sub>*: The test is similar to the SLR<sub>1</sub> but the ankle dorsiflexion and eversion was performed before the SLR. The structural differentiation was done by hip adduction or internal rotation.

*Common peroneal neurodynamic test-SLR<sub>3</sub>*: The test is similar to SLR<sub>1</sub> and SLR<sub>2</sub>, but the ankle movements of plantarflexion and inversion were performed before the SLR component.

The neurodynamic test findings were recorded as positive or negative, depending upon the reproduction of patient symptoms and alteration of symptom responses during structural differentiation.

### NERVE TRUNK PALPATION (NTP)<sup>20</sup>:

*Sciatic nerve palpation*: Sciatic nerve was palpated in the distal margin of the gluteal fold at or near the point between a line connecting greater trochanter and ischial tuberosity, where it exits from the greater sciatic notch.

*Tibial nerve palpation*: Tibial nerve was palpated in the medial aspect of the distal one-thirds of lower leg where it passes through the tarsal tunnel.

*Common peroneal nerve palpation*: Common peroneal nerve was palpated at near the fibular head (traced from posterior to anterior distal to the knee laterally) where it winds around the head and travels distally in the upper-third of the leg.

The nerve trunk palpation responses were recorded as positive or negative depending upon the mechanical allodynia provoked on manual palpation and reproduction of patient symptoms along the course of the nerve trunk.

### VIBRATION PERCEPTION THRESHOLD (VPT)

The VPT testing was done using Vibrotherm<sup>TM</sup> Biothesiometer<sup>42</sup> with the probe placed on the subject's skin. The therapist slowly increased the intensity of vibratory stimulus until onset of vibration sense is reported. Minimum intensity of vibration felt as a sensation reported by the subject was taken as the VPT. Both appearance and disappearance of the sensation of vibration were measured. Appearance of vibration was measured by turning up the vibration stimuli until the subject was just able to perceive vibration. Disappearance was measured by increasing the stimuli to above that of the appearance value, and then slowly reducing the stimuli to where the subject no longer felt the stimulus.<sup>43</sup> The therapist who performed the VPT testing using the equipment was trained prior and intra-rater reliability was established in five healthy subjects prior to the study. The ICC was found to be .91.<sup>44</sup> The procedure is then repeated on the other foot by the same therapist. The total contact duration was maintained to be less than 30 seconds to prevent adaptation and interval between two trials was maintained at 4 mins to facilitate recovery of cutaneous mechanoreceptor afferents to vibratory stimulus.<sup>45</sup> Total duration of testing VPT per side was then 10 mins.

### THERMAL PERCEPTION THRESHOLD(TPT)- METHODS OF LEVELS (MLE):

The procedure for testing thermal perception thresholds was done as per described by Malanda et al<sup>46</sup> and done earlier by Kumar et al.<sup>44,47</sup> The Methods of Levels (MLE) was used in this study.

MLE is characterized by confirming or denying a well-defined temperature change. Starting from 32°C, temperature rises (warm sensation) or decreases (cold sensation) with a 2°C step (rate of change 1°C/s). Based on the subjects answer ("yes" or "no" sensation) the °C amplitude of the following temperature step is doubled ("no" answer) or halved ("yes" answer) until a minimal perceptive criterion is established. In this "yes/no" procedure post-stimulus speed of reaction and by that reaction time does not play a role. By doing so a complete MLE test consists of several single stimuli resulting in a finally acquired reaction-time free temperature threshold. Anticipation or prediction of stimuli is prevented by random inclusion of "dummies" (no temperature change after the auditory signal) and combining two separate sequences of levels stimuli in a single test sequence. In this study levels thresholds were determined by applying temperature stimuli directly after an auditory cue (change rate 1°C/s). The testing of cold sensation sequence preceded warm sensation. Return to adaptation temperature (32°C) started as soon as participant responded "yes" or "no" (return rate 4°C/s). The inter-stimulus interval was randomized between 4 and 6 s and the minimal perceptive criterion was set to 0.1°C. Final MLE threshold for either cold or warm sensation was considered the mean of the last "yes" and "no" answered temperature step value.

## NEUROPATHY-SPECIFIC QUALITY OF LIFE- NEUROQOL

The NeuroQoL developed by Vileikyte et al,<sup>33</sup> is a self-administered questionnaire which questions the presence and frequency of symptoms in the past 4 weeks. The first part has seven questions each of which are scored on a 5-point likert scale from "all the time" to "never." Each question is also accompanied with three options for bothersomeness (very much; some bother; none). The second part has on quality of perceived symptoms. The third part is for weakness, unsteadiness in standing and gait. The fourth part is on influence on work situations and finally on

social influence and self-perceived quality of life. Total score ranges from 0-100 where maximum scores indicate worst perceived quality of life.

The outcome measures were taken in random order, (selected by a toss of a coin method) by another physiotherapist who was blinded to study design. Total assessment duration per patient was for one-hour.

## DATA ANALYSIS

All correlations were analyzed using Karl-Pearson's correlation co-efficient at 95% confidence interval using SPSS 11.5 for Windows. Spearman's Rho was used for correlating neurodynamic testing and nerve trunk palpation findings. R values for interpretation of correlation were prefixed into four categories as  $r=0.0-0.3$  (weak);  $>.3$  and  $<.6$  (fair);  $>.6$  and  $<.9$  (good); and  $>.9$  (excellent). Secondary analysis was done using one-way ANOVA for comparison of groups based on positive-tested nerves on neurodynamic assessment for difference in the other variables.

## RESULTS

Of the total 366 patients screened from August 2007 to September 2009, 112 fulfilled the inclusion criteria. The demographic characteristics of all 112 patients are provided in table-1 and neurodynamic assessment findings were summarized in table-2.

## CORRELATION ANALYSES

*NPQ versus VPT, HPT, CPT and NeuroQoL:*

There was a statistically insignificant weak negative correlation between NPQ score and VPT in volts with  $r = -.018$ . NPQ had a fair positive correlation with HPT ( $r=.436$ ) (figure-1a) and CPT ( $r=.349$ ) (figure-1b) both of which were statistically significant. NPQ had a statistically significant fair negative correlation with NeuroQoL ( $r=-.377$ ) (figure-1c).

**Table 1: Demographic characteristics of patients in this study**

Demographic factor	Descriptive
Age (years)	62.95 ± 6.73
Gender- Male(%)	64 (57.1%)
female (%)	48 (42.9%)
Duration of diabetes (years)	5.74 ± 2.26
Duration of neuropathic pain (years)	3.63 ± 1.62
Neuropathic pain questionnaire	56.50 ± 7.01
Vibration perception threshold (in volts)	45.91 ± 2.15
Heat perception threshold (in degrees Celsius)	16.64 ± 4.01
Cold perception threshold (in degrees Celsius)	16.16 ± 3.38
Neuropathy-specific quality of life	37.24 ± 13.47

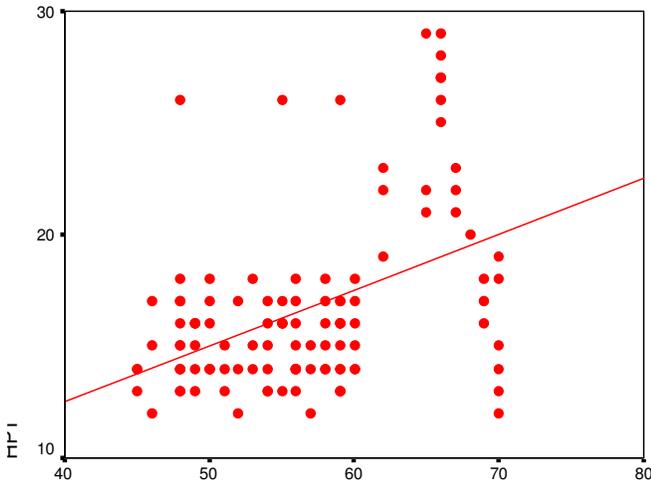
**Table 2: Neurodynamic assessment findings in the patients**

Nerves tested positive, N (%)	Neurodynamic testing	Nerve trunk palpation
Sciatic nerve	3 (2.7%)	0 (0%)
Tibial nerve	15 (13.4%)	10 (8.9%)
Common peroneal nerve	14 (12.5%)	16 (14.3%)
Sciatic + tibial nerve	19 (17%)	15 (13.4%)
Sciatic + common peroneal	7 (6.3%)	4 (3.6%)
Tibial + common peroneal	18 (16.1%)	21 (18.8%)
Sciatic + tibial + common peroneal	36 (32.1%)	46 (41.1%)

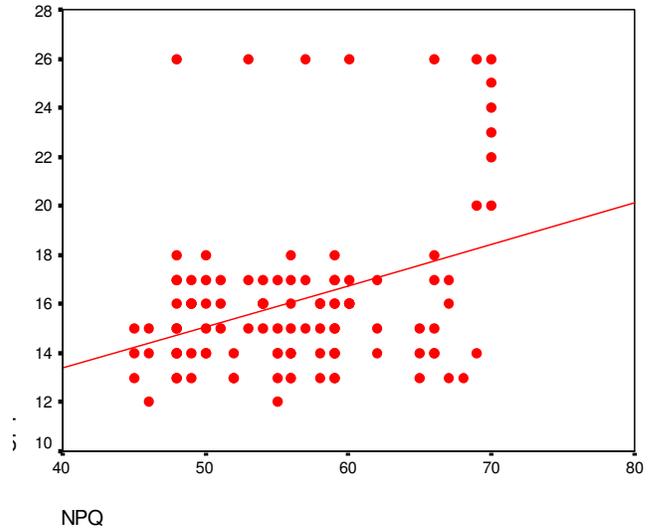
**Correlation analyses:**

NPQ versus VPT, HPT, CPT and NeuroQoL:

(Figure 1a)



(Figure 1b)



(Figure 1c)

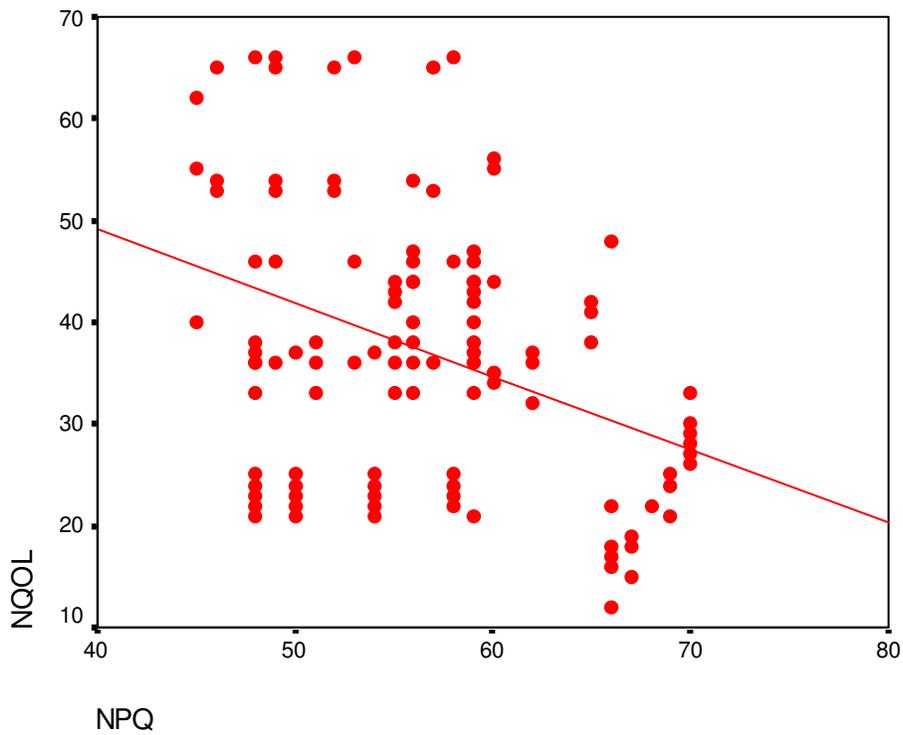
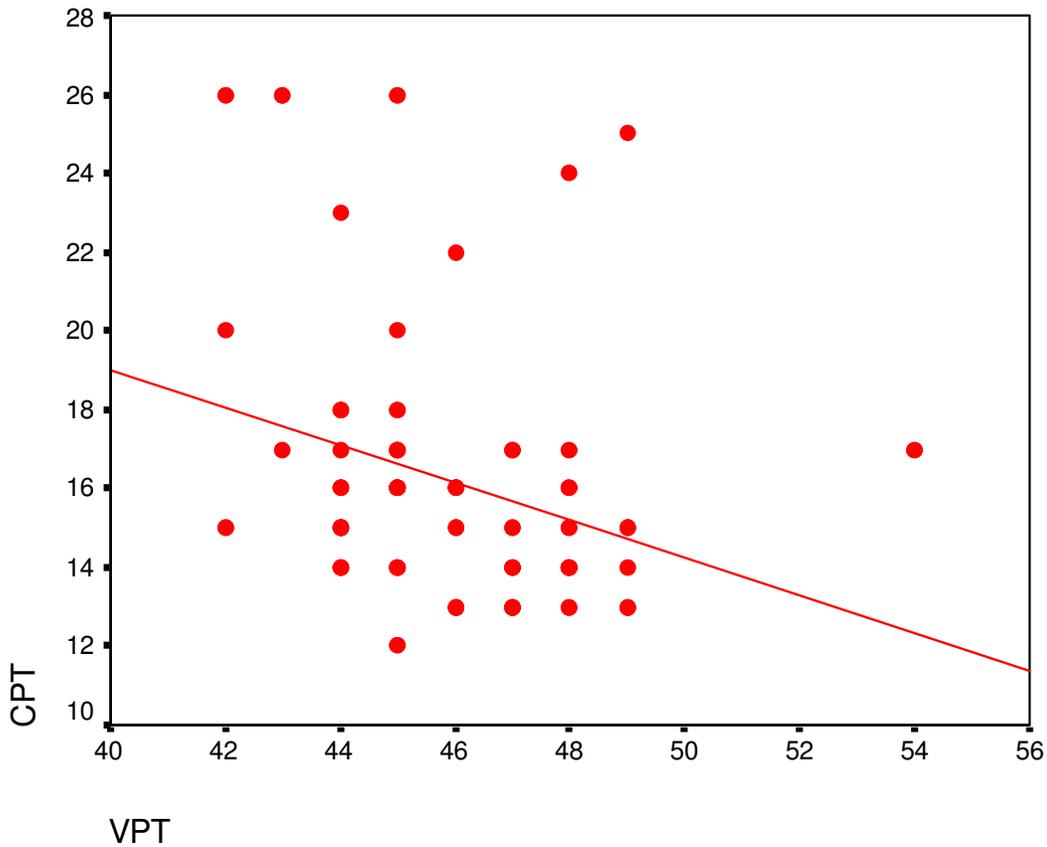


Figure 1a, 1b, 1c: showing scatter plots for correlation between NPQ and HPT, CPT and NQOL respectively.

*VPT versus HPT, CPT and NeuroQoL:*

VPT had a statistically insignificant weak negative correlation with HPT ( $r=-.012$ ) and NeuroQoL ( $r=-.069$ ); and a fair negative correlation with CPT ( $r=-.304$ ) that was statistically significant (figure-2).

**Figure 2: showing scatter plot for fair negative correlation between VPT and CPT**



**HPT VERSUS CPT AND NEUROQOL**

HPT had a weak negative correlation with CPT ( $r=-.026$ ) and a weak positive correlation with NeuroQoL ( $r=+.284$ ), the latter was statistically significant.

**CPT VERSUS NEUROQO**

CPT had a weak negative correlation with NeuroQoL ( $r=-.054$ ) that was not statistically significant.

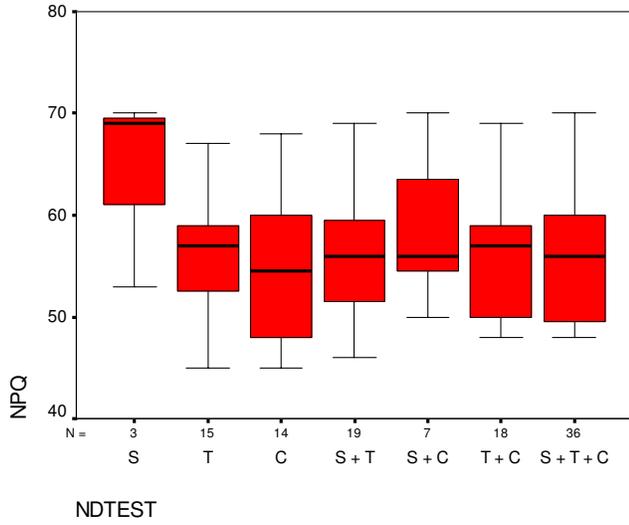
**NDT AND NTP**

Spearman's rho showed statistically significant ( $p=.000$ ) good positive correlation between NDT and NTP at  $r=.741$ .

