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Original Research Article

MANAGEMENT OF POSTURAL LOW BACK PAIN AMONG THE INFORMATION TECHNOLOGY PROFESSIONALS: A MULTIPLE THERAPUETIC INTERVENTION APPROACH

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ABSTRACT

Objective: This study aimed to find out the effectiveness of multiple therapeutic intervention combinations to manage Postural Low back pain among the Information Technology [IT] Professionals.

Study design: The randomized control study design.

Materials and Methods: All the subjects (N=90) were randomized into three groups which consists of one control and two experimental groups. The subjects in the Experimental group I were given Motor Control Training and Ergonomic Training whereas the Experimental group II were given Myofascial Release, Motor Control Training and Ergonomic Training was given for a period of 6 weeks that includes first 3 weeks of Myofascial Release along with Motor Control Training and Ergonomic Training, further the Motor Control Training and Ergonomic Training was continued for the period of 4 to 6 weeks duration. The subjects in the control group were not given any therapeutic modalities throughout the study. The effectiveness of the therapeutic interventions were measured through three outcome parameters such as Back pain intensity, Back pain disability and Transversus Abdominis muscle strength. The Analysis of Covariance and Scheffe's post hoc tests were applied to study the treatment effectiveness. The effectiveness of the therapeutic intervention at three different time intervals was also analyzed using repeated measures ANOVA and if found significant, a Newman Keul's post hoc tests was employed to study the significance between two time intervals.

Results & Conclusion: The results of this study concluded that the Experimental group-II is found to be better than Experimental group-I and Control group in the reduction of Low Back pain intensity, Back pain disability and Transversus Abdominis muscle strength of the Software professionals with Postural low back pain.

KEY WORDS: Postural Low back pain, Myofascial Release, Information Technology employees, Ergonomic Training, Motor Control Training.

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INTRODUCTION

Information Technology profession involves the use of computers and the employees belonging to this profession spend majority of their work time with computers. The job domain of the information technology industry requires the professionals to perform repetitive monotonous tasks in the sedentary sitting position that makes them prone to work related musculoskeletal disorders (WRMSDs). WRMSDs describe a wide range of inflammatory and degenerative disease conditions that result in pain and functional impairment affecting the neck, shoulders, lower back, elbows, wrists, and hands [1]. Likewise, Postural back pain is a major public and occupational health problem which are highly prevalent among the information technology (IT) and BPO sectors [2]. Several risk factors are contributing to the occurrence of this occupational health problem among the IT workers and are categorized as individual, work-related physical risk factors, work related psychosocial and occupational risk factors [3]. The work related physical risk contributing to the occurrence of Low Back Pain (LBP) among IT workers include faulty posture, repetitive tasks, lack of ergonomic knowledge and poor workstation arrangements. A previous study indicated that poor workstation ergonomics has been shown to significantly contribute to the development of LBP [4]. Specifically, the chair design and the utility of backrest and arm support which varies according to the workplace and individual preferences influence the level of back strain [5].

The presence of computer in the workplace leads to a set of peculiar characteristics of the workstation which require the workers to stay in a static posture for long periods [6] and it is most frequently cited risk factors leading to musculoskeletal disorders [7]. This deviation from normal alignment may suggest the presence of imbalance and abnormal strain on the musculoskeletal structure [8]. Further, an accumulated computer usage has been linked to increased risk of LBP [9]. Specifically, sitting for more than half a day at work in combination with awkward postures or frequently working in a forward bent position has been found to increase the likelihood of having LBP [4,10]. Studies also indicated that specific tasks performed while sitting in an ergonomically unfit chair for longer periods was also associated with low back pain (LBP) [11]. A slouched posture is a kind of abnormal sitting posture with flexed lumbar spine occurs during day-to-day sitting activities [12,13]. As a result of this prolonged flexed posture, if extends for a long time, the neutral position is lost and the spine is potentially exposed to injury [14,15]. Although the etiology of LBP is complex and multifactorial, an incorrect sitting posture could play a relevant role in determining both an increase of stress within the disc [16,17] and a sustained stretch of passive lumbar structures in combination with poor back muscle activity [18].