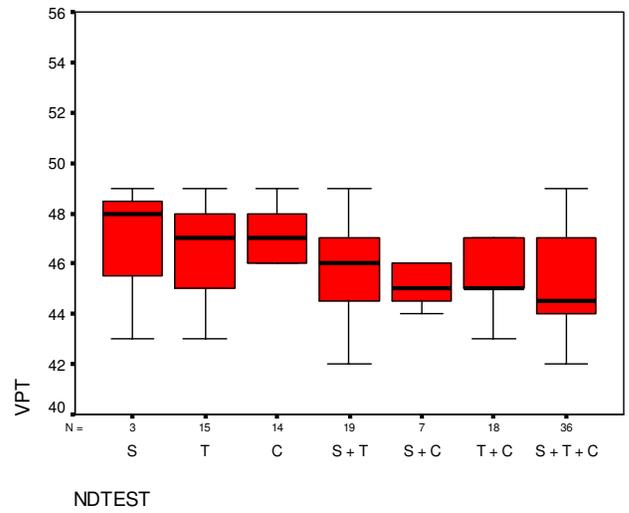
**SECONDARY ANALYSIS**

One-way ANOVA showed statistically insignificant differences between the groups based on patients' positive-tested nerves on neurodynamic testing and the other measures (NPQ, VPT, HPT, CPT, and NeuroQoL).

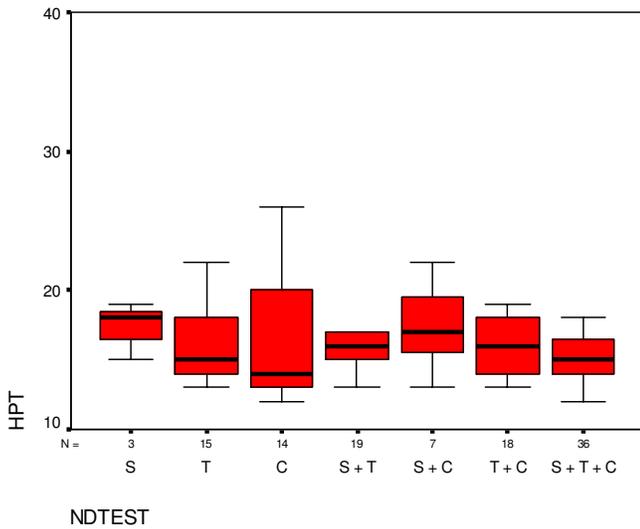
**Figure 3a**



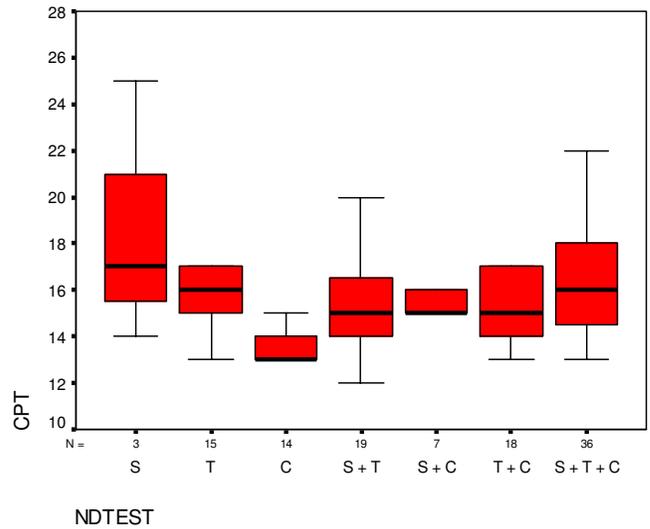
**Figure 3b**



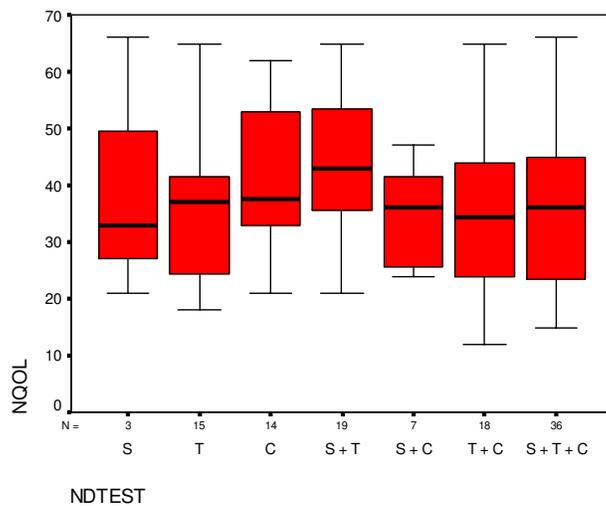
**Figure 3c**



**Figure 3d**



**Figure-3e**

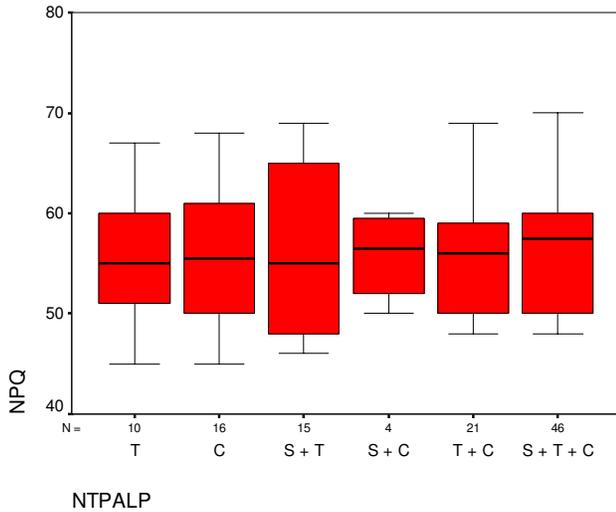


**Figures 3a-e: showing comparison between groups based on positive-tested nerves on neurodynamic testing on NPQ, VPT, HPT, CPT and NQOL respectively.**

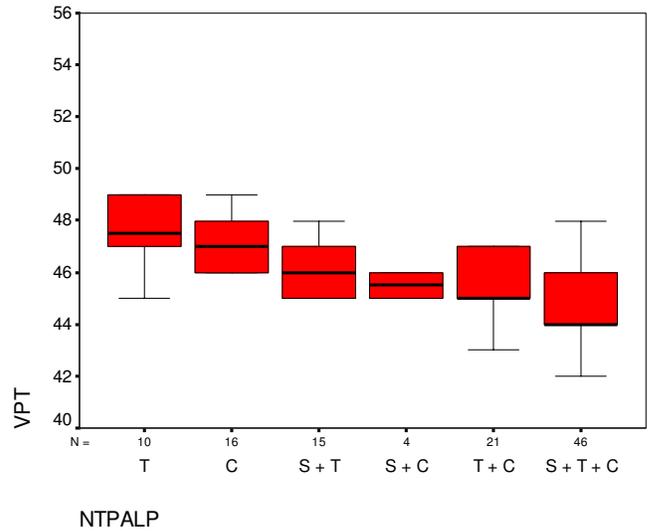
One-way ANOVA showed statistically significant differences between the patients' positive-tested

nerves on nerve trunk palpation and NPQ, VPT and CPT, whereas the differences in HPT and NeuroQoL were not statistically significant. Post-hoc analysis revealed that NPQ scores, VPT and CPT were higher in the group which had all three nerves tested positive on palpation.

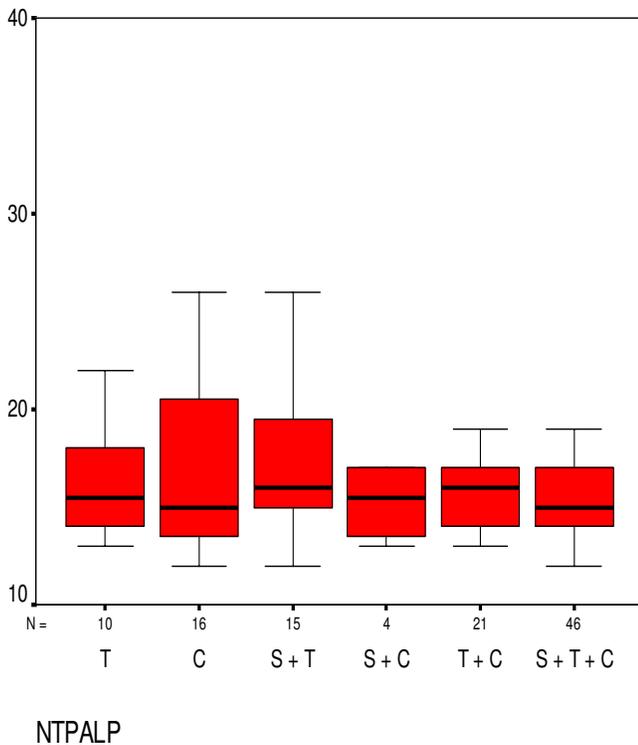
**Figure 4a**



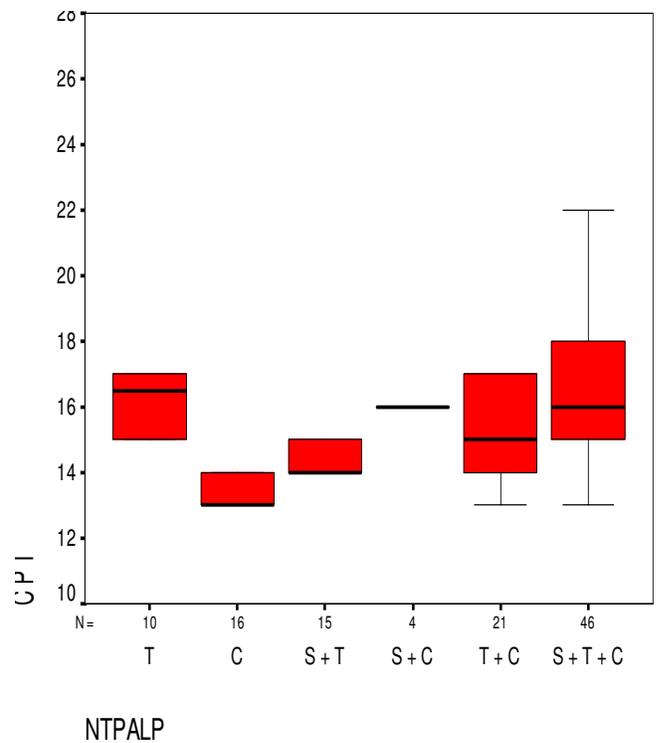
**Figure 4b**



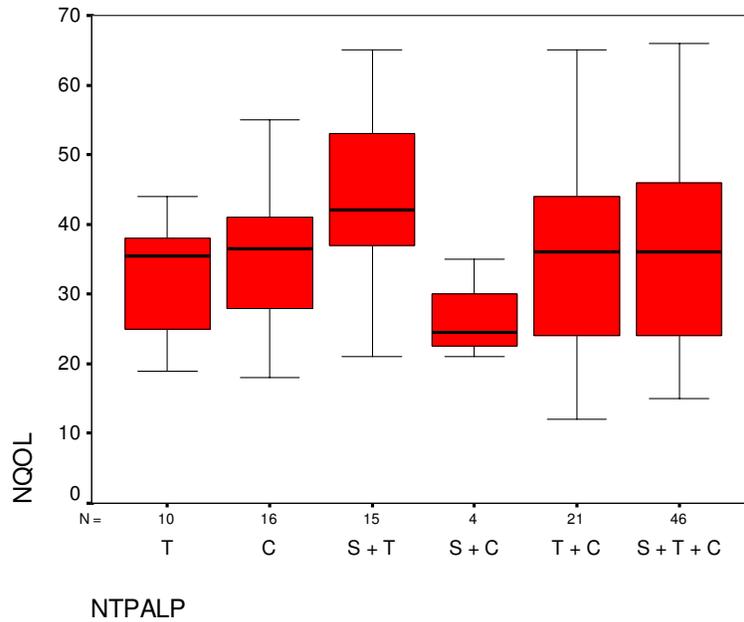
**Figure 4c**



**Figure 4d**



**Figure 4e**



**Figures 4a-e: showing comparison between groups based on positive-tested nerves on nerve trunk palpation on NPQ, VPT, HPT, CPT and NQOL respectively**

**DISCUSSION**

The study showed a good positive correlation between neurodynamic test findings and nerve trunk palpation that is, the nerve tested positive on neurodynamic testing also showed mechanical allodynia on nerve trunk palpation. Though the two procedures assess different properties of mechanosensitivity in symptomatic peripheral nerves, the inter-dependence between neural longitudinal gliding (induced by neurodynamic testing) and transverse gliding (induced by nerve trunk palpation) was well demonstrated. Coppieters and Butler<sup>48</sup> suggested that sliders and tensioners are two different mechanical properties of nerves which could be elicited during neurodynamic test movement components and sliders facilitate neural sliding between nerve and its interface whereas tensioners facilitate intraneural gliding between nerve fascicles and neural connective tissue sheaths.<sup>49</sup> Butler<sup>50</sup> explained activity-specific mechanosensitivity for peripheral nerves and the study thus observed nerve-specific mechanosensitivity in PDPN patients.

We tested the three main nerves of the lower limb affected in diabetic peripheral neuropathy

namely the sciatic, tibial and common peroneal nerves. All the nerves have a common component of SLR in their neurodynamic test and the three nerves are connected to each other in that the latter two are branches from the former one.<sup>51</sup> A highly irritable distal nerve could elicit symptoms during testing proximal nerve eg., tibial nerve symptoms could be reproduced during sciatic neurodynamic testing and vice versa. We relied more on the symptom reproduction and structural differentiation during neurodynamic testing than range of motion for our analysis and this reduced objectivity of our findings. Same applied for nerve trunk palpation, where we did not quantify the pressure sensitivity using a pressure algometer as it was earlier used by Walsh et al.<sup>52</sup>

Neuropathic pain scores correlated well with quality of life scores and quantitative sensory testing measures, which suggested that subjective perception of responses and subjective reporting of activity limitations and participation restrictions related well with objective clinical evaluation of sensory perception threshold testing. A well-proven inter-relationship between these measures indicates the predictability of pathogenesis of the disorder and further cohort studies can explain

the causal relationship between the measures in PDPN patients. Understanding of mechanisms of peripheral neuropathic pain would enable effective clinical decision-making and use of appropriate musculoskeletal physiotherapy techniques.<sup>53</sup> Though statistically significant, the strength of correlation found was only fair to good, indicating further studies on larger sample size to have larger observed effects.

VPT values correlated negatively with CPT, which showed that dysfunction in large fibers and small fibers in PDPN were inter-twined and though large fiber dysfunction precedes small fiber dysfunction in DPN, the physiologic function of cutaneous receptors and/or the afferent fibres for these two sensations are yet to be explored. The receptor afferents for vibration sensation are myelinated and include both large diameter (group Aa, diameter 12–20 mm, conduction velocities 72 to 120 m/s) and medium diameter (group Ab, diameter 6–12 mm, conduction velocities 36 to 72 m/s) fibres. Merkel disk receptors respond maximally to low frequencies (5–15 Hz), Meissner's corpuscles to mid-range frequencies (20–50 Hz), and pacinian corpuscles to high frequencies (60– 400 Hz). Humans are most responsive to vibration at frequencies of 200–250 Hz.<sup>54</sup>

The observed lack of relationship between the other measures could be attributable to the rigor in the study design, random order of testing to minimize the influence of sequence of testing or effect of testing a measure on the patients' response to the other test measure. Also, the observed relationship could be due to the disorder only if future case- control studies find association in the outcome measures.

Future studies could be on other neuropathic pain states and correlated with other outcome measures such as real-time diagnostic ultrasound for longitudinal nerve motion,<sup>55</sup> current perception threshold testing for fiber-specific sensory testing, and as longitudinal studies to establish a cause-effect relationship between the related measures.