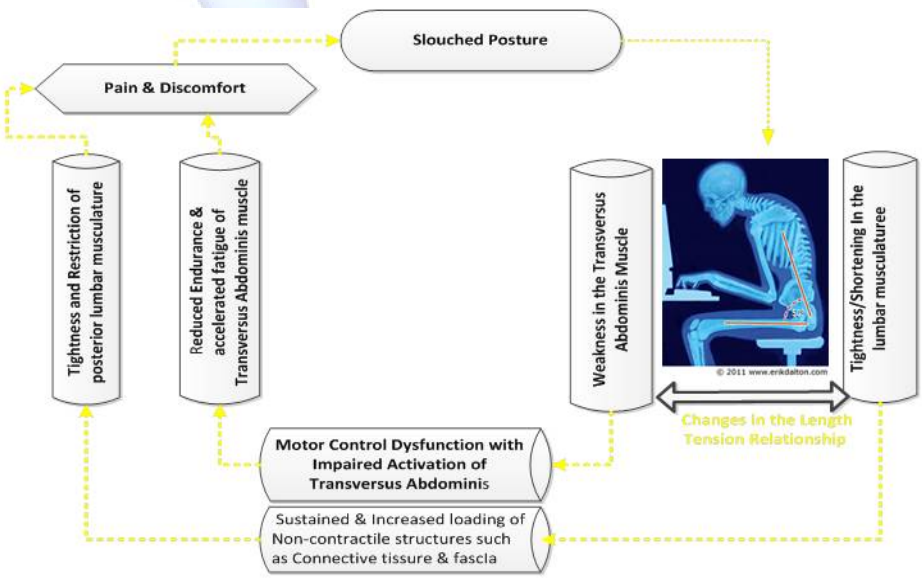
The impact of slouched posture and its associated impairments leading to postural low back pain is depicted in figure 1. A specific impairments noted in these patients consists motor control deficits in the transversus abdominis muscle and tightness of myofascial structures around lower lumbar region, leading to myofascial pain. It had been demonstrated that individuals with a history of low back pain show a delay in contraction of the transversus abdominis (TrA) muscle during a trunk disturbance, leading to an inappropriate stabilization pattern which causes recurrences and also these patients have an impaired ability to depress the abdominal wall [19]. On the other side, long hours of sitting in one position lead to myofascial tightness in the lower back region. These muscles which are prone for tightness generally have a lowered irritability threshold and are readily activated with movements consequently creating abnormal movement patterns in the body and it is one of the potential sources of pain, which is secondary to muscle imbalance [20]. Also, if the muscle goes for tightness, the fascia will also goes for tightness and vice versa due to its intimate connection with the muscle. Eventually, patients with low back pain develop trigger points in the iliocostalis lumborum, logissimus thoracis, multifidus, quadratus lumborum and gluteus medius muscle [21,22]. Unless these trigger points are not altered, the management of Postural low back pain is not complete. Several studies have been conducted to demonstrate the effectiveness of motor control training in individuals with low back pain who have impaired control of the deep (e.g. transversus abdominis and multifidus) and superficial trunk muscles responsible for maintaining the stability of the spine [23,24]. Strength, co-ordination and timing of Transversus Abdominis (TrA) and Multifidi (MF) muscles contraction is important in stabilizing the low back and it might be one of the factors to prevent and reduce LBP in general population [25]. Specifically, the contraction of TrA leads to increased intra-abdominal pressure, tensioning of the thoraco-lumbar fascia and an inward displacement or narrowing of the abdominal wall without pelvic or spine movement [26,27]. Moreover, the TrA is important for sustaining the spinal cord and the conditioning of TrA would eventually contribute to functional improvement [28]. These motor control exercises utilize principles of motor learning to retrain control of the trunk muscles, posture, and movement pattern, ultimately leading to a reduction in the levels of pain and disability. A Previous study also concluded that motor control exercises are found to be superior to other treatments [29].

Similarly, myofascial release therapy is one of the effective manual techniques to release area of impaired sliding fascial mobility, and to improve pain perception over short term duration in people with non-specific low back pain [30]. It is a highly interactive stretching technique that requires response from subject's body to find the direction, power and duration of stretch and to assist maximum relaxation of tight or restricted tissues [31]. A more recent study also indicated that the myofascial release therapy is very effective in reducing the pain related disability and improving lumbar range of motion in subjects with mechanical low back pain [32,33]. Besides these interventions, few more studies demonstrated the impact of ergonomic training on low back pain in professionals belonging to different occupational settings [34,35,36].

Based on the understanding of the impairments resulting from Postural Low Back pain, a need for multiple therapeutic interventions is highly warranted focusing on the three specific impairments noted in these patients viz. (i) Faulty Posture (ii) tightness of myofascial structures around lower lumbar region, leading to myofascial pain and (ii) motor control deficits in the transversus abdominis muscle.

The tightness in the myofascial structures around lower lumbar region needs to be addressed first since the hypertonic muscle reflexively inhibiting the anterior Transverses abodominis muscle [37]. So an appropriate therapeutic intervention is to be adopted to release this tightness before addressing the motor control deficits in the transversus abdominis muscle. Even though the effectiveness of, myofascial release therapy, motor control training and ergonomic training are demonstrated individually, the combined therapeutic intervention focusing on postural back pain has not been demonstrated yet. Thus, the objective of this study is to find out the effectiveness of myofascial release, motor control training and ergonomic training on postural low back pain among the Information Technology Professionals.

Fig. 1: The impact of slouched posture and its associated impairments in Information Technology Professionals.



MATERIALS AND METHODS

Study Design: A randomized control study design was used with two intervention groups and a control group to assess the effectiveness of multiple therapeutic interventions consists of Myofascial Release [MFR], Motor Control Training [MCT] and Ergonomic Training [ET] on postural low back pain among the Information Technology Professionals.

Subjects: Employees belonging to two different Multinational Information Technology companies located in Coimbatore formed the population for this study. Among them, ninety male subjects [N=90] who diagnosed to have postural low back pain were recruited using criterion based sampling approach. Before selection, all the subjects were examined by the physician to exclude structural bony abnormalities and degenerative disorders around the lumbar spine. The criteria adopted to include the subjects with postural low back pain include: (i) aged between 25 and 40 years who are working only on day shift; (ii) pain primarily aggravated by functional activities which required sustained postures and relieved by postural modification, (iii) symptom duration of greater than 3 months and the subjects were required to experience low back pain on at least one day/ week over previous 3 months, (iv) 'Mild' to 'Moderate' back pain intensity in the Visual analogue scale, (v) software employees who work using computer for five hours a day for at least five days a week.

Methods: All the subjects (N=90) were identical prior to the application of selected therapeutic interventions ($F > 0.05$) [Table 3]. All the subjects (N=90) were randomized into three groups of 30 each using simple random technique before the application of the planned therapeutic interventions. The demographic characteristics of the subjects are shown in table-1. Subjects assigned to the Experimental group II [MFR group] were exposed to Myofascial Release (MFR), Motor Control Training (MCT), & Ergonomic Training (ET) whereas those who were assigned Experimental group I [MCT] were given Motor Control Training (MCT), & Ergonomic Training (ET). Subjects in the Control group were not exposed to any therapeutic intervention. All the therapeutic interventions were given for the period of 6 weeks. In order to study the effectiveness of the therapeutic interventions, three outcome parameters were chosen. These include Low back pain intensity measured by Visual Analogue Scale; Back pain disability measured by Revised Oswestry Back Pain and Disability Questionnaire and; the Transversus Abdominis Muscle Strength measured by Pressure Biofeedback apparatus. All the three measurement tools used in the study were found to be reliable and valid as shown by the previous studies viz, Visual analogue scale [38] Revised Oswestry Back pain and Disability Questionnaire [39] and Pressure Biofeedback Apparatus [40].

Description of Experimental Interventions

Ergonomics Intervention [ET]: The Workstation Ergonomic Program is given for the duration of 6 weeks through 8 interactive group meetings. All the group meetings took place at the work place, during work time under the supervision of the investigator. The maximum number of participants in the large group meeting is 25 and the small group is 10 respectively. The goal of large group meeting is behavioral modification with regard to work style in which detailed general guidelines about the workstation ergonomics and body posture in the sitting position were instructed. During small group meeting, a practical demonstration is made at their workplace environment and solutions for individual barriers with regard to behavioral modification were discussed. In addition to these group meetings, the investigators provided onsite ergonomic adjustment of the computer workstation design as per the requirements of the subjects.

Motor control training [MCT]: The motor control training used in this study is provided to all the subjects in the Experimental groups in two phase viz. Phase-I: Initial Testing & Familiarization Phase in which Quantification of back and abdominal muscles was carried out using Pressure Bio Feedback apparatus (first 2 weeks) and; (ii) Training Phase in which all the subjects were given a set of Motor control exercises (6 weeks) as per the protocol.

(i) Initial Testing & Familiarization Phase: For the purpose of testing, three activities were selected based on the recommendations of the previous studies viz. (i) Prone abdominal tuck in; (ii) Crook lying abdominal tuck in and; (iii) Controlled leg lowering [41,27,42]. The total duration of this exercise session was 10 minutes per day and it was performed on alternative day for the first two weeks. The objective of this phase is quantification of back and abdominal muscles in terms of pressure changes in the Pressure bio feedback Unit. Before beginning the training program, all the subjects were given basic information about the procedure of testing and training the TrA muscle contraction. First, the subjects were positioned in pone lying position and an inflatable bag of the Pressure Biofeedback Unit (PBU) was placed between the anterior superior iliac spine and the navel. Before starting the contractions, the bag was inflated to a pressure of 70 mmHg with the valve closed. Participants were instructed to breathe using the abdominal wall and then the inflatable bag was adjusted to 70 mmHg again. Patients were requested to perform three TrA muscle contractions with the following verbal commands standardized by the investigator: "Draw in your abdomen without moving the spine or pelvis" and maintain these contractions for 10 seconds [43]. A pressure reduction of at least 4 to 10 mmHg was defined as a successful result [19,43] to contract the TrA using the Pressure Biofeedback Unit. This test represents an inner range concentric contraction of the TrA muscle to lift the abdominal contents and wall and, thereby decrease the pressure in the pressure biofeedback unit. The contraction of multiûdus muscle can be assessed by the palpation of muscle bulk and by the quality of voluntary contraction at each lumbar vertebral level [44]. Specifically, crook lying abdominal tuck-in and controlled leg lowering was trained in the pressure of 40 mmHg.