As we shift from an evidence-based to an evidence-informed paradigm<sup>56</sup> for clinical decision-making, a study as this one added valuable information towards understanding the mechanisms behind patients' symptoms in PDPN. Appropriate clinical reasoning<sup>57</sup> combined with

adequate therapeutic skills would provide efficient interventions for relief of symptoms in PDPN patients which have to be studied in future controlled clinical trials.

## CONCLUSION

There was a good positive correlation found between NDT and NTP. There was a fair positive correlation found between NPQ and HPT; NPQ and CPT. There were a fair negative correlation found between NPQ and NeuroQoL; VPT and CPT.

## ACKNOWLEDGMENTS

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## Attitudes of Occupational Therapy department towards Communication skills

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### ABSTRACT

Over the last 30 years, communication skills in the medical school curriculum have received a considerable amount of attention among scholars in a variety of disciplines. In Occupational Therapy students and therapists are required to acquire and demonstrate their proficiency in communication. Good provider communication skills have been linked to more efficient health care organizations and effective health care delivery, provider, and patient satisfaction, and fewer incidents of malpractice. **Objectives:** 1. To determine the attitudes of Occupational Therapy department towards Communication skills learning. 2. To determine if the attitudes towards communication skills correlate with the level of academic year and professional skills. **Methodology:** The study consisted of answering a one time questionnaire named Communication skills Attitudes Scale (CSAS) by students and staff of Occupational Therapy School & Centre, as per the inclusion criteria. **Results:** The mean scores of positive attitudes in undergraduates (50.75), postgraduates' students (49.08) & staff (46.82) were much higher than mean scores of negative attitudes in undergraduates (34.83), postgraduates' students (34.51) & staff (35.45). There was statistical significant difference between positive attitudes of undergraduates & staff. **Conclusion:** Occupational Therapy department had more positive attitudes than negative attitudes in relation to communication skills learning as well as the level of academic year and professional skills increase, the attitudes towards Communication skills learning become more positive.

**Keywords:** Occupational Therapy, Communication skills learning, affective learning, Attitudes

### INTRODUCTION

The changing role of ergo medicine in society and the growing expectations patients have of their therapist means that the content and delivery of ergo-medical curricula also have to change. The focus of health care has shifted from episodic care

of individuals in hospitals to promotion of health in the community, and from paternalism and anecdotal care to negotiated management based on evidence of effectiveness and safety. Medical training is becoming more students centered, with an emphasis on active learning rather than on the passive acquisition of knowledge, and on the assessment of clinical competence rather than on the ability to retain and recall unrelated facts. Rigid educational programs are giving way to more adaptable and flexible ones, in which student feedback and patient participation have increasingly important roles. A continuously evolving, high quality medical education system is needed to assure the continued delivery of high quality medicine<sup>(1)</sup>.

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Over the last 30 years, communication skills in the medical school curriculum have received a considerable amount of attention among scholars in a variety of disciplines, including communication. Research on communication skills training suggests good communication skills may improve the physician-patient relationship and are related to positive health outcomes for patients, such as improved compliance, satisfaction with care, and benefits to physical and psychological health. In addition, good provider communication skills have been linked to more efficient health care organizations and effective health care delivery, provider, and patient satisfaction, and fewer incidents of malpractice<sup>(2)</sup>.

Attitudes involve evaluations by which we attach good or bad qualities to a topic or an organization or a person. Attitudes drive behavior. If we can change a person's attitude we may change his or her behavior. Attitudes have three main components: affective (the way we feel), cognitive (the way we think) and behavioral (the way we act) towards a particular entity. Affective attitudes reflect emotional reactions and may change after repeated exposure to situations involving the goal for the attitude. Cognitive components of attitudes are believed to be more fundamental and constant over time and more closely connected to basic values. Cognitive attitudes are difficult to influence but may change when new knowledge is presented; provided the knowledge is convincing and the presenter is credible<sup>(3)</sup>. The focus of this study is on measuring attitudinal aspect of the affective domain.

Thus, this study was conducted to determine & measure the attitudes of Occupational therapy departments towards Communication skills learning. As mentioned before affective attitudes may change over repeated exposure to any situations. It was expected that as the level of academic year and professional skills increase, the attitudes towards Communication skills learning become more positive. Thus, this study also aims at correlating attitudes Communication skills learning with the level of academic & professional skills.

## AIMS & OBJECTIVES

1. To determine and measure the attitudes of Occupational Therapy students and therapists towards Communication skills learning.
2. To determine if the attitudes towards communication skills correlate with the level of academic year and professional skills.

## METHODOLOGY

This was a cross sectional survey carried out at the Occupational Therapy School & Centre, Mumbai during working hours. The study initiated after receiving approval from the Ethics Committee for Research on Human Subjects of Seth G S Medical College & K E M Hospital, Mumbai. Students studying in the II, III and IV year of Bachelor of Occupational Therapy, Interns, I, II, III year of Masters' of Occupational Therapy as well as Clinical and Teaching staff of the Occupational Therapy School & Centre participated in study. The study consisted of answering a one-time questionnaire named Communication Skills Attitudes Scale (CSAS).

### Inclusion Criteria

1. Students of the Bachelor of Occupational Therapy Course (2<sup>nd</sup> year, 3<sup>rd</sup> year or 4<sup>th</sup> year) studying at the Occupational Therapy School and Center, Mumbai
2. Interns of the Occupational Therapy School and Center, Mumbai
3. I, II, III year of Masters' of Occupational Therapy as well as Clinical and Teaching staff of the Occupational Therapy School & Centre, Mumbai
4. Age 18 years or more
5. Willingness to provide written informed consent for participation in the trial

### Exclusion Criteria

1. Not willing to provide written informed consent.

## Outcome Measures

### Communication skills Attitudes Scale (CSAS)

This 26-item measure uses a five-point Likert-type scale, and it includes positive and negative statements about communication skills training. Examples of positive CSAS items included, "Learning communication skills will help me respect patients," and "In order to be a good doctor I must have good communication skills." Thus positive CSAS items included item numbers 1, 4, 5, 7, 9, 10, 12, 14, 16, 18, 21, 23, and 25. Examples of negative CSAS items included, "I can't see the point in learning communication skills," and "Communication skills learning should be left to psychology students, not medical students." Thus negative CSAS items included item numbers 2, 3, 6, 8, 11, 13, 15, 17, 19, 20, 22, 24, and 26. All negative CSAS items were reverse coded for analysis, so that higher scores on all items indicated more positive attitudes toward communication skills training. The reliability coefficient for all CSAS items was 0.87.

Communication Skill Attitude Scale was administered only for one time. The data collected was divided according to academic level as well as on positive attitude factors and negative

attitude factors and analyzed statistically. Communication Skill Attitude scales was analyzed by using the Unpaired Student 't' test.

## RESULTS

138 subjects as per inclusion criteria were taken up for the study as shown in **table no. 1**

**Table no. 2** Comparison of positive attitudes

**Table no. 3** Comparison of negative attitudes

**Graph no.1** Graphical representation of positive & negative attitudes of Occupational Therapy department.

## DISCUSSION

Medical student's attitudes towards doctor-patient communication have been for long a concern among medical teachers, curriculum planners and policy makers and have been addressed in many studies. With reference to these concerns there have been numerous studies undertaken to elevate level of medical students' attitudes towards communication skills.

**Table 1: Stratification of sample size**

Sr. No.	Academic Level	No. of subjects
	<b>Under- graduate</b>	
1.	Second Year	27
2.	Third Year	22
3.	Fourth Year	24
4.	Interns	27
	<b>Total</b>	100
	<b>Post- graduate</b>	
5.	First Year	07
6.	Second Year	10
7.	Third Year	10
	<b>Total</b>	27
8	<b>Academic staff</b>	11
	<b>Grand Total</b>	<b>138</b>

138 subjects as per inclusion criteria were taken up for the study

**Table 2: Comparison of positive attitudes**

	Mean	Unpaired 't' test	P- value
Undergraduates	50.75		
Postgraduates	49.08	1.05	< 0.10
Postgraduates	49.08		
Staff	46.82	1.06	< 0.10
Undergraduates	50.75		
Staff	46.82	2.07	<0.05

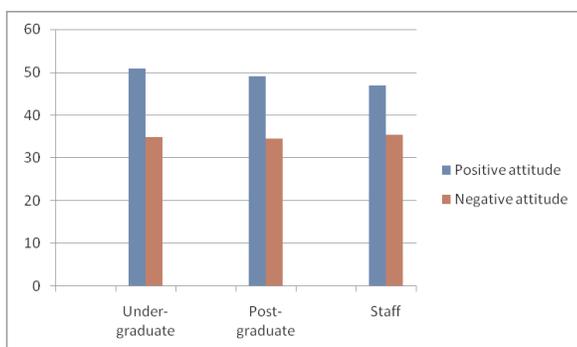
Comparing the results in the table no. 2 it was found that there was no statistical significant difference between positive attitudes of Undergraduates & Post graduates students ( $t= 1.05$ ,  $p<0.10$ ) as well as Post graduates & staff ( $t= 1.06$ ,  $p<0.10$ ) while there was highly statistical significant difference between positive attitudes of Undergraduates students & staff ( $t= 2.07$ ,  $p<0.05$ ).

**Table 3: Comparison of negative attitudes**

	Mean	Unpaired 't' test	P- value
Undergraduates	34.83		
Postgraduates	34.51	1.19	< 0.10
Postgraduates	34.51		
Staff	35.45	0.60	< 0.10
Undergraduates	34.83		
Staff	35.45	0.34	< 0.10

Comparing the results in the table no. 3 it was found that there was no statistical significant difference between negative attitudes of Undergraduates & Post graduates students ( $t= 1.19$ ,  $p<0.10$ ) as well as Post graduates & staff ( $t= 0.60$ ,  $p<0.10$ ) and also Undergraduates students & staff ( $t= 0.34$ ,  $p<0.10$ ).

However, comparing the results from table 2 & 3 with respect to positive & negative attitudes, it was found that the mean scores of positive attitudes in undergraduates (50.75), postgraduates' students (49.08) & staff (46.82) were much higher than mean scores of negative attitudes in undergraduates (34.83), postgraduates' students (34.51) & staff (35.45).

**Graph 1: Graphical representation of positive & negative attitudes of Occupational Therapy department.**

Graph 1 is graphical representation of positive & negative attitudes of Occupational Therapy department. X-axis represents undergraduates, postgraduates & staff of Occupational Therapy department while Y-axis represents mean values of positive & negative attitudes of CSAS.

But there have been negligible studies on attitudes towards communication skills learning among occupational therapists. Thus, the purpose of this study is to determine and measure the attitudes of Occupational Therapy students and therapists towards Communication skills learning as well as whether these attitudes correlate with the level of academic year and professional skills.

As mentioned in results, comparing the mean scores of table 2& 3, Occupational Therapy department had more positive attitudes than negative attitudes in relation to communication skills learning which is also seen in graph 1. This may be due to the fact that in Occupational Therapy curriculum, a major emphasis is laid on communication skills learning and patient - therapist relationship is given priority right from the first year of the course. Positive attitudes towards communication skills learning training are significantly related to perceived importance of communication skills & confidence as well as knowledge when communicating with patients.

There are some studies which show that perceived importance of medical communication skills was positively associated with perceived confidence about communicating with patients which suggests that positive attitudes towards communication skills learning may be helpful to Occupational therapy department in terms of helping Occupational therapist to feel more comfortable and confident about their communication skills when interacting with patients. By improving attitudes towards communication skills training, instructors may be helping students to gain confidence in their ability to perform these skills.

Also as mentioned in the results though there was no statistical significant difference between positive attitudes of undergraduates & post graduates as well as post graduates & staff but there was statistical significant difference between positive attitudes of undergraduates & staff. This finding may be due to the wide experience of the staff of communication with patients over the period of time as compared to the novice or beginning undergraduates. Repeated exposure to many situations involving good communication skills while providing patients care may have helped therapist to gain better & effective health care delivery. This could be the reason for more

positive attitudes among staff then undergraduates students. However, studies comparing communication skills between more experienced medical students and beginning medical students have demonstrated mixed results. Some studies have shown that the experience third and fourth-year medical students gain by actually communicating with patients tends to improve their communication skills<sup>(2)</sup>. Yet few studies have examined how attitudes towards communication skills training may differ between beginning and advanced medical students as well as it is important to compare how knowledge of good communication skills may change over time.

Occupational Therapy School is where therapists first encounter information about the impact of their communication behaviors on patient satisfaction and health outcomes. Therefore, the attitudes they develop about communication skills during communication skills training courses may influence more general attitudes about the value of these skills. Since attitudes are often important predictors of behaviors, occupational therapy students who have negative perceptions of communication skills training may devalue the importance of these skills, and ultimately they may decide that they are not important enough to develop or practice when interacting with patients. This suggests that the attitudes towards communication skills training might affect the learning and retention of these skills since positive attitudes toward communication skills training were related to increased knowledge of appropriate communication behaviors with patients.

## CONCLUSIONS

Occupational Therapy department had more positive attitudes than negative attitudes in relation to communication skills learning as well as the level of academic year and professional skills increase, the attitudes towards Communication skills learning become more positive.

Thus, Communication skills learning will continue to be an important component of the

curriculum. While the results of the current study shed light on relationships among attitudes towards communication skills learning of Occupational Therapist.

Interventions targeting affective learning of communication skills, in conjunction with cognitive and behavioral training, need to be developed to help Occupational Therapy students understand the importance of communication and the complexity of communication issues in health care.

There are some limitations to our study:

1. Small sample size.
2. Study undertaken at only one institute.
3. Perception and correlation to actual behavior are not studied.
4. Detailed item wise analysis is also not studied.

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## Determination of Cardiovascular Responses of Children to Maximal Treadmill Exercise with Bruce Treadmill Protocol

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### ABSTRACT

This study aimed to determine the cardiovascular responses of children to maximal treadmill exercise with Bruce Treadmill Protocol and to compare these responses between girls and boys. A total number of 20 subjects with age ranging from 5-11 years were included in the study. Subjects were separated to two groups i.e. group A, group B on the basis of their gender. Group A comprised of 10 girls, while 10 boys made up Group B. The treadmill is started at Stage-1 which has a speed of 2.7 km/hr and an incline of 10%, after 3 minutes both speed and incline is increased to 4.0 km/hr and 12% respectively to Stage 2. Blood pressure was recorded in supine position immediately after completion of exercise and at 1,2,3,4,5,6,7,8,9 and 10 minutes of recovery. Heart rates was recorded at each minute of the recovery, till it became stable. Recorded data show that there is no significant, difference in both the vascular variables of Heart rate and Blood pressure in response TST both during Exercise and during Recovery Levels of circulating hormones especially around the period of puberty, help to explain some of the sex differences in anaerobic fitness but the evidence is equivocal and current data suggest that sexual maturity does not exert any independent effect on anaerobic fitness once age, body mass, body composition are concurrently controlled for., Improvements in neural adaptations with age, complete myelination of nerve fibres, improved muscle coordination during multi-joint exercise and an improved capability to recruit motor units or more fully activate muscles help to explain age-related improvements in anaerobic fitness.

### INTRODUCTION

Exercise testing is integral to the evaluation of children and adolescents with symptoms associated with exercise suspected to be cardiac in origin and remains the most objective method to assess

A total number of 20 subjects with age ranging from 5-11 years were included in the study. Subjects were separated to two groups i.e. group A, group B on the basis of their gender. Group A

comprised of 10 girls, while 10 boys made up Group B. The treadmill is started at Stage-1 which has a speed of 2.7 km/hr and an incline of 10%, after 3 minutes both speed and incline is increased to 4.0 km/hr and 12% respectively to Stage 2. Blood pressure was recorded in supine position immediately after completion of exercise and at 1,2,3,4,5,6,7,8,9 and 10 minutes of recovery. Heart rates was recorded at each minute of the recovery, till it became stable. Recorded data show that there is no significant difference in both the vascular variables of Heart rate and Blood pressure in response TST both during Exercise and during Recovery Levels of circulating hormones, especially around the period of puberty, help to explain some of the sex differences in anaerobic fitness but the evidence is equivocal and current data suggest that sexual maturity does not exert any independent effect on anaerobic fitness, once age, body mass, body composition are

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concurrently controlled for. Improvements in neural adaptations with age, complete myelination of nerve fibres, improved muscle coordination during multi-joint exercise and an improved capability to recruit motor units or more fully activate muscles help to explain age-related improvements in anaerobic fitness.