(ii) Training Phase: The motor control exercise protocol used in this study consisted of 11 exercises in which the first seven were taught to subjects on the first day. The other four were added to the protocol on the 10th day (Appendix 1). Both the groups were exposed to a same type of exercise protocol throughout the study.

Myofascial Release Technique [MFR]: MFR is defined as the facilitation of mechanical, neural, and psychophysiological adaptive potential as interfaced via the myofascial system [45]. It represents a widely employed manual technique specific for fascial tissues, to reduce adhesions, restore and/or optimize fascia sliding mobility in both acute and chronic conditions [46-49]. The investigators chose two specific treatment techniques (i.e. Gross Release Technique of the Quadratus Lumborum and Gross and Focused Release technique of Erector Spinae) as one of the experimental intervention to release the tightness and restrictions in the myofascial structures of the Lower back region. The whole treatment session consists of 30 minutes in which subjects were exposed to this intervention 3 times a week on alternate days and continued the same for the period of 3 weeks. The procedure of both the techniques adopted in this study was culled from previous study [45] and it is described as follows:

Gross Release Technique of the Quadratus Lumborum

Patient Position: Side Lying

Therapist Position: Standing at the patient side at the hip level.

Technique: Perform a Gross Release of the Quadratus Lumborum with the patient positioned over a roll for maximum passive stretch. The therapist place one hand proximal to the attachment on the pelvis and the other hand proximal to the attachment on the lower ribs. Apply stretch using crossed or uncrossed arms, as illustrated, until tightness or a restriction is felt. Hold, wait for the release and stretch again. Repeat the release and stretch again. Repeat the release sequence until an end-feel is reached.

Fig. 1a: Gross release of the Quadratus Lumborum.

Gross Release Technique of the Erector Spinae

Patient Position: Prone Lying

Therapist Position: Standing at the patient side at the level of Trunk

Technique: Perform a Gross Release of the Erector Spinae with arms crossed and hands widely spaced. Hold, wait for the release and stretch again. Change the angle of the stretch in response to the feedback from the patients. Repeat the release sequence until an end-feel is reached or until no further stretch is possible.

Fig. 2: Gross release of the Erector Spinae.

Focused Release Technique of the Erector Spinae

Patient Position: Prone Lying

Therapist Position: Standing at the patient side at the level of Trunk

Technique: Perform a Focused Release of the Erector Spinae with arms crossed using the broad surface of the palms or the ulnar border of both hands. Hold, wait for the release and stretch again. Repeat the release sequence until an end-feel is reached or until no further stretch is possible.

Fig. 3: Focused release of the Erector Spinae.

DATA ANALYSIS AND RESULTS

Demographic characteristics of the subjects: The demographic characteristics of the subjects are presented in table 1. The mean age of all the subjects in the control group, experimental group-I and the experimental group-II is measured as 29.13, 28.53 and 28.73 respectively. Similarly, all the three groups are unique in with respect to the body mass index where it falls between the ranges of 25 to 26. Moreover, the mean working hours of the subjects was measured as 43.76, 43.20 and 42.97 hours per week for the control group, experimental group-I and the experimental group-II.

Table 1: Distribution of subjects with respect to age, BMI and working hours.

Groups	N	Mean Age, (SD) (In years)	Body Mass Index (Mean)	Working hours per week Mean, (SD)
Control Group	30	29.13, (3.44)	25.86, (2.34)	43.76, (3.23)
Experimental Group-I	30	28.53, (3.43)	25.56, (2.38)	43.20, (2.98)
Experimental Group-II	30	28.73, (3.57)	26.33, (3.28)	42.97, (2.75)

Statistical Analysis:

The Repeated measures ANOVA was used to analyze the effect of experimental interventions on each group at different time intervals, and if significant difference found, a Newman Keuls Post hoc tests was used to find out the effect of the interventions between the three different time intervals. In order to compare the effects of selected experimental interventions on the dependent variables, an Analysis of Co Variance [ANCOVA] was used. When the F-ratio was significant, Scheffe's post hoc test was used to find out which intervention combination used in the study is the source for the significance of adjusted post treatment means. Statistical significance was accepted at 0.05 level of confidence.

From the table 2, it is observed except the control group, a significant difference exists in the two experimental groups with respect to all the three dependent variable values taken at the pre-intervention phase, at the end of 3rd week and at the end of 6th week (P>0.05). Further, a Newman-Keuls post hoc test was conducted to find out whether is any significant difference exists in the three dependent variables in each group by comparing the scores at any two time periods at a time (Table 3). Except meager difference observed in the Control group, all the observed differences in the experimental group is found to be significant at 0.05 level.

Table 2: one way repeated measures ANOVA for the dependent variables of all the samples in the control group and other two experimental groups between three different time intervals.

Variables	Groups	Source of Variation		Sum of Squares	df	Mean Square	F ratio
Back Pain Intensity	Control Group	Between Subjects		10.08	29	0.35	
		Within Subjects	Between Weeks	0.51	2	0.25	1.2
			Within Weeks	14.94	58	0.25	
	Experimental Group-I	Between Subjects		2.6	29	0.09	
		Within Subjects	Between Weeks	176.6	2	88.3	1259.36*
			Within Weeks	4.06	58	0.07	
	Experimental Group-II	Between Subjects		5.18	29	0.18	
		Within Subjects	Between Weeks	345.41	2	172.7	1445.88*
			Within Weeks	6.93	58	0.12	
Back Pain Disability	Control Group	Between Subjects		417.04	29	14.38	
		Within Subjects	Between Weeks	19.87	2	9.93	0.8
			Within Weeks	715.93	58	12.34	
	Experimental Group-I	Between Subjects		178.32	29	6.15	
		Within Subjects	Between Weeks	1815.85	2	907.93	116.88*
			Within Weeks	450.56	58	7.77	
	Experimental Group-II	Between Subjects		187.1	29	6.45	
		Within Subjects	Between Weeks	10641.89	2	5320.94	951.09*
			Within Weeks	324.48	58	5.59	
Transversus abdominis muscle strength	Control Group	Between Subjects		4.2	29	0.14	
		Within Subjects	Between Weeks	0.31	2	0.16	1.86
			Within Weeks	4.89	58	0.08	
	Experimental Group-I	Between Subjects		4.83	29	0.17	
		Within Subjects	Between Weeks	157.05	2	78.52	744.76*
			Within Weeks	6.11	58	0.1	
	Experimental Group-II	Between Subjects		9.53	29	0.33	
		Within Subjects	Between Weeks	291.97	2	145.99	558.70*
			Within Weeks	15.16	58	0.26	

*Significant at 0.05 level

Table 3: Newman-keuls' test showing the pairwise comparison of dependent variables of three groups at different time intervals.

Measure	Groups	Time			Mean Difference	r	RCV
		Base line	Week 3	Week 6			
Back Pain Intensity	Experimental Group-I	5.38	3.28		2.10*	2	0.11
		5.38		1.98	3.40*	3	0.13
			3.28	1.98	1.30*	2	0.11
	Experimental Group-II	5.28	2.33		2.95*	2	0.3
		5.28		0.55	4.73*	3	0.36
		2.33	0.55		1.78*	2	0.3
Back Pain Disability	Experimental Group-I	37.32	30.05		7.27*	2	1.06
		37.32		26.54	10.79*	3	1.27
		30.05	26.54		3.51*	2	1.06
	Experimental Group-II	38.05	22.63		15.42*	2	1.68
		38.05		11.53	26.51*	3	2.02
		22.63	11.53		11.10*	2	1.68
Transversus abdominis muscle strength	Experimental Group-I	4.54	6.42		1.88*	2	0.1
		4.54		7.76	3.22*	3	0.19
			6.42	7.76	1.34*	2	0.1
	Experimental Group-II	4.61	6.91		2.30*	2	0.14
			6.91	9.02	4.41*	3	0.17
		4.61		9.02	2.10*	2	0.14

*Significant at 0.05 level

(RCV=Range Critical Value); (r=ordered position of the magnitude of means).

Table 4: Computation of analysis of covariance [ANCOVA] for low back pain intensity, disability and transversus abdominis muscle strengh among the control group and the two experimental groups.

Data	Source of variation	Sum of Square	df	Mean Square	'F' Ratio
LOW BACK PAIN INTENSITY					
Pre-treatment Means	Between	0.35	2	0.17	0.447 (P=0.641)
	Within	34.05	87	0.39	
Adjusted Post treatment Means	Between	341.77	2	170.89	766.73*
	Within	19.17	86	0.22	
BACK PAIN DISABILITY					
Pre-treatment Means	Between	8.53	2	4.26	0.56 (P=0.562)
	Within	639.24	87	7.35	
Adjusted Post treatment Means	Between	10184.39	2	5092.19	490.43*
	Within	892.94	86	10.38	
TRANSVERSUS ABDOMINIS MUSCLE STRENGTH					
Pre-treatment Means	Between	0.11	2	0.05	0.2 (P=0.818)
	Within	22.97	87	0.26	
Adjusted Post treatment Means	Between	292.74	2	146.37	358.93*
	Within	35.07	86	0.41	

*Significant at 0.05 level

The pretreatment scores of all the three outcome measures were subjected to statistical treatment using analysis of Covariance and the obtained F ratio is less than the required F table at 0.05 levels [Table 4]. Hence it is inferred that all the mean scores of all the dependent variables consisting of Back pain intensity (p=0.641), disability (p=0.562) and Transversus abdominis muscle strength (p=0.818) were identical at the Pre-intervention stage before subjected to the selected therapeutic interventions.