Exercise testing is integral to the evaluation of children and adolescents with symptoms associated with exercise suspected to be cardiac in origin and remains the most objective method to assess physical fitness and endurance<sup>1</sup>. An increasing emphasis has been placed on physical fitness in the media during the last 2 decades. However, during that same time period, physical education programs have decreased in school<sup>2</sup> Exercise testing provides information on exercise capacity and facilitates assessment of pathophysiologic characteristics, effectiveness of medication, and risk of potential disease<sup>3</sup>.

The treadmill test does not require prior experience or practice and is thus suitable for children. Treadmill Stress Test (TST) is a diagnostic method with a number of indications for children and adolescents. The risk posed by TST in children and adolescents is very low when compared to adults. An increasing number of tests have been designed for children in the past 20 years, mainly to evaluate cardiopulmonary fitness or arrhythmia, and also to assess exercise-induced changes in airway resistance<sup>1</sup>.

An often used protocol is the Bruce treadmill protocol, which was originally designed for adults but is now also applied worldwide for children from the age of 4 years. For accurate exercise results, it is extremely important to avoid any interruption during stress testing, owing to the striking immediate changes following cessation of exercise which have been noted in continuous recordings<sup>4</sup>.

The knowledge of the physiological and biological processes taking place during maturation is essential to understand the etiopathogenesis of hypertension and of other risk factors associated with major cardiovascular events<sup>5</sup>.

Also, the measurement of maximal oxygen uptake ( $\text{VO}_2 \text{ max}$ ), Heart rate and blood pressure recorded at this point of maximal oxygen uptake

is widely used as the standard of cardiopulmonary functional reserve in children and adolescents<sup>6</sup>.

But since Cumming et al. reported a strong correlation between the maximal endurance time and maximal oxygen uptake, endurance time is therefore a good alternative for testing young children in the clinical setting<sup>7</sup>.

The cardiac events that occur from the beginning of one heartbeat to the beginning of the next are called Cardiac Cycle. The Cardiac cycle consists of a period of relaxation called Diastole, during which the heart fills with blood followed by a period of contraction called Systole and Heart Rate may be defined as 'number of heart beats per minute'. Normal values for Resting Heart (HR) rates are 70-80 bpm in adults and upto 100 bpm in children<sup>8</sup>.

Blood Pressure (BP) means the force exerted by the blood against any unit area of the vessel wall. The effect of pressure on blood flow is greater than one would expect, reason being - that an increase in arterial pressure not only increases the force that pushes the blood through, the vessels also distend the walls at the same time which decreases vascular resistance<sup>9</sup>.

The heart pumps blood into the aorta, the mean blood pressure in the aorta is high, averaging about 100mm Hg. Also because heart pumping is pulsatile, the arterial pressure alternates between systolic pressure level of 120mm Hg and a diastolic pressure level of 80mm Hg at normal resting state in adults<sup>10</sup>.

For each heartbeat, BP varies between systolic and diastolic pressures. Systolic pressure is peak pressure in the arteries, which occurs near the end of the cardiac cycle when the ventricles are contracting. Diastolic pressure is minimum pressure in the arteries, which occurs near the beginning of the cardiac cycle when the ventricles are filled with blood. Digital Blood Pressure Sphygmomanometer are much easier to use and accurate compared to the traditional mercury manometer.<sup>11</sup>

It has been reported that both boys and girls have a lower cardiac output (Q) than adults at a given absolute submaximal rate of work or  $\text{O}_2$  uptake ( $\text{VO}_2$ ). This lower Q at a given submaximal to maximal rate of work is attributed to a lower

stroke volume (SV), which is only partially compensated for by a higher heart rate -HR<sup>12</sup>.

A number of epidemiological studies have established normal blood pressure values as well as the effect of exercise on these variables of blood pressure, heart and endurance time in children of different populations but few are from India. To my knowledge, there are even fewer data available for endurance testing of Indian children and comparing the differences between the two sexes. The objective of this research is to analyse the difference between the fitness levels of girls and boys (age 5-11 years) in the Urban Indian set up<sup>13</sup>.

## MATERIALS AND METHOD

A total number of 20 subjects with age ranging from 5-11 years were included in the study. Subjects were separated to two groups i.e. group A, group B on the basis of their gender. Group A comprised of 10 girls, while 10 boys made up Group B. The subject's recruited were children of AIIMS Para-Medical team living in AyurVigyan Nagar.

Subjects were were asked to follow the Bruce Treadmill Protocol. The Bruce Protocol is a maximal exercise test where the subject works to the point of complete exhaustion as the treadmill speed and incline is increased every three minute.

The treadmill is started at Stage-1 which has a speed of 2.7 km/hr and an incline of 10%, after 3 minutes both speed and incline is increased to 4.0 km/hr and 12% respectively to Stage 2 .

1. Subjects were invited to participate in the study. The purpose and goal of the study was explained both to the subjects and their parents. Those willing to participate were then screened as per the inclusion criteria and exclusion criteria mention above. An informed consent was taken from both the subjects as well as parents of the eligible subjects.

2. These subjects were then taken to the exercise department. A detailed verbal discription explaining the procedure was given to the subject. A manual demonstration on how to perform

exercise on the treadmill and how to use the safety valve was given. They were encouraged to ask questions pertain the safety and working of the treadmill to avoid apprehension on the part of the young subjects. When the subjects agreed that they understood the intervention, he/she underwent the following procedure

A complete evaluation of the subject was done and demographic data such as age, weight and height were also obtained. Subject was then made to lie down supine on the exercise plinth for 10 minutes, during which the baseline values for heart rate (HR) and blood pressure (BP) were obtained and recorded with appropriately sized cuff.

The subject was then instructed to perform graded exercise testing to exhaustion on the treadmill with the standard Bruce Protocol. Unlike the original Bruce Protocol, keeping the age and safety factor in mind the subjects were permitted to hold the handlebar of the treadmill during the study. They were vigorously encouraged to reach a level of maximal exercise. The test was terminated when the subject refused to continue despite strong verbal encouragement. This endurance time was recorded. The subject was placed in supine position immediately after exercise. Heart rates were monitored and recorded every minute during the exercise and also at the time of termination. The heart rate recorded at the time of termination was labeled as Maximal Heart Rate.

Blood pressure was recorded in supine position immediately after completion of exercise and at 1,2,3,4,5,6,7,8,9 and 10 minutes of recovery. Heart rates was recorded at each minute of the recovery, till it became stable.

Mean resting heart rates were lower in boys than in girls. There was no statistical

## RESULTS

Mean resting heart rates were lower in boys than in girls. There was no statistical

significant difference in the resting heart rate between sexes of the older age. The mean maximal

heart rates for all subjects were virtually identical,  $197 \pm 9$  beats/min for girls and  $199 \pm 5$  beats/min for boys, with no significant difference with respect to age or sex. During recovery an abrupt decline in heart rate occurred in all age groups during the first minute after exercise to an average of  $148 \pm 9$  beats/min for girls and  $157 \pm 4$  beats/min for boys. Heart rates at the end of recovery were 6% to 18 % above resting heart rates. The mean endurance time for all age groups for boys was  $10:00 \pm 00:01$  minutes and for girls were  $8:57 \pm 00:01$  minutes.

The resting systolic BP and diastolic BP increased with advancing age for boys and girls. No significant difference was found in resting SBP in boys versus girls. In response to exercise, maximum SBPs were similar for boys and girls.

## DISCUSSION

Despite the low prevalence of cardiopathies among children and adolescents, in addition out heart diseases and checking functional capability, Treadmill Stress Test (TST) helps to assistant doctors to more confidently allow ordinary physical activities or sports practice to ruling those with exercise-related symptoms<sup>14</sup> Regular TST may give parents more confidence as well to allow their children - whether they have a condition or not - to lead their lives as normally as possible, without the many times unnecessary constraints on their physical activities<sup>15</sup>. The Bruce Treadmill Protocol is the most widely used standard treadmill exercise test; the progressive increase in grade and speed allows reproducible evaluation of subjects of all ages and levels of fitness<sup>16</sup>. We slightly modified the test procedure by permitting the children to hold the guardrails (handle bars). In our experience, walking on treadmill with increments of speed and inclination till maximal performance without rail holding is too difficult for many children aged 5-11 years. This is why; we preferred the safety of holding the rail in these young children. This strategy enabled more young children to perform this maximal exercise test. Rail holding, however, is known to increase endurance time and reduce physiological strain (e.g. HR,

VO<sub>2</sub>) during sub maximal exercise. Tolerance level to exercise in children may be the result of emotional factors rather than real fatigue. These conditions may justify the lower exercise time length and lower maximum HR reached by the younger ones.

Formulas used to calculate maximum HR expected in adults do not apply for maximum HR expected in pediatric populations. Children's physiologic response to exercise is similar to that of adults, with progressive increase proportional to exertion increase, but differs in the maximum values reached and in lowest correlation between HR and age range<sup>17</sup>. Normal children in different age ranges reach HR max above 180 bpm. Values above 200 bpm are commonly found. Children with HR max < 180 bpm have either not been properly exercised or present chronotropic deficit. In the present series, irrespective of gender, HR max was >180 bpm, which suggests all adolescents have been exercised properly. Near identical maximal heart rates in response to exercise suggest that endurance times can be compared between boys and girls as a measure of performance. Endurance times were slightly lower for girls than for boys at all age groups<sup>18</sup>. Thus the mean endurance time for girls was lower compared to boys, even though the difference between the endurance times of both the sexes was not significant (40.3 seconds). Although endurance times increased with age for both sexes. My findings suggest that cardiovascular conditioning is slightly reduced for females than for males.

Heart rate increases in parallel with increasing exercise intensity. Heart rate is stimulated to increase through the activation of mechano-, chemo- and baroreceptors sending afferent signals to the cardiovascular control centre in the brain. This in turn adjusts sympathovagal balance to the SA node bringing about a change in HR<sup>19</sup>. At the onset of exercise, there is a rapid increase in HR. Due to its speed of response; this is suggested to arise through a withdrawal of parasympathetic modulation which enables the HR to increase up to the intrinsic rate of approximately 100 beats/min. Thereafter, any increase in HR is stimulated through an increased sympathetic modulation. Increased sympathetic cardiac modulation is evident from approximately 25% peak VO<sub>2</sub> onwards and by the time exercise reaches an

intensity of 50–60% of peak  $\text{VO}_2$ , data suggest that vagal modulation disappears all together. Very few studies have reported the dynamics of autonomic control of HR during exercise in children<sup>20</sup>.

The recovery of power is faster in children than in adults during repeated brief maximal intensity exercises that are separated by short rest intervals. For instance, Hebestain reported that prepubertal boys recovered faster than adult men despite having similar body-mass-related peak  $\text{VO}_2$ . Percentage recovery in Peak Power (PP) was significantly higher than recovery in Total Mechanical Work (TMW) in boys and men. The authors suggested that the faster power recovery in boys compared to men could be partially explained by the lower PP, TMW and percent fatigue in boys, the lower post-exercise blood lactate concentration in boys, and faster removal of post-exercise metabolites in boys compared to men. Despite the range of research protocols used in different laboratories, the results consistently suggest that boys and girls recover more quickly than men and women, respectively, during a series of repeated maximal intensity sprints of short duration separated by short rest periods<sup>21</sup>. The quicker recovery of power output in young people can, at least in part, be attributed to the faster time constant for phosphocreatine resynthesis in children and adolescents compared to adults<sup>22</sup>.

Despite the range of research protocols used in different laboratories, the results consistently suggest that boys and girls recover more quickly than men and women, respectively, during a series of repeated maximal intensity sprints of short duration separated by short rest periods. The quicker recovery of power output in young people can, at least in part, be attributed to the faster time constant for phosphocreatine resynthesis in children and adolescents compared to adults

In order to interpret these cardiovascular variables, we need to understand the role of cardiovascular system in children. Without an efficiently functioning pump and blood distribution network the exercising muscle would not receive the necessary oxygenated blood and nutrients to allow exercise to continue for more than a minute or so. Additionally, the by-products of oxidative and anaerobic metabolism could not be removed nor would the heat generated by

muscular activity be adequately dissipated, all potentially limiting the ability of an individual to exercise.

Although we have a relatively complete understanding of how an adult's cardiovascular system responds to exercise, the practical, technological and ethical limitations in assessing cardiovascular function in the exercising child mean that our knowledge of children's responses is only slowly taking shape<sup>23</sup>. There is also the added challenge of interpreting these responses in relation to growth and maturation, so that fair comparison can be made with the responses of adults. It is important to understand the factors that interact to regulate cardiac output (Q). We know that cardiac output is the product of heart rate (HR) and stroke volume (SV) and changes in either or both of these variables will affect Q. Stroke volume refers to the amount of blood expelled by the heart in each beat and is measured in millilitres (ml). It represents the difference between the volume of blood in the ventricles before contraction (preload) and that remaining in the ventricles after the heart has contracted (afterload). Preload is influenced by the capacity of the ventricles, how much they distend as they fill with blood and most importantly venous return. The heart can only pump out the amount of blood it receives back from the systemic circulation; therefore venous return is critical in determining SV. Muscular, thoracic and ventricular 'pumps' all aid venous return. Afterload is determined by the strength with which the heart muscle contracts to eject the blood contained within the ventricles and by the systemic vascular resistance. Systemic vascular resistance refers to the resistance to flow provided by the vascular network. If systemic vascular resistance is low, afterload will be reduced and SV will increase<sup>24</sup>.

Contractility is influenced firstly by preload – the stretching of the myocardial fibres through the volume of blood filling the ventricles promotes the Frank–Starling mechanism that in turn aids contractility. Secondly, contractility is related to the size and thickness of the myocardial mass – an increased cardiac muscle mass produces more force facilitating ejection of blood from the ventricles<sup>25</sup>. Stroke volume increases with increasing body size. An autopsy study with children indicated that heart weight and

ventricular wall thickness also increased relative to body mass, stature and BSA. Finally, the ratio of heart volume to body mass stays constant through 8–18 years; hence it is clear that heart size increases in direct proportion with body size<sup>26</sup>

Finally, the myocardial auto-rhythmic cells have the attribute of being able to generate innate action potentials and thus safeguard a basic HR. The sympathetic nervous system innervates the SA node, the atrioventricular (AV) node, the atria and the ventricles of the heart, and its regulation of HR occurs through a combination of both neural and hormonal pathways. The inotropic effects of catecholamine's noradrenaline and adrenaline released by the sympathetic nervous system and adrenaline secreted by the adrenal glands both act to increase contractility, serving to increase HR. Conversely the parasympathetic nervous system, through the release of its neurotransmitter acetylcholine (A.Ch), reduces HR. However, the net effect of sympathetic and parasympathetic autonomic modulation is to increase and decrease heart rate, respectively<sup>27</sup>.

During exercise Stroke volume increases progressively up to moderate submaximal intensities (approximately 40–50% peak  $\text{VO}_2$ ) and then plateaus until termination of exercise. This response is, however, dependent on body position. In the upright body position at the commencement of exercise there is a rapid increase in SV. Stroke volume increases approximately 30–40%, soon attaining its maximal level even during submaximal exercise. This increase in SV reflects the combined effects of vasoconstriction and the action of the skeletal muscle pump in redistributing the blood that had been naturally residing in the lower extremities at rest<sup>28</sup>. It has been suggested that there is a small (<5%) increase in SV reflecting an enhanced contractility, in the supine as well as the upright body positions, but this is not always demonstrated.

With increasing exercise intensities venous return continues to rise but due to a reduced filling time caused by the increasing HR, end diastolic diameter (EDD) stays stable. However, towards maximal exercise the rapidity of the HR can outpace venous return, such that ventricular filling is reduced slightly, reflected in a slight decline in EDD. Left ventricular end systolic diameter (ESD) reduces with increasing exercise

intensity, representing an enhancement in myocardial contractility with exercise<sup>29</sup>.