Further, the final adjusted means were calculated and subjected to statistical treatment using ANCOVA. From the obtained F ratio, it is inferred that there is significant difference between the Pre-intervention means and the adjusted post intervention means of all the three groups at 0.05 levels [Table4]. It is witnessed that when compared with the pre-intervention stage, a significant difference is observed in all the three outcome measures at the end of the post-intervention period after subjected to the selected therapeutic interventions. Since significant F ratio was recorded, the scores are further subjected to statistical treatment using Scheffe's post hoc test and the results are shown in Table 5.

Table 5: Scheffe confidence interval test scores showing the adjusted post hoc means of dependent variabes among the three groups.

Dependent Variables	Groups (Adjusted Post Intervention Means)			Mean Difference	F-Ratio
	Control Group	Experimental Group-I	Experimental Group-II		
Back Pain Intensity	5.26	1.98		3.29	98.08*
	5.26		0.55	4.72	788.84*
		1.98	0.55	1.43	690.76*
Back Pain Disability	37.51	26.54		10.98	153.15*
	37.51		11.53		345.58*
		26.54	11.53	14.99	192.42*
Transversus abdominis muscle strength strength	4.67	7.76		3.08	8.23*
	4.67		9.02	4.29	41.15*
		7.76	9.02	1.21	49.38*

*Significant at 0.05 level

In analyzing the effect of 6 weeks of therapeutic intervention on two dependent variables such as back pain intensity and disability, both the Experimental group-II and the Experimental group-I showed a better reduction in pain and disability than the control group [Table 5]. Further, a significant difference is also found between the Experimental group-I and Experimental group-II in which the Experimental group-II is found to be better than the Experimental group-I. While analyzing the effect of 6 weeks of therapeutic intervention on the improvement of Transversus abdominis muscle strength, a similar trend is noticed in which both Experimental group-II and Experimental group-I, showed a better improvement in muscle strength than the control group [Table 5]. Also, a significant difference is observed between the Experimental group-I and Experimental group-II in which the Experimental group-II found to be better than the Experimental group-I in improving the Transversus abdominis muscle strength of the subjects.

RESULTS AND DISCUSSION

This study is the documentation of the application of multiple therapeutic interventions in managing postural low back pain among the Information Technology Professionals. The Investigators advocated two experimental intervention combinations in which the first experimental group (Experimental group-I) received motor control training and ergonomic training whereas second experimental group (Experimental group-II) received Myofascial release therapy, motor control training and ergonomic training with an expectation to see whether there is any significant difference between the groups with respect to three outcome parameters (i.e. Back pain intensity, Disability and Transversus abdominis muscle strength). All three measurement tools used in the study were found to be reliable and valid as shown by the previous studies viz, Visual analogue scale [38] Revised Oswestry Back pain and Disability Questionnaire [39] and Pressure Biofeedback Apparatus [40]. The total intervention period consist of 6 weeks in which measurements were taken at three time intervals (Pre-intervention, at the end of 3rd week and at the end of 6th week) to find out the effectiveness of each intervention combinations on the selected outcome variables. All the three groups [N=3] are identical prior to the exposure of therapeutic interventions as shown by the non-significant F ratio in the analysis of covariance table (Table 2).

The results of the study indicated that there is a consistent reduction in the back pain intensity & disability throughout three time intervals (pre, 3rd week & 6th week) in both the experimental groups (Table 4). Specifically, the patients in the Experimental-II (MFR group) reported 34% reduction in pain whereas the experimental group-I (MCT group) demonstrated a 24% decrease at the end of 6th week of the intervention period. Likewise, the Experimental-II (MFR group) reported a 29% decrease whereas the Experimental group-I shown a 12% reduction in functional disability following the application of the therapeutic interventions (Table 4). There is no significant difference noted in the control group between three different time intervals. Thus, in analyzing the effect of 6 weeks of therapeutic intervention on both back pain intensity and its subsequent disability, the experimental groups showed a significant improvement than the control group ($p<0.05$).

While taking into account of Transversus Abdominis Muscle Strength, a 46% improvement is noted in the experimental-II group whereas the experimental-I reported a 30% improvement when compared to its pre-intervention scores. From these findings, it has been observed that along with reduction of pain & disability and there is a progressive improvement in the Transversus Abdominis Muscle Strength across the three time intervals in the experimental groups.

Further exploration was carried out to find out which therapeutic intervention combination is superior in managing postural low back pain among the Information technology professionals. The data was subject to analysis using ANCOVA. From the analysis, it is observed that the adjusted post hoc means on Back pain intensity of Experimental group-II, Experimental group-I, and the control group were found to be 0.55, 1.98, and 5.26 correspondingly. Similarly, adjusted post hoc means on Back pain disability of Experimental-II, Experimental group-I, and the control group were reported to be 11.53, 26.54 and 37.51 respectively. Also, a significant difference was found between the Experimental group-I and Experimental group-II (Table 2). From these findings, it is concluded that Experimental group-II was found to be better than the Experimental group-I and Control group in reducing both pain intensity and its subsequent disability among the patients with postural low back pain.

The superior effect of the Experimental group-II is mainly due to the application of Myofascial release therapy [MFR] because the other two treatment combinations consist of Motor Control Training [MCT] and Ergonomic Training [ET] was applied commonly to both the experimental groups. Thus the finding of this study validated the findings of the previous studies which supported the effectiveness of MFR on reducing low back pain [50,51]. Also, a more recent study demonstrated that when MFR is given in adjunct with specific back exercises significantly reduced the back pain intensity and functional disability among Chronic back pain subjects [52]. Conceptually, this analgesic effect of MFR can be attributable to the stimulation of afferent pathways and excitation of afferent A delta fibers which can cause segmental pain modulation [53] as well as modulation through the activation of descending pain inhibiting systems [54]. Moreover, under normal conditions, the fascia and connective tissue tend to move with minimal restrictions [55]. When the subject is continuously working in faulty posture at the computer workstation for a long period of time, it exposes them to repetitive strain injury and is thought to decrease fascial tissue length and elasticity, resulting in fascial restriction. Through myofascial release, a manual traction was applied to these fascial restrictions which will encourage blood flow to an imbalanced area. As a result, this augments lymphatic drainage of toxic metabolic waste, realigns fascial planes and resets the proprioceptive sensory ability of soft tissue [56]. This vasomotor response might contribute to the enhanced clinical effectiveness. Moreover, the enhanced pain reduction may result from reactive hyperemia in the local area, due to counter-irritation effect or a spinal reflex mechanism that may produce reflex relaxation of the involved muscle [50]. It is also possible that pain relief due to MFR is secondary to returning the fascial tissue to its normative length by collagen reorganization [52].

With respect to the activation of Transversus abdominis muscle, it has been noted that the subjects in Experimental group-II show better results than the Experimental group-I. This might be attributed to the application of myofascial release therapy followed by motor control training and ergonomic training. The rationale behind this effectiveness is based on the principle of Sherrington law of reciprocal inhibition which states that a hypertonic antagonist muscle may be reflexively inhibiting their agonist [37]. Therefore, restoring normal muscle tone and/or length of tight or shortened lower back muscles must be addressed first before attempting to strengthen the weakened or inhibited anterior Transversus abominis muscle.

This study also demonstrated that the treatment combinations consist of MCT and ET was also found to be better in reducing of Back pain intensity and disability. Even though the observed improvement is due to the combined effectiveness of Motor Control training and Ergonomic training, previous studies supported the effectiveness of each technique on pain reduction. Previous studies indicated that isolated motor control training demonstrated a statistically significant reduction in pain and disability [57-60] by enhancing segmental stabilization [61]. An earlier study demonstrated that there would be functional improvement following ergonomic training [62] and two main reasons contributing to this improvement consist of reconditioning of trunk muscles and the improved neuromuscular control of the segmental muscle of the lumbar spine. Likewise, several other studies also demonstrated the effectiveness of ergonomic intervention in managing low back pain arising out of faulty postures [6,63,64]. Unlike previous studies, this study demonstrated the combined effectiveness of Motor Control training and Ergonomic training in reducing back pain intensity and disability as well as produced a notable improvement in Transversus abdominis muscle strength among postural low back pain subjects.

There are some limitations in this study that could not be overlooked. It include: (i) back posture improvement which is considered as one of the vital component in the management of Postural low back pain has not been recorded objectively through the measurement of lumbar angle and a future study is warranted to measure this issue; (ii) Only the intensity of pain is addressed and the pressure pain threshold which is used to find out the pain sensitivity of the trigger points in these patients are not objectively recorded as an outcome measure; (iii) the effectiveness of the selected therapeutic intervention combinations were observed for the period of 6 weeks and its long term sustainability was not observed.

CONCLUSION

It is concluded that the intervention combination consisting of Myofascial Release Therapy, Motor Control Training, and Ergonomic Training is found to be better than the other two groups, both in reducing pain and disability as well as improving Transversus abdominis muscle strength among postural low back pain subjects. When compared to control group, the intervention combination consisting of Motor Control Training, and Ergonomic Training (ET) also produced a significant improvement in all the outcome parameters. This study provided an impairment model and a rationale for a multiple therapeutic intervention to manage low back pain arising out of faulty posture. The results of this study adds value to the existing literature by demonstrating the effectiveness of multiple therapeutic intervention combinations consisting of Myofascial Release, Motor Control Training and Ergonomic training in the management of Postural Low Back Pain among the Information Technology Professionals.