During submaximal exercise, children typically have a lower absolute SV than adults at all levels of submaximal exercise or when working at a given  $\text{VO}_2$ . This is characterized by a smaller SV and a higher HR to deliver the same Q. Indeed, adults nearly double SV from rest to maximal exercise<sup>30</sup>

There is speculation that hormonal factors, especially around the period of puberty, may account for some of the characteristic observations in maximal intensity exercise performance. Hormones have both primary and secondary effects. For example, concentrations of circulating growth hormone and testosterone in males and oestradiol in females are markedly increased during puberty. More so in boys, there is a substantial gain in lean body mass during puberty. Muscle mass, estimated by creatinine excretion, accounts for as much as 42% of the total body composition in boys at the age of 5 years and increases to approximately 54% by the age of 17 years. Whereas in girls, the muscle mass increases from 40 to 45% of the total body mass. The advantages of having greater active muscle mass to recruit during exercise, is potentially useful in providing an enhanced functional capacity and metabolic rate in the exercise performance of post pubertal or adolescent boys compared with girls<sup>31</sup>. Alterations in muscle mass, muscle fibre type or muscle fibre diameter during growth and maturation help to explain some but not all the age- and sex-related changes in anaerobic fitness. Genetics exert a significant influence on anaerobic fitness. A greater preponderance of type II muscle fibres in adolescence and adulthood than in childhood helps to explain the increase in anaerobic fitness with age. Differences in muscle metabolism between children and adults in their responses to maximal intensity exercise suggest a reduced reliance on anaerobic metabolism during childhood<sup>32</sup>. Levels of circulating hormones, especially around the period of puberty, help to explain some of the sex differences in anaerobic fitness but the evidence is equivocal and current data suggest that sexual maturity does not exert any independent effect on anaerobic fitness, once age, body mass, body composition are concurrently controlled for<sup>33</sup>. Improvements in neural adaptations with age, complete myelination

of nerve fibres, improved muscle coordination during multi-joint exercise and an improved capability to recruit motor units or more fully activate muscles help to explain age-related improvements in anaerobic fitness<sup>34</sup>. However, a full understanding of the development of anaerobic fitness awaits further research.

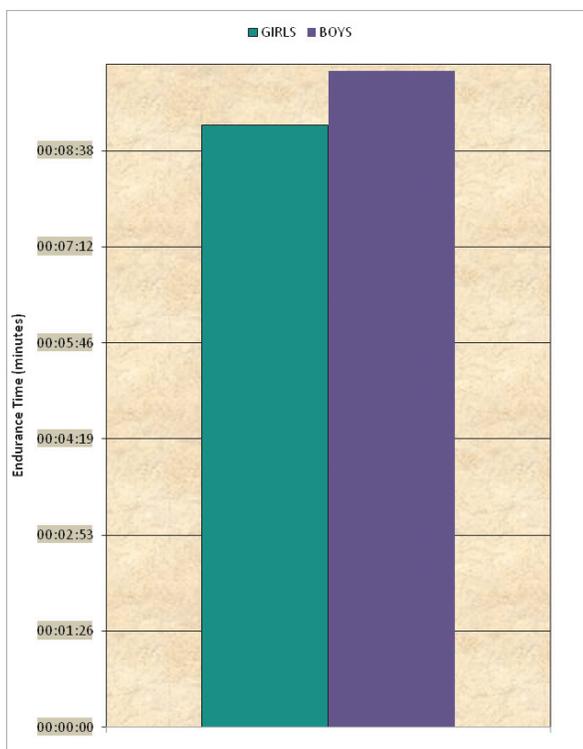
### CONCLUSION

Based on the results of the present study, in which we assessed the cardiovascular response to the treadmill stress test in normal 5 to 11 year old Urban Indian children and found that both girls and boys in the prepubertal stages had similar cardiopulmonary endurance times. Also recorded data show that there is no significant difference in both the vascular variables of Heart rate and

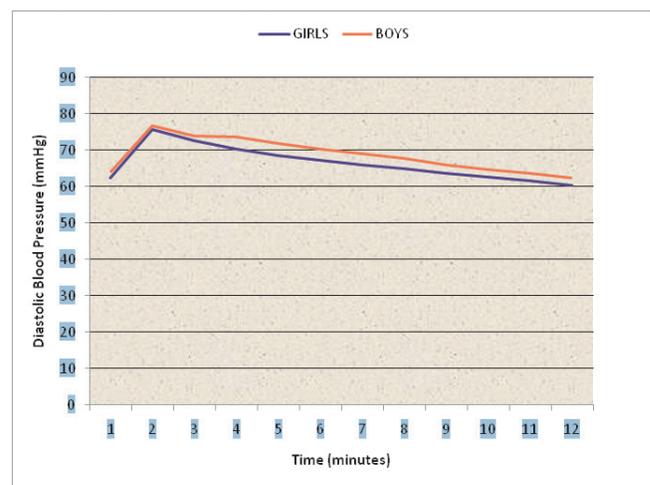
**Table 1: Comparison of Pre and Post Treadmill Stress Test (TST)**

VARIABLES	GIRLS		BOYS	
	MEAN	S.D.	MEAN	S.D.
Resting/Baseline Heart Rate (in beats/min)	97.9	8.3	96.1	10.8
Maximal HR After TST	197.2	9.4	199.0	5.2
Heart Rate Recovery time (in minute)	49:54	0:00	57:06	0:00
TST Endurance time (in minute)	9:08	1:25	10:00	1:15

**Graph Showing Comparison Of Mean Endurance Time Of Girls And Boys**



**Comparison Of Both Baseline Diastolic Blood Pressure And Its Decline From Maximal Value During Recovery In Boys And Girls**



Blood pressure in response TST both during Exercise and during Recovery.

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## Effect of Exteroceptive and Proprioceptive Sensory Stimuli on H Reflex and on Excitability of Nerve

Narkeesh A\*

Nidhi A\*\*

### ABSTRACT

**Objectives** To find out the effect of exteroceptive and proprioceptive stimuli on H reflex latency and on excitability of nerve and to compare these effects with different exteroceptive and proprioceptive stimuli., **Method and Procedure:** A sample of 30 normal healthy female subjects with age group between 19–25 years participated in study. Each subject was given different exteroceptive (Hot Pack, Cold Pack) and proprioceptive (Quick Stretch, Weight bearing) stimuli. For each stimuli pre and post readings were taken for H reflex latency and amplitude of H/M which suggests excitability of nerve. The effects were then analyzed for each stimulus and compared., **Results & Conclusion:** There was significant increase in the H reflex latency with cold pack and weight bearing. H/M ratio decreased with cold pack, quick stretch and weight bearing. On comparing the effect of different stimulus there was significant change in the latency with cold pack and hot pack and in the H/M between cold pack and hot pack and weight bearing. Thus with this study we can say that there is change in the latency of H reflex and on the excitability of nerve with different exteroceptive and proprioceptive stimuli.

**Key Words:** H- reflex latency, Excitability of nerve (H/M), Exteroceptive stimulus, Proprioceptive stimulus.

### INTRODUCTION

Our nervous system acts like a telephone system where information is transmitted from and to the brain. Any input which is given to the body from outside or inside the body brings changes in the output from the brain. In various neurological disorders there is problem in various sensory systems and also in motor response, affecting purposeful activity. In these cases treatment introduce the information to the client in the form of sensory input, the information is then transduced into chemical and electrical transmission and through ascending and descending pathways brings a response<sup>1</sup>.

H reflex is an electrophysiological study which tells about the peripheral nerve excitability with different sensory stimulus. Paul Hoffman described H-reflex in 1918. It is a monosynaptic reflex elicited by sub-maximal stimulation of the tibial nerve and recorded from the calf muscle<sup>2</sup>. H-reflex is extensively used as both a research tool and clinical tool<sup>3</sup>. H-reflex is the electrical analogue of the monosynaptic stretch reflex (Knee jerk reflex) evoked by electrically stimulating the afferent nerve instead of mechanically stretching the muscle spindle<sup>4</sup>.

H-reflex involves conduction from the periphery to the spinal cord<sup>5</sup>. The arc is that the stimulus travels along the Ia fibers, through the dorsal root ganglion and is transmitted to the anterior horn cell which fires it down along the alpha motor axon to the muscle. The outcome is a motor response. H-reflex is easily obtained in the soleus muscle<sup>2</sup>.

H reflex is accompanied by a motor wave M wave which is visible when the stimulation strength is increased from low stimulation

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strength. H reflex also measures the excitability of the nerve by estimating the peak to peak maximum H reflex amplitude to the M wave amplitude. It estimates the motorneuron pool activation and thus tells about excitability<sup>2</sup>.

The other H reflex parameter is the latency which measures nerve conduction along the entire length of the afferent and efferent pathways and is thus important in determining the peripheral and CNS disorders.

H reflex is highly modifiable by peripheral sensory inputs and the descending postural commands and is also modified by age, gender, body mass index, skin temperature and height<sup>6</sup>.

Various authors have studied the effect of different sensory stimulus on H reflex parameters. Susan Dewhurst et al 2005 studied the effects of temperature and reported that warming had no effect on H-reflex output in any group, cooling increased H-reflex output only in younger group. In both groups H latency increased with cooling and reduced with warming<sup>7</sup>. Calancie et al 2000 had studied the effect of lower extremity load (50%, 75%,100%) on motorneuron pool excitability in healthy individuals with four different stimulus (soleus H- reflex, soleus H- reflex with vibration, Achilles tendon reflex, Quadriceps tendon reflex) and concluded that load had no effect on the any of the reflexes<sup>8</sup>.

Our sensory system is divided into exteroceptive and proprioceptive system.

Exteroceptors include the skin thermoreceptors. They are of two type one for perceiving cold and another for perceiving hot. They are the receptive portion of the sensory neuron where warmth receptors are unmyelinated C fibers. Receptor for cold are small thin myelinated type A delta fibers which stimulate at around 15°C and reaches peak stimulation at around 24°C. Warmth receptors are stimulated at around 30°C and fades at around 45°C<sup>9</sup>.

Cold and warmth receptors are stimulated by the change in the rate of intracellular chemical reaction. When the sensory stimulus is of optimal intensity it results in the change in the voltage of the membrane, and generates receptor potential and when it rises above the threshold elicits action potential in the nerve fibers, and transmitted towards the CNS.

Heat and cold signals are carried by anterolateral pathway. The anterolateral fibers originate in the spinal cord mainly in dorsal horn lamina I, IV, V and VI. They reach into brain in the form of anterior and lateral spinothalamic tract. The tactile signals are transmitted into the ventrobasal complex and from here to the sensory cortex along with the signals from the dorsal column<sup>10</sup>.

The deep sensory receptors (proprioceptors) include muscle receptors and the joint receptors. Muscle receptors include muscle spindle, Golgi tendon organs, free nerve endings and pacinian corpuscles whereas joint receptors are Golgi type endings, free nerve endings, ruffini endings and paciniform endings.

Proprioceptive sense is carried by the dorsal column pathway. The nerve fibers of first order neuron enter the dorsal white column of the same side. The fibers travel upward as fasciculus gracilis and fasciculus cuneatus. The axons of second order neuron called internal arcuate fibers cross median plane and ascend as single compact bundle, the medial lemniscus. Then these fibers terminate by synapsing on the third order neuron in the ventral posterolateral nucleus of the thalamus. Then the axons pass through the posterior limb of internal capsule and corona radiata to reach the somesthetic area in the postcentral gyrus of the cerebral cortex<sup>10</sup>.

## STATEMENT OF THE STUDY

This study aimed at finding and comparing the effect with different exteroceptive and proprioceptive stimulus on latency and on excitability of nerve.

## INCLUSION CRITERIA

Normal BMI subjects between 19–25 years, right foot dominant (based on waterloo footedness questionnaire) and limb length and leg length between 75-99 cm and 27-49 cm respectively.

## EXCLUSION CRITERIA

Subjects having Neurological disorders, limb length discrepancies, any mental disorder, hyper sensitive to heat and cold, recent trauma and systemic illness.

## METHOD

Subjects were made to lie down and the limb length and leg length was measured. Subjects were given explanation about the procedure. Right posterior tibial nerve was stimulated at the popliteal fossa. Latency and amplitude of H and M wave was recorded.

## PROCEDURE

Subjects were conveniently selected based on inclusion and exclusion criterion. Procedure was explained and their consent was taken. They were made to lie down prone in a comfortable position to record the base value, posterior tibial nerve was stimulated in popliteal fossa and recording of H reflex latency and amplitude of H and M wave was done. After this lateral aspect of leg which corresponds to the cutaneous supply of the posterior tibial nerve is stimulated with cold pack for 5 minutes to activate the cold receptors, immediately after which recordings were done both for latency and amplitude. Then a gap of 10 minutes was given to stop the activation of these receptors. Again a basal recording was done followed by application of hot pack for 8 minutes to stimulate the heat receptors, and then both recordings were taken. From the data, H/M amplitude ratio was calculated to measure the excitability of nerve.

After a gap of 10 minutes a basal reading was taken then the subject were given a series of proprioceptive stimulus which are quick stretch for 10 times to stimulate the deep muscle receptors and recording of latency and amplitude of H and M wave was done. With gap of 10 minutes basal recording of same parameters was done and then subject was made to stand on floor for 5 minutes in full weight bearing and after which subject was

made to lie down prone again and readings were taken.

## DATA ANALYSIS AND RESULT

The data was analyzed using SPSS 10.0 software package. Paired t test was used for analyzing the dependent variables. One way Analysis of Variance (ANOVA) and Post hoc analysis by Schiffé's test was used for comparing the values of H reflex latency and ratio of amplitude of H/M. Mean and standard deviation of H reflex latency and H/M without application of any stimulus and after application of each exteroceptive (Hot pack, Cold pack) and proprioceptive (Quick stretch, Weight bearing) was calculated for both groups. To see the effect pre and post values were compared and to

	MD (PRE-POST) H LATENCY	Mean difference $\pm$ SD	Pre Vs Post	
			T value	P value
<b>COLD PACK</b>	Pre-Post MD	0.40 $\pm$ 0.31	-7.016	P < 0.05
<b>Hot Pack</b>	Pre-Post MD	-0.12 $\pm$ 0.55	1.221	P > 0.05
<b>Quick Stretch</b>	Pre-Post MD	0.17 $\pm$ 0.65	-1.468	P > 0.05
<b>Weight Bearing</b>	Pre-Post MD	0.29 $\pm$ 0.74	-2.155	P < 0.05

compare the effect of exteroceptive and proprioceptive stimulus multiple Schiffé's test was used. A 0.05 level of significance was used for all comparisons.

	MD (PRE-POST) H/M	Mean difference $\pm$ SD	Pre Vs Post	
			T value	P value
<b>COLD PACK</b>	Pre-Post MD	-0.22 $\pm$ 0.53	2.337	P < 0.05
<b>Hot Pack</b>	Pre-Post MD	0.19 $\pm$ 0.77	-1.348	P > 0.05
<b>Quick Stretch</b>	Pre-Post MD	-0.12 $\pm$ 0.24	2.800	P < 0.05
<b>Weight Bearing</b>	Pre-Post MD	-0.22 $\pm$ 0.36	3.412	P < 0.05

Table 1 shows the mean difference, t value and p value of pre and post H latency with cold pack, hot pack, quick stretch and weight bearing. Significant changes were found in the pre and post values of H latency with cold pack and weight bearing at  $p < 0.05$ .

Table 2 shows the mean difference, t value and p value of pre and post H/M with cold pack, hot

proprioceptive stimulus on H reflex latency and on H/M or excitability of nerve and to compare the H reflex latency and excitability of nerve with different exteroceptive and proprioceptive stimulus.

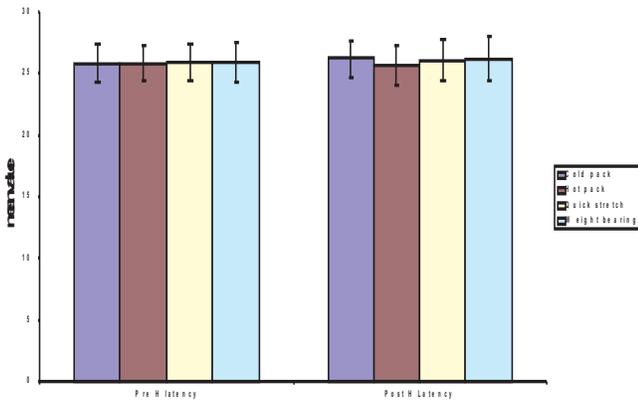
Thirty normal female subjects were taken on the basis of inclusion and exclusion criteria. The study was conducted at approximately the same time everyday. In all subjects measurements of H reflex latency and ratio of H/M which measures excitability of nerve was attained, analyzed and compared with exteroceptive stimulus (Cold Pack, Hot Pack) and proprioceptive stimulus (Quick Stretch, Weight Bearing).