Conflicts of interest: None

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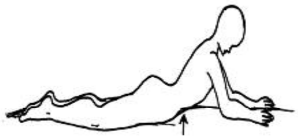
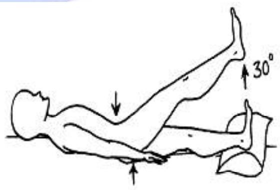
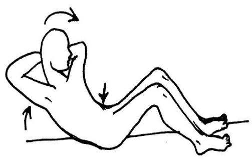
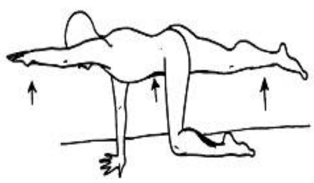
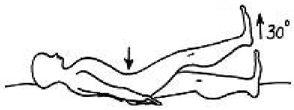
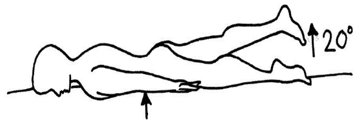
Appendix 1: (Motor Control Exercises Protocol)

1. Passive Extension: Subjects were asked to lie in prone lying position. They were then instructed to keep their hands on the couch at shoulder level and tuck-in their abdomen. They then asked to extend their spine without lifting their pelvis. This position was to be held for 5 seconds and repeated 10times for the first seven days, then for 15 times between seven and ten days and finally for 20 times from 10th day to 6 weeks.	
2. Foot bridging: Subjects were asked to be in crook lying position with their arms on their sides. Abdomen tuck-in was to be performed, followed by lifting the pelvis of the couch, till the hips were in neutral position. This position was to be held for 5 seconds and repeated 10 times for the first seven days, then for 15 times between seven and ten days and finally for 20 times from 10thday to 6 weeks.	
3. Heel bridging: Subjects were asked to lie supine with their heels on a pile of pillows causing hips to flex to approximately 30°. They were then instructed to tuck in the abdomen and lift their pelvis off the couch till the hips were in a neutral position. This position when attained was to be held for 5 seconds. The repetition was gradually increased from 10 sec., till day 7, to 15 sec. till day 10, to 20 sec. till 6 weeks.	
4. Curl-up: Subjects were asked to lie in a crook lying position with their hands behind their heads. They were then instructed to tuck-in their abdomen and bring their heads towards their knees without holding their breath. The exercise was considered complete only when subjects were able to lift their scapulae off the couch and hold this position for 5 seconds. The repetition was gradually increased from 10 sec., till day 7, to 15 sec. till day 10, to 20 sec. till 6 weeks.	
5. Quadruped position with alternate arm and leg extension: Subjects were to be in quadruped position. They were then asked to tuck-in their abdomen and raise one of their arms and opposite side leg at the same time. The position was held for 5 seconds and then repeated with other side arm and opposite side leg. The repetition was gradually increased from 10 sec., till day 7, to 15 sec. till day 10, to 20 sec. till 6 weeks.	

6. Supine straight leg raise: The subjects were to be in supine position with arms at their sides. They were then to tuck-in their abdomen and lift one of their legs without bending knee to about 30° of hip flexion. The position was held for 5 seconds and then repeated with other leg. The repetition was gradually increased from 10 sec., till day 7, to 15 sec. till day 10, to 20 sec. till 6 weeks.

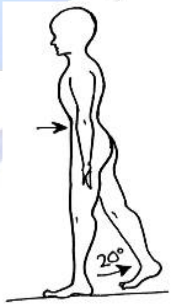


7. Prone straight leg raise: The subjects were to be in a prone lying position with their arms at the sides. They were then instructed to tuck-in their abdomen and extend one of their hips, without bending knee, to approximately 20°. This position was to be maintained for 5 seconds and then repeated with other leg. The repetition was gradually increased from 10 sec., till day 7, to 15 sec. till day 10, to 20 sec. till 6 weeks.



8. Standing straight leg raise: This exercise was included in the protocol on the 10th day. The subjects were to be in a standing position with arms at the sides. They were then instructed to tuck-in their abdomen and flex one of their hips to approximately 30° without bending knee. This exercise was then repeated with the other leg. This exercise was to be performed 20 times a day.

9. Standing hip extension: This exercise was included in the protocol on the 10th day. The subjects were to be in the standing position with arms at their sides. They were then instructed to tuck-in their abdomen and extend one of their hips to approximately 20° without bending knee and repeat it with other leg. This exercise was to be performed 20 times a day.



10. Hip-Knee flexion: This exercise was included in the protocol on the 10th day. The subjects were to be in the standing position with their arms at their sides. They were then instructed to tuck-in their abdomen and to bend one of their hip and knee. Minimal support of a table or a wall was permitted with one of their hands. This exercise was to be repeated with the other leg. This exercise was to be performed 20 times a day.

11. Single leg Knee squat: This exercise was added to the protocol on the 10th day. The subjects were to be in a standing position with minimal support of a table or a wall with one of their hands. They were then instructed to tuck-in their abdomen and stand on one leg and bend their hip and knee of stance leg to approximately 20° and return to neutral. This was then repeated while standing on the other leg. Total repetition of this exercise was 20 in a day.