After analysis of data it was found that there were significant changes in the H reflex latency with Cold Pack and Weight Bearing. When excitability of nerve was analyzed it was found that there was significant change in the excitability of nerve with Cold Pack, Quick Stretch and Weight Bearing. On comparison of H reflex latency with different exteroceptive and proprioceptive stimulus, there was significant changes in the mean difference (MD) of H reflex latency between Cold Pack and Hot pack. On the excitability of nerve there was significant difference in the mean difference of excitability of nerve between Cold Pack and Hot Pack and between Hot Pack and Weight Bearing.

In the current investigation, the result showed a significant increase in the H reflex latency with Cold Pack and Weight Bearing. However there was decrease in the H reflex latency with Hot Pack but the reduction in the latency was not statistically significant. Similarly with Quick Stretch the H reflex latency increased but was not statistically significant. With comparison with different stimulus, there was significant change in the H reflex latency between Cold Pack and Hot Pack, but noteworthy is that other stimulus failed to significantly alter the latency.

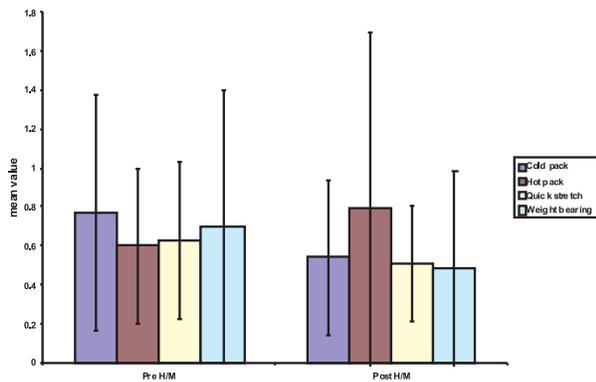
The change in the latency with different temperature could be due to the change in the rate of intracellular chemical reaction<sup>46</sup>. One probable explanation for increase in the H reflex latency with Cold receptors stimulation is that there is an increase in skin surface resistance with cold thus latency is increased or this could be due to the prolongation of the time for opening of the voltage gated sodium channel, thus reducing the

Comparison of mean value for H. Latency at Pre and Post sessions between Cold pack, Hot pack, Quick stretch and Weight bearing



Graph 2

Comparison of mean value for H/M at Pre and Post sessions between Cold pack, Hot pack, Quick stretch and Weight bearing



pack, quick stretch and weight bearing. Significant changes were found in the pre and post values with cold pack, quick stretch and weight bearing at  $p < 0.05$ .

**DISCUSSION**

This was an experimental study which determined the effect of exteroceptive and

conduction velocity and increasing the H reflex latency. This result is partially supported by Susan Dewhurst et al (2005) who concluded in their study that cooling increased H reflex latency (+5.3%) but the result of warming in their study had decreased the H reflex latency (-5.5%)<sup>7</sup> which is not in accordance to the result of the present study.

The result from the present study suggested significant decrease in the H/M or in the excitability of the nerve with Cold Pack, although there was increase in the H/M ratio with Hot Pack but it failed to achieve a significant value. Both proprioceptive stimuli (Quick Stretch, Weight Bearing) significantly decreased the H/M ratio. On comparing the H/M with different stimulus, it was found that there was significant change in the mean difference of H/M between Cold and Hot Pack and between Hot Pack and Weight Bearing.

One reason for this kind of a response could be that the quick stretch was given with knee extension and continuously for 10minutes so this could have inhibited the excitability of the motor neuron pool.

Takeshi Sato et al (1997) studied the effect of skin temperature variation from 33<sup>o</sup>ze to 22<sup>o</sup>ze on motor neuron pool excitability and found that motor neuron pool excitability exhibited maximum excitability when skin temperature was 26<sup>o</sup>ze and decreased with temperature above and below 26<sup>o</sup>ze<sup>11</sup>. In contrast to the result of the present study, Calancie B et al (2000) found that under static condition lower extremity motor neuron excitability is not affected by superincumbent load<sup>8</sup>. Egawa et al (2003) showed in their study that somatosensory input like weight bearing inhibits the soleus H reflex circuit during upright standing in humans. The explanation offered for this inhibition is the effect of segmental and supraspinal factors. The segmental factors consist of inhibitory interneuron and presynaptic inhibition of the Ia terminal and suggested that all these factors integrate in a presynaptic manner in the spinal cord to modulate the excitability of the alpha motor neuron pool of the soleus to allow a static posture to be maintained in humans<sup>6</sup>.

Thus we can accept our null hypothesis and alternate hypothesis partially. The alternate hypothesis is valid in terms of changes in the H

reflex latency with Cold Pack and Weight Bearing and on the H/M with Cold Pack, Quick Stretch and Weight Bearing. Between the different stimuli, alternate hypothesis is accepted for latency between Cold Pack and Hot Pack and for H/M between Cold Pack and Hot Pack and between Hot Pack and Weight Bearing. Null hypothesis is accepted for latency and H/M with Hot Pack. The latency of H reflex also accepts the null hypothesis with different stimuli.

To summarize the result of the study we can say that there was a change in the latency of the H reflex and on the ratio of H/M with different exteroceptive and proprioceptive stimulus.

## CONCLUSION

Significant effects were found in H reflex latency with Cold Pack and Weight Bearing and on H/M or excitability of nerve with Cold Pack, Quick Stretch and Weight Bearing.

The Multiple Comparison Schiffe's test results showed significant change is produced in H reflex latency with Cold Pack as compared to Hot Pack and other proprioceptive stimulus. Significant change in H/M or excitability of nerve was found with Cold Pack, Hot Pack and Weight Bearing.

Thus, it can be concluded that exteroceptive and proprioceptive stimulus has effect on H reflex latency and on the H/M ratio and can be used in clinical settings as a treatment measure to modify the motor response in neurological disorders.

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## Influence of Ankle Dorsiflexor torque on Balance Performance in Elderly

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Nidhi Yadav\*\*

### ABSTRACT

**Objective-** Ageing is associated with changes to the structure and function of the foot and ankle, and there is preliminary evidence that foot problems impair balance. The present study was done with the aim to study the effects of resisted ankle dorsiflexors exercises on balance in elderly individual with the help of balance measures FRT, BBS. The lower extremity muscle torque was evaluated using strain gauge., **Method-** 20 elderly subjects both males and females, age-group >60 years were divided into two groups: Group 1 (n=10) resisted exercises for 20 minutes and 4 sessions/week for 6 weeks and Group 2 (n= 10) was encouraged active life style. The balance scores were assessed using FRT, BBS., **Result-** Within group analysis shows that both groups had significant improvement in the variables ( $p < 0.05$ ) but there was no significant change between the groups ( $p < 0.05$ )., **Conclusion-** Interventions to improve the strength and flexibility of the foot improve balance and help to reduce the risk of falls.

### INTRODUCTION

An estimated functional 25 to 30% of adults aged 65 years and older fall each year.<sup>1</sup> Maintaining balance and performing functional task depends on interaction of multiple sensory, motor and integrative systems. These systems include vision, vestibular function, peripheral sensation, strength and reaction time. Functioning of each of these factors declines with age. By directly assessing an individual's physiological abilities, impairments in one or more physiological domains can be identified and their contribution to physical ability can be determined.<sup>2</sup> The likelihood of having difficulty in carrying out basic life activities increases as individual ages.<sup>3</sup> Fall in elderly generally affect their quality of life. Risk factors associated with

falls include musculoskeletal weakness, balance deficit, history of falls, visual deficit, gait abnormalities, cognitive impairments, arthritis, impaired activities of daily living, cardiovascular diseases, depression, medication, use of assistive device or age (>80 years). However, muscle weakness, impaired gait and diminished balance are the most significant risk factors for falling.<sup>(4)</sup>

Flexibility at ankle joints provide an important contribution to safe execution of many functional tasks (example walking, negotiating stairs, rising from a chair) and added efficiency in maintenance of postural ability. Ankle movements are also necessary for muscular responses used to maintain perturbations to balance, such as rapid compensatory stepping movements. Loss of joint range is considered to be a part of normal aging process. Therefore, decreased ankle ROM with age may compromise balance, thus limiting functional activities such as ambulation.<sup>(5)</sup>

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The ability to maintain control of posture is critical for the successful performance of most daily activities. Visual, vestibular and somatosensory signals are sent to the CNS, which can adjust body sway and posture by integrating the information and by controlling skeletal muscles

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to appropriately generate joint torque and adjust joint angles. Wolfson et al found that torque generated by the ankle muscles were reduced in older adults who were identified as having the greatest balance impairment on the sensory organization test. Impairment in any component of the postural control system can lead to instability and fall in older people. <sup>(6)</sup> Loss of balance and falls in the elderly constitute a major problem associated with human suffering as well as high costs for society. Falls might occur during various daily activities, such as tripping or tangling the feet, reaching movements or bending. Many of these activities are constrained by limits of stability (LOS). LOS can be described as the maximum distance a person can intentionally displace his/her centre of gravity, and lean his/her body in a given direction without losing balance, stepping or grasping. Ageing is associated with decreased LOS, muscle strength and foot sensation. Investigators have reported significant correlations between postural stability, quadriceps, ankle dorsiflexion and hand-grip strength, tibialis anterior latency and functional clinical balance testing among older adults. <sup>12</sup>

Impairment motor performance of an older individual is often characterized by a slowing of movements, a decline in muscle strength during growth and ageing have been a matter of sporadic scientific interest. Physiological evidence indicates that there is a 30-40% decline in isometric forces and approximately 18% reduction muscular mass between 2<sup>nd</sup> and 7<sup>th</sup> decade of life. Strength decline was found to correlate significantly with the type-2 fiber atrophy in old age. Simmonson et al (1947) found leg strength has been found to decline more rapidly with the age than handgrip. Maximum strength would be expected to depend on total number of muscle fibers recruited. Consequently, the assumed age dependent decrease in the total number of muscle fibers together with the muscle atrophy might be the primary cause of decline in the strength during ageing. Other mechanisms such as change in endocrine activity, reduction of the intra-muscular blood flow in the neuromuscular system and in contractile protein and protein metabolism have been suggested as associated with decline in muscle strength, with age and may cause the decrease in the total number of muscle fibers. <sup>(7)</sup>

Maximum isometric force decreases, the muscles fatigue more rapidly and the rate of tension development is slower. Concentric contractions are more affected by age related changes in the neuromuscular system than are eccentric contractions. When poor posture exists, many unfavorable changes takes place altering the structures of the parts, disturbing their normal relations and the normal muscular balance is lost. Elderly people with the history of falls had less than non-fallers. The difference was more prominent at ankle than knee and was most pronounced in the ankle dorsiflexors. <sup>(8)</sup>

Studies by Sunil Bhatia, et al show that Lower limb and trunk muscle strengthening have positive effect on balance improvement in elderly however no significant differences in clinical outcome between the two groups. <sup>(8)</sup> Shalini Grover & Abha Khurana found a significant differences in ankle and subtalar range of motion and balance scores in females implying correlations exists between ankle dorsiflexors ROM and balance in females <sup>(5)</sup>. Study by Hylton B. Menz, et al stated that foot and ankle characteristics particularly ankle flexibility, plantar tactile sensation and strength of toe plantarflexors muscles, are significant independent predictors of balance and functional ability in older people. Programs to improve the strength and flexibility of the foot and intervention to augment plantar sensation may be beneficial in improving mobility and reducing the risk of falls. <sup>2</sup>

As studies have shown that improving ankle ROM, especially dorsiflexion has a positive correlation with balance and studies have seen the effect of improving general lower extremity muscle strength on balance, the present study was done with the aim to study the effects of ankle dorsiflexor torque on balance measurements in elderly and the influence of resisted ankle dorsiflexors exercises on balance in elderly individual with the help of balance measures (FRT, BBS) and IADL was studied. One reliable and valid performance-based functional measurement test is the berg balance scale that addresses various static and dynamic functional capabilities in sitting and standing. <sup>(9)</sup> The functional reach test evaluates the maximal distance a person can reach forward while maintaining a fixed base of support. <sup>(10)</sup> Lower extremity muscle force was evaluated using strain

gauge. Studies have shown that the strain gauge to be reliable tool for clinical measure testing. <sup>(7)</sup> The Lawton IADL is an easy to administer assessment instrument that provides self-reported information about functional skills necessary to live in the community. <sup>(11)</sup>

## METHODOLOGY

Study design was experimental in nature.

Sample 20 subjects (n=20) were included in the study, randomly assigned into 2 groups, Group A (n=10) training group and group B (n=10) control group. Subjects were recruited from physiotherapy OPD of Banarsidas Chandiwala Institute of Medical Sciences and residents of Karol Bagh. Inclusion Criteria was elderly individuals, age group 65-75 years (both males and females), ability to walk without assistive devices and asymptomatic degenerative conditions like osteoarthritis, lumbar spondylosis etc. <sup>(7)</sup> Exclusion Criteria was presence of any musculoskeletal impairment that could account for possible imbalance and falls such as cardiovascular accidents, cardiac problems, transient ischaemic attack or lower limb joint replacement, <sup>(7)</sup> presence of any neurological impairment such as Parkinson's disease, stroke, Multiple Sclerosis, etc. Persons undergoing balance training and strengthening exercise training for lower limbs, Uncooperative patients, those having any severe respiratory or peripheral vascular diseases, recent fracture in lower limb or upper limb, arthroplasty of hip, knee and ankle, acute symptoms of Lumbar spondylosis and Cervical spondylosis and Rheumatoid arthritis

Dependent variables were BBS, FRT, IADL and Strain gauge and Independent variable was Dorsiflexors strengthening exercises. Patients were explained about the nature and purpose of the study and written informed consent was taken from those willing to participate in the study. In both the groups, the measures of balance (FRT, BBS) and IADL and ankle dorsiflexors muscle force using strain gauge was done as base line measurement on the first day (pre-test scores) prior to start of study, and repeated after 6 weeks at the completion (post test scores).

GROUP A - resisted exercise training for ankle dorsiflexors muscles was done with the patient in supine lying position; manual resistance applied to dorsum of foot to resist dorsiflexion while stabilization applied to lower leg; hold time 30 sec, rest time 30 seconds after each contraction (to avoid fatigue). Duration of exercise training - 20 minutes/session and 4 sessions/ week for 6 weeks was done.

GROUP B - no intervention except encouragement for performing their usual activities of daily living independently.

## RESULTS

SPSS-8 was used for data analysis. Paired T-Test applied within the group, unpaired T-Test applied between groups. Level of significance p-value < 0.05 considered significant. The mean pre-test scores for FRT, BBS & Strain gauge nearly the same for both groups indicating both groups were same at starting point. Paired t-test was applied to compare the pretest (Base line score i.e 0 sessions) and post test (completion of 6 weeks) for FRT, BBS & Strain gauge. Within group significant improvement seen in FRT, BBS & Strain

	GROUP	N	Mean	Std. Deviation
FRT PRE	Exp. (1)	10	16.56	3.768
	Cont.(2)	10	17.10	4.094
FRT POST	Exp. (1)	10	23.65	4.956
	Cont.(2)	10	19.92	4.371
BBS PRE	Exp. (1)	10	48.40	4.551
	Cont.(2)	10	48.60	2.989
BBS POST	Exp. (1)	10	52.80	2.936
	Cont.(2)	10	51.00	2.944
SG PRE	Exp. (1)	10	4.05	1.860
	Cont.(2)	10	4.13	1.546
SG POST	Exp. (1)	10	6.92	2.218
	Cont.(2)	10	5.19	1.537
IADL PRE	Exp. (1)	10	3.60	.843
	Cont.(2)	10	5.20	1.317
IADL POST	Exp. (1)	10	3.60	.8433
	Cont.(2)	10	5.20	1.3166

**Independent Samples Test**

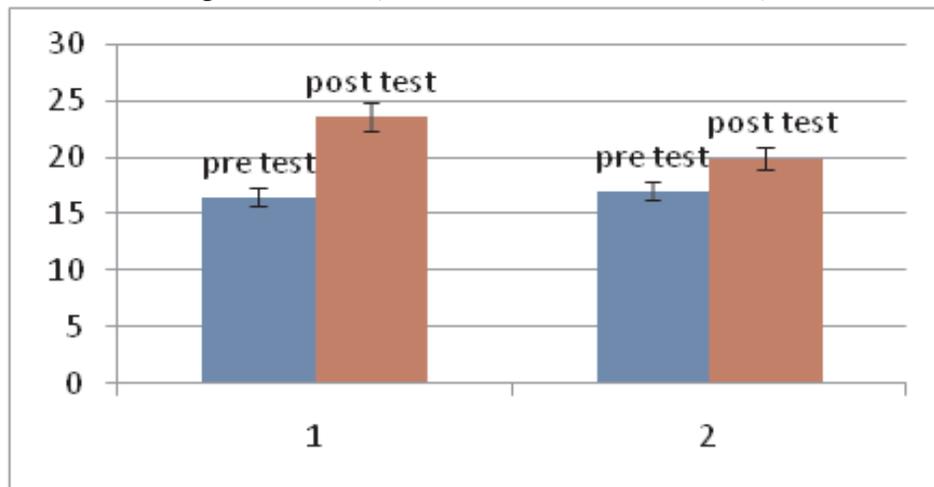
	t-test	Significance (2-tailed) P<0.05
FRT (PRE)	.307	>0.05
FRT(POST)	1.785	>0.05
BBS (PRE)	.116	>0.05
BBS(POST)	1.369	>0.05
SG (PRE)	.111	>0.05
SG (POST)	2.024	<0.05
IADL (PRE)	3.236	<0.005
IADL(POST)	3.236	<0.005

**Paired Samples Test**

		EXPERIMENTAL GROUP (GROUP 1)		CONTROL GROUP (GROUP 2)	
		t-test	Sig.( 2-tailed) P<0.05	t-test	Sig ( 2-tailed) P<0.05
Pair 1	FRTPRE- FRTPOST	7.870 <sup>*</sup>	<0.05	8.880	<0.05
Pair 2	BBSPRE - BBSPOST	6.736	<0.05	6.000	<0.05
Pair 3	SGPRE - SGPOST	5.327	<0.05	4.999	<0.05

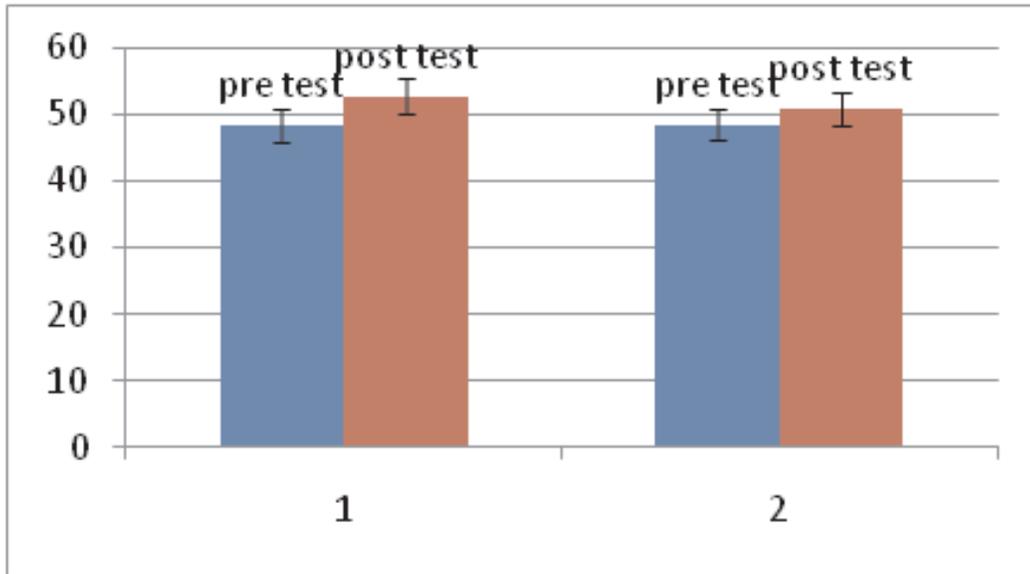
MEAN % IMPROVEMENT	GROUP 1(N=10)	GROUP 2 (N=10)
Functional reach test	42.8%	16.49%
Berg balance scale	8.884%	4.938%
Strain Gauge	70.99%	23.257%

**Figure 1: FRT (PRE AND POST test scores)**



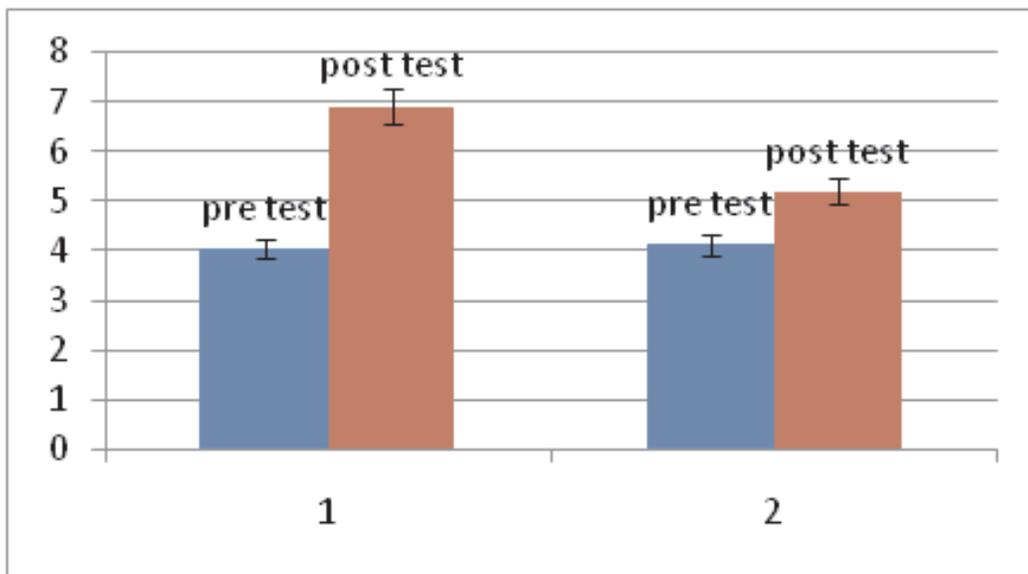
1- EXPERIMENTAL GROUP, 2- CONTROL GROUP

**Figure 2: BBS (PRE AND POST test scores)**



1- EXPERIMENTAL GROUP, 2- CONTROL GROUP

**Figure 3: STRAIN GAUGE (PRE AND POST test scores)**



1- EXPERIMENTAL GROUP, 2-CONTROL GROUP

gauge scores in both group A and group B (p-value < 0.05).

**GROUP STATISTICS**

**DISCUSSION**

The results of the study show an increase in the FRT, BBS and ankle dorsiflexors muscle torque in both groups, though no statistically significant improvement seen when both groups were

compared except in ankle dorsiflexors muscle strength. The study helps us decipher that improving ankle dorsiflexors muscle strength as well as encouraging elderly to maintain their active life style, thus maintaining their ankle ROM helps improve balance.

Study by Hylton B. Menz et al, also show that programs to improve the strength and flexibility of the foot and intervention to augment plantar sensation may be beneficial in improving mobility and reducing the risk of falls. <sup>(2)</sup>Contribution of

sensorimotor factors<sup>(2)</sup> and flexibility at the ankle joints<sup>(5)</sup> by maintaining an active life style contributed to improved scores in FRT, BBS and muscle strength in control group.

By constant use of the ankle and foot muscles the strength and range of motion was maintained & improvement in FRT scores. The capacity to control one's balance while leaning or bending is critical to daily living. A measure of leaning or bending, AP-LOS, may be influenced by (i) ankle muscle strength; (ii) ankle range of motion and (iii) mechanoreceptor sensitivity in the feet.<sup>12</sup> Increased FRT scores reflected increase in muscle force, joints flexibility, balance control as well as self confidence and psychological well being. The possible reason may be that anterior translation of the body during forward reaching, getting up from seated position and walking requires adequate dorsiflexion range of motion which allows superincumbent body weight to rotate over the foot. Ankle dorsiflexion also stops the backward movement produced by the destabilizing force and helps to create an anteriorly directed counter-moment and helps re-equilibrate the body.<sup>(5)</sup>

As the only source of direct contact with the ground during weight-bearing tasks, the foot contributes to the maintenance of stability in two main ways: (i) by providing mechanical support for the body via the osteoligamentous architecture of the arch and the coordinated function of lower limb muscles, and (ii) by the provision of sensory information regarding body position from plantar tactile mechanoreceptors. It is therefore likely that deficits in foot posture, flexibility, strength, or sensation impair this support function and predispose to loss of balance.<sup>2</sup> This could be the reasons for results seen in both the groups.

Study by Shehab M. Abd El- Kader showed that exercise training in older adults resulted in decrease in stance postural sway and the exercise group had fewer falls during their experimental tests of balance compared with subjects who did not exercise.<sup>(1)</sup>

The strengthening exercises had positive effect on muscle strength. It has been well established that aging is associated with loss in muscle strength. The resistance training is recognized as beneficial for the health. Progressive resisted exercises in elderly produce the strength that result

from the increased motor unit activation of trained muscles and hypertrophy of muscle fibres. In a study done by Laidlaw DH, strength training improves the steadiness of slow lengthening contractions performed by older adults. The older aged should focus on increasing and maintaining the lower extremity strength and power across a range of intensities in order to decrease the functional limitation and disability.<sup>(8)</sup>

IADL scores were not affected much to start with since the patients were not bed-ridden or having much chronic disabling conditions.

## CONCLUSION

Both treatment techniques were effective in improving balance measures. Interventions to improve the strength by resistive training of ankle dorsiflexors and flexibility of the foot by encouraging in independent ADL's, improves balance and help reduce the risk of falls in elderly.

## CLINICAL RELEVANCE

A simple exercise of improving ankle dorsiflexors muscle strength in all elderly individuals to improve balance should be undertaken and emphasized in clinical practice. While teaching exercises to patients with OA (knee & hip joints), Lumbar Spondylosis or any other degenerative condition as well as geriatrics healthy population also, considerations should be taken to improve ankle dorsiflexors muscle torque & improve their balance along side. Training to avoid falls should consider functional ankle strength training as well as improvement in ankle range of motion.

## LIMITATIONS OF THE STUDY

1. There could be minor variations in the manual resistance applied by the therapist, though for this the same therapist has applied resistance.

## FUTURE STUDIES

3 month follow-up can be undertaken.

Comparison of ankle dorsiflexors and plantarflexors muscle strength in balance improvements.

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## To study the effect of body mass index on postural balance

Savita Tamaria\*

Kulmani Sirohi\*\*

### ABSTRACT

The purpose of this study was to determine the correlation of BMI on postural balance. **Methods:** A sample of 30 male's subjects took part in the study. All the 30 male volunteer were randomly divided into three groups according to their body mass index as Underweight (Group A), Normal (Group B), and Overweight (Group C) then two balance tests were carried out to evaluate the correlation between body mass index and postural balance. **Results:** showed that high body mass index (BMI) demands more displacements to maintain postural balance. Thus "High body mass index (BMI) effect the postural balance". **Conclusion:** high body mass effects the postural balance

**Key Words:** Body Mass Index, Functional Reach Test, Time up & go Test

### INTRODUCTION

Balance is defined as the process that maintains the centre of gravity within body's support base and requires constant adjustments that are provided by muscular activity and joint positioning. The ability to balance and maintain a stable posture is integral in the execution of most movements. Most nervous and musculoskeletal system diseases can alter this balance control.<sup>1</sup>

Maintaining postural balance requires sensorial detection of the body's movements, integration of sensory-motor information into the central nervous system and appropriate motor response. Muscular control and dynamic maintenance of balance involve the activity of coordinates of muscular kinetic chains<sup>2</sup>. Adipose tissue accumulation and body mass increase can cause a reduction in the body balance and be a major contributing factor concerning falls, particularly

when combined with low muscular mass, which can generate biomechanical failure of muscular responses and loss of stability mechanisms<sup>3</sup>.

The body mass index (BMI) or Quetelet index is a heuristic measure of body weight based in person's weight and height. It was invented between 1830 and 1850 by the Belgian polymath Adelphe Quetelet during the course of developing "social physics". Body mass index is defined as the individual's body weight divided by the square of his or her height. Its unit of measure is  $\text{kg}/\text{m}^2$ .<sup>4</sup> While the formula previously called as Quetelet index for BMI new term "body mass index" was published in 1972 in the journal of Chronic Disease by Ancel Keys<sup>5</sup>. It is a diagnostic tool of classifying sedentary (physically inactivity) individuals with an average body composition.

A BMI of 18.5 to 25 may indicate of optimal weight, a BMI lower than 18.5 suggest the person is underweight while the value above 25 indicates the person is overweight<sup>6</sup> The BMI is generally used as a means of correlation between groups related by general mass and can serve as a vague means of estimating adiposity<sup>7</sup>.

Multiple assessment instruments have been done and evaluated focusing on different aspects of physical performance. Among the physical

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performance test measure for body mass index, are the Functional reach test and Timed Up and Go test.

The Functional Reach Test is an assessment tool for balance first developed by Duncan et al in 1990. According to this study, the Functional Reach Test is the maximal distance one can reach forward beyond arm's length while maintaining balance over a fixed base of support. Age-related norms for functional reach have been determined for American population. Scores of less than 7 inches are indicative of a frail individual who is limited in mobility and activity of daily living skills and who demonstrates increased fall risk<sup>8</sup>.

The Timed Up and Go test was developed by Podsiadlo and Richardson. Timing with a stopwatch begins when the patient is instructed with "go" and ends when the patient returns to the starting position in the chair. Low score of completion of task in less than 10 seconds correlates with good functional independence, and high score of completion of task in more than 20 seconds correlates with poor independence and higher risk of falls<sup>9</sup>.

The purpose of this study was to find out the correlation between body mass index and postural balance.

## AIM AND OBJECTIVES

To evaluate the correlation between body mass index and postural balance.

## MATERIAL & METHODS

A sample of 30 male's subjects took part in the study. The subjects of this study were students of BanarsidasChandiwala Institute of Physiotherapy, Kalkaji, New Delhi.

All the 30 male volunteer were randomly divided into three groups according to their body mass index as Underweight (Group A), Normal (Group B), and Overweight (Group C) then Functional Reach Test & Time Up & Go Test was performed on them.

A Correlation study design was used in this study to compare the correlation between body

mass index (BMI) and postural balance using Functional Reach Test (FRT) and Timed Get Up and Go Test (TUG).

## INCLUSION CRITERIA

Age group of 20-30 years, No physical activity for minimum of six months, Absence of neurological, cardiovascular, metabolic, rheumatic or vestibular diseases, No injuries or previous surgery on the leg, The subjects must be ready to take the physical tests, during the course of study.

## EXCLUSION CRITERIA

Less than 20 years of age, Less than 90 degree of shoulder flexion, Unable to follow a three step command, Unable to stand unassisted for 60 seconds, Hip or knee joint replacement, Weight bearing pain in the lower limb.

## VARIABLES

The dependent variables for this study were Functional Reach Test (FRT), Timed Get up and go test (TUG). independent variables were Body Mass Index (BMI)

## PROCEDURE

1. The purpose of the study was explained to the subjects and they were encouraged to participate in the study.
2. Subjects were taken in the study, only if they met the inclusion criteria.
3. The study was initiated only after taking an informed consent from the subject.
4. Subjects were randomly divided into three groups according to their body mass index as Underweight (Group A), Normal (Group B), Overweight (Group C).
5. Verbal description of the procedure was given to the subject. After this, the demographic data was collected, which included Age (years), Weight (kg), Height (cms), etc.

6. A base line assessment of the subject was done prior to the start of the study.

7. Following this, the Functional Reach Test (FRT)- A yardstick is attached to a wall at about shoulder height. The patient is positioned in front of this so that on flexing the shoulder to 90 degree and initial reading on the yardstick can be taken. The examiner takes a position 5-10 feet away from the patient viewing the patient from the side. Position the patient close to the wall so that they may reach forward along the length of the yardstick. The patient is instructed to stand with feet shoulder distance apart then make a fist and raise the arm up so that it is parallel to the floor. The examiner take an initial reading on the yardstick, usually the knuckle of the third metacarpal. The patient is instructed to reach forward along the yardstick without moving the feet .The therapist take a reading on the yardstick of the farthest reach attained by the patient

without taking a step.<sup>10</sup> ( Refer Fig 1 ) The initial reading is subtracted from final to obtain the functional reach score. and Timed Up and Go Test (TUG)- Performed with the patient wearing regular footwear and sitting back in the chair with arm rest. On the word, "GO" the patient is asked to stand up from the arm chair, walk 3 meters (in a line) then turn and walk back to chair and sit down again. was conducted according to the standardized protocol.<sup>11</sup>

Subjects were instructed to inform immediately in case of any discomfort during the test. The therapist will record three readings, each reading has been taken at a gap of 5 minutes for both the tests (FRT & TUG) and a rest period of 10 minutes was given between the two tests. The data thus collected in data collection form was recorded.

**Figure 1: Subject performing Functional Reach Test (FRT).**



**Figure 2: Subject performing Timed Get Up and Go test (TUG)**

### DATA ANALYSIS, CORRELATION COEFFICIENT(r)

Pearson product -moment correlation coefficient, also known as  $r$ ,  $R$ , or Pearson's was used to measure the strength of the linear relationship between two variables that is defined in terms of the (sample) covariance of the variables divided by their (sample) standard deviations.

Formula:

$$r = \frac{\sum (X - \bar{X})(Y - \bar{Y})}{N \sigma_X \sigma_Y}$$

Where  $r$  = coefficient of correlation;

$\bar{X}$  =  $\frac{\sum X}{N}$  i.e., derivation of the item of series  $X$  from the mean ( $X$ );

$\bar{Y}$  =  $\frac{\sum Y}{N}$  i.e., derivation of the item of series  $Y$  from the mean ( $Y$ );

$\sigma_X$  = standard derivation of series  $X$ ;

$\sigma_Y$  = standard derivation of series  $Y$ ;

$N$  = number of pairs of observations.

### RESULTS

Correlation of outcome variables of Group A (Underweight) Mean & SD FRT was 6.69, 2.41 respectively for TUG Mean & SD was 8.48, 2.55 respectively.

Correlation of outcome variables of group B (Normal) Mean & SD FRT was 15.03, 4.58 respectively for TUG Mean & SD 7.51 2.20 respectively.

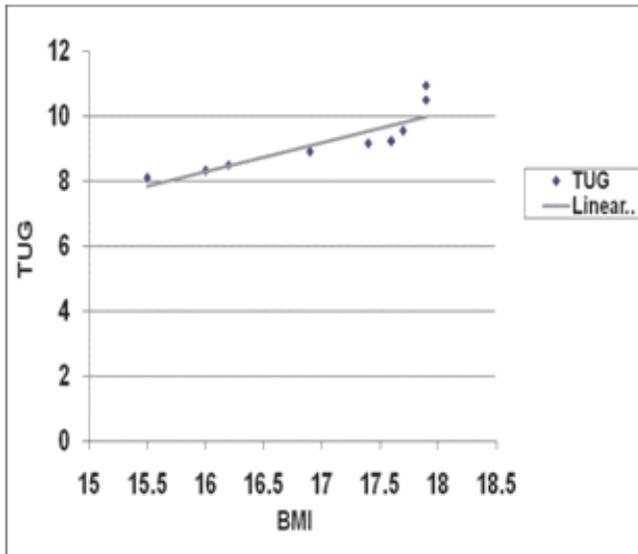
Correlation of outcome variables of Group C (Overweight) Mean & SD FRT was 8.35, 3.49 respectively for TUG Mean & SD 8.95, 1.59 respectively

Correlation coefficient of body mass index (BMI), Functional reach test (FRT) and Timed Up and Go test (TUG) in Group A, was TUG  $r = 0.855$ , FRT  $r = -0.48$

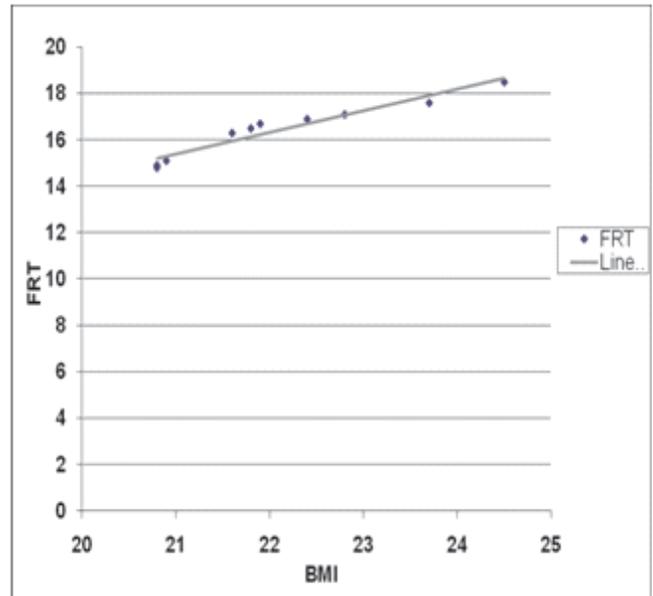
Group B TUG  $r = 0.987$ , FRT  $r = 0.964$

Group C TUG  $r = 0.811$ , FRT  $r = -0.32$

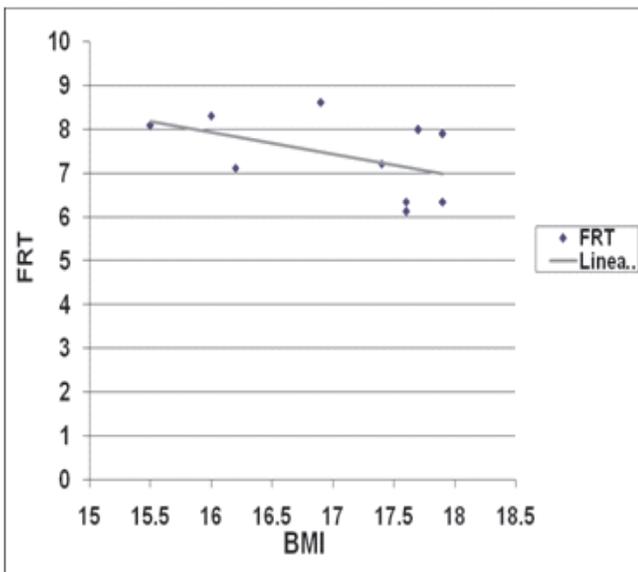
**Fig 3: Correlation between BMI and TUG in Group A (Underweight)**



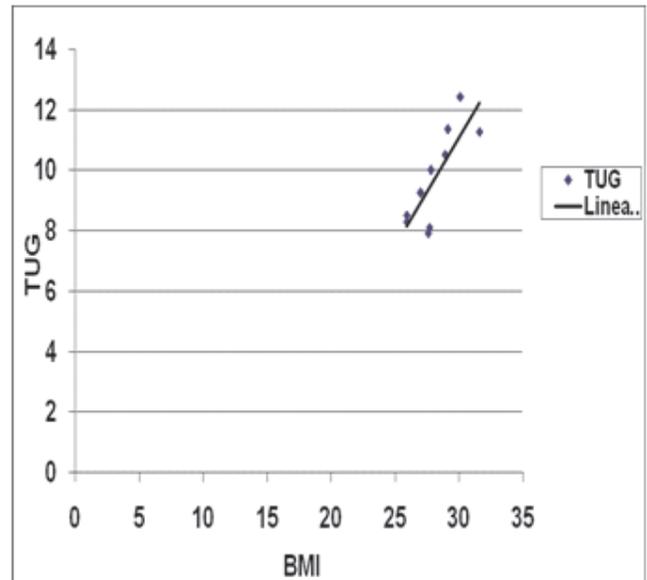
**Fig 6: Correlation between BMI and FRT in Group B (Normal)**



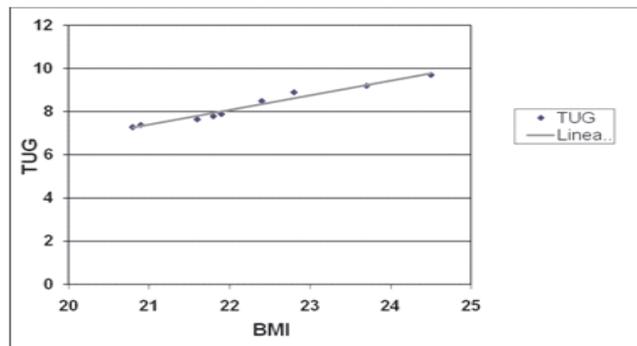
**Fig 4: Correlation between BMI and FRT in Group A (Underweight).**

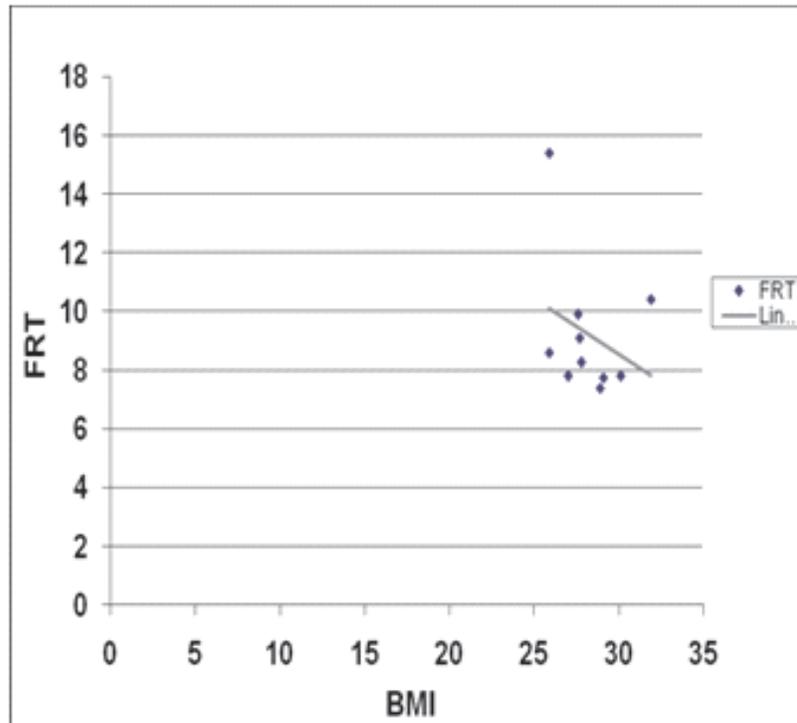


**Fig 7: Correlation between BMI and TUG in Group C (Overweight).**



**Fig 5: Correlation between BMI AND TUG in Group B (Normal).**



**Fig 8: Correlation between BMI and FRT in Group C (Overweight).**

## DISCUSSION

Proper balance control is a key aspect of activities of daily living. Balance is the process that maintains the COG within the body's support base. Balance emerges from a complex interaction of sensory (afferent) systems, motor (efferent) systems and CNS integration processes<sup>25</sup>. Studies have demonstrated that BMI is used to assess an individual's body weight relative to what is normal or desirable for a person of his or her height. Therefore, clinical assessment of individual's response to exercise is important, as it provides global examination of the sensory, motor and CNS system. Therefore, it is necessary to assess the BMI of individual, as we know that body weight is a strong used clinically to assess the postural balance. The most popular Functional Reach Test (FRT), The Berg Balance Scale, Timed Walking Test and Timed Get Up and Test (TUG).

Functional Reach Test and Timed Get Up and Test are the clinical tool that assesses balance in patients with difficulties in maintaining postural stability. There are many studies done clinically to determine that increase in the body weight leads to improper body mass index which may

affect on their work posture and flexibility, but not much is done to determine these factor in healthy individual. Therefore, this study was undertaken to provide a statistical data regarding the correlation between body mass and balance in the adult population.

This study showed a positive correlation between body mass index and increased postural instability (greater shifts required in order to keep postural balance) and was in agreement with Hills (1991), who affirmed that excess weight and low level of physical activity increased postural instability<sup>12</sup>. The authors report that obesity (high body mass index) will affect the selection of motor strategies employed to maintain postural balance<sup>13</sup>

The result of the current study showed that the mean score of Functional Reach Test and Timed Get Up and Go Test for Group A ( underweight) is 6.69 and 8.48 , Group B ( normal ) is 15.03 and 7.513 and Group C ( overweight ) is 8.38 and 8.95 . The mean difference indicate that high body mass index is significantly correlated with decrease score of Functional Reach Test and decrease in flexibility and the timed get up and go test duration was increased in these subjects when compared with normative data. The correlation

coefficient between two indexes (TUG and BMI) in Group (A) and Group (C) is positive which indicate highly significant correlation between body mass and posture stability. The correlation coefficient between (FRT and BMI) in Group (A) and Group (C) is negative which indicate that with increase in body mass index, the score of FRT decreases results in decrease in flexibility and postural dysfunction. This correlation degree allows us to safely infer that the mechanical factor provided by the inertia of the body mass and the effort to balance it against the force of gravity through muscular action is an important element when maintaining posture<sup>14</sup>.

These results safely suggest that incorporating the evaluation of body mass index, plus the subjects response to the functional balance tests, can help to understand and thus we use this correlation in order to prevent falls and others incapacities of individuals with high body mass index. A 20% increase in body mass reduces the ability to make adjustments in response to external disturbances in the orthostatic position and increase postural instability<sup>15</sup>.

The author JasabantaSethi (2008) conducted a study to indentify the correlation between different body mass index with dynamic posture and flexibility of computer workers. A significant correlation was seen with high body mass index in computer workers with increase scores of dynamic posture and decrease flexibility because increase in body weight can cause alteration in the activity of coordinates of muscular kinetic chain. This study provides the insight to the therapist about the relationship between and posture and flexibility.<sup>16</sup>

Many studies have demonstrated that the anthropometric values such as height, arm's length, age, trunk length and shoulder length were found to affect functional reach score.

The author Veronica Southard conducted a study in 2008, to assess the effect of body mass index on postural stability in the healthy sedentary individuals. While determining the body mass index, the postural control was assessed by TUG test and it was concluded that TUG test duration was increased in these (high BMI) overweight subjects as their gait speed reduced

due to the increase in the body weight. Another study states that residential and mobility status were also identified as the strongest predictors of TUG test performance.<sup>17</sup>

Excessive adiposity can also initiate the risk of slipping during walking. It has been demonstrated there is an exponential increase in ankle torque requirements as the body fat increases (Corbeil, Simoneau&Rancourt, 2001). In addition increased body mass leads to increased moment of inertia about ankle joint (Corbeil, et al 2001), which may present as a disadvantage in the reactive - recovery phase of a typical slip -induced falls.

In year 2007 Angyan L and Teczely T conducted a study to examine the relation ship between body balance functions and body characteristics, motor abilities and reaction time. The results of the study concluded that the increase in body mass index, back muscle strength and endurance capacity is associated with better postural stability. But in contrast to this study many studies states that body weight is a strong predictor of postural stability (Olivier Hue, 2007).<sup>18</sup>

Thus, in support of many studies done in past and the current study it can concluded that the individual with high body mass index maintain shorter times in balance and longer times unbalanced as compared with non -obese individuals, such that obesity would influence the limits of postural stability.

## CONCLUSION

Based on the results of the present study, it can be concluded that high body mass index (BMI) demands more displacements to maintain postural balance. Thus it was found that "High body mass index (BMI) effect the postural balance" holds true.

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This century will be the century of the brain. Intelligence will define success of individuals; it remains the main ingredient of success. Developed and used properly, intelligence of an individual takes him to greater heights. Ask yourself, is your child intelligent! If yes, is he or she utilizing the capacity as well as he can? I believe majority of people, up to 80% may not be using their brain to best potential. Once a substantial part of life has passed, effective use of this human faculty cannot take one very far. So, parents need to know how does their child grow and how he becomes intelligent in due course of time. As the pressure for intelligence increases, the child is asked to perform in different aspects of life equally well. At times, it may be counter-productive. Facts about various facets of intelligence are given here. Other topics like emotional intelligence, delayed development, retardation, vaccines, advice to parents and attitude have also been discussed in a nutshell. The aim of this book is to help the child reach the best intellectual capacity. I think if the book turns even one individual into a user of his best intelligence potential, it is a success.

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This book has been addressed to young doctors who take care of children, such as postgraduate students, junior doctors working in various capacities in Pediatrics and private practitioners. Standard Pediatric practices as well as diseases have been described in a nutshell. List of causes, differential diagnosis and tips for examination have been given to help examination-going students revise it quickly. Parent guidance techniques, vaccination and food have been included for private practitioners and family physicians that see a large child population in our country. Parents can have some understanding of how the doctors will try to manage a particular condition in a child systematically. A list of commonly used pediatric drugs and dosage is also given. Some views on controversies in Pediatrics have also been included. Few important techniques have been described which include procedures like endotracheal intubations, collecting blood samples and ventilation. I hope this book helps young doctors serve children better.

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