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Original Research Article

Effect of back extensor muscle endurance training on back pain incidence rate in computer users: a pilot study

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ABSTRACT

Background: Sit and work for more than seven hours per day increases risk of low back pain among computer users. Prevention of low back pain emerges as an important workplace healthcare measure. The objective was to examine the effect of back extensor endurance training on back pain incidence rate and to use back endurance position hold time score as back pain predictive marker in computer users.
Methods: Seventy-three subjects with low and medium back endurance position hold time score included in this randomized control trail. Subjects categorized as prevention group (n=38) and control group (n=35). Prevention group performed back endurance exercise program three times in a week for 12 weeks. Control group not received any training. Back endurance hold time score measured before and after 12 weeks for both groups with Biering-Sorensen test. Back pain incidence and severity evaluated using 100 mm visual analog scale.
Results: Preventive groups' back endurance hold time significantly high after training ($p<0.05$). There was inverse relationship between position hold time score and back pain incidence rate in both groups ($r=-0.415$ and -0.02 for both the groups). Position hold time scores from control group significantly associated with back pain incidence rate ($p<0.05$). Back pain incidence rate was 51.4 % (control group) and 15.7% (prevention group).
Conclusions: Back extensor endurance training is effective in prevention of back pain incidence rate among high risk computer users. Future studies required to incorporates these trainings in workplace preventive health programs.

Keywords: Back pain prevention, Biering-Sorensen test, Computer users, Extensor endurance, Work health, Work-related musculoskeletal disorders

INTRODUCTION

Low back pain (LBP) is most common health problem with about 90% of people experiencing at some point of time in their life.[1] Most of the back pains are muscular in origin especially low back pain which occur as lumbar muscles get weaker. Many studies suggested that improved lumbar muscle endurance could be helpful in prevention and treatment of LBP.[2]

Muscle endurance is the ability to perform repeated contraction for longer time by an isolated muscle or muscle group.[3] Poor endurance of trunk extensor muscles might cause strain on lumbar spine and leads to LBP.[4] The Biering-Sorensen test is probably the most reliable way to evaluate isometric back extensor muscle endurance. It measures Position hold Time (PHT) of unsupported lower back in horizontal plane.[5] In a longitudinal study by Luoto et al, measured PHT by Biering-Sorensen test and concluded that isometric back endurance PHT could be predictive tool for future back pain and derived norms for test scores as poor (PHT score <58 seconds), medium (PHT score 58-104 seconds) and good (PHT score >104 seconds) performers. The findings of the study claim that poor performers have three-fold risk of LBP compared to good performers.[6]

One of our previous study showed that LBP incident rate was about 62.6% among software employees who has sedentary workstyle that predominantly include sitting time for more than seven hours.[7] This scenario in turn posing a major financial burden to society.[8] So unarguably, prevention of LBP appears to be highly important with suitable preventive programs as it was evident that back muscle endurance training could greatly reduce incidence rate of LBP.[9] The objective of the present study was to observe the importance of back muscle endurance training for LBP prevention. So, subjects with low and medium endurance PHT scores (according to Luoto et al classification) were selected as study population. The subject's trunk extensor muscle endurance assessment tested with Biering-Sorensen test.

Evaluation of trunk extensor muscle endurance

The Biering-Sorensen test was used to evaluate back extensor muscle endurance by measuring the position hold time (PHT) of unsupported trunk in horizontal direction from treatment couch. Prior to test, subjects were demonstrated and explained about test procedure and allowed to do warm up on static bicycle at self-determined speed for two minutes. During the test, the subject was asked to lay down on treatment couch in prone position with upper edge of iliac crest aligned with edge of couch. So that upper body was suspended horizontally and lower body fixed to couch by strapping around hips, knees and ankles. A pillow placed under ankles to relive stress and hands positioned sideways. The subject was instructed to hold trunk in horizontal position. The horizontality was ensured by placing an inclinometer between the shoulder blades. Any deviation more than 10 degrees, the subject encouraged to correct back. If the position was not immediately corrected, or no longer holds the position then the test terminated. The total time from position hold to failure measured as Position Hold time (PHT). Based on the PHT score the subjects were included in this study. Only the subjects with low and medium PHT scores were included in this study.

The objective of this pilot study was to investigate the effect of trunk extensor endurance training on LBP incidence rate in computer users. To use the screening of trunk extensor muscle endurance PHT as a back pain predictive tool.

METHODS

Study population

Seventy-three eligible subjects (male and female) were recruited for this study from Q-city tech park in Hyderabad. The study conducted at Preventa Curo-Centre for Workplace Healthcare and Research. An informed consent statement was obtained from all study subjects.

Inclusion criteria

The inclusion criteria were: (1) age between 21-45 years (2) had fulltime employment and minimum seven hours of working time per day (3) no back pain from last 6 months to study start time (4) low and medium Biering-Sorensen test scores.

Exclusion criteria

Subjects were excluded if they had: (1) any episodes of back pain (2) any history of accidents and road traffic injuries (3) undergoing any treatment or medications (4) contraindication to exercise therapy (5) good Biering-Sorensen test score (6) already undergoing any systemic back strengthening exercise program.

Anthropometric measurements

All subjects duly filled a questionnaire which was designed to elicit demographic data. Anthropometric measurements like height, weight and body mass index were included in the questionnaire. A stadiometer (Brand: Prime Surgicals) calibrated from 20-210 cm was used to measure height of each subject to the nearest 0.1 cm. Body weight in light clothes measured to nearest 0.1 kg using Omron HN 289 calibrated from 0-150 kg. Body mass index (BMI) calculated by dividing weight in kilograms by height in meters squared.

Study procedure

The study design was a randomized control trail. The study procedure and rationale were explained to each subject. Following the initial anthropometric measurements, the subjects were randomly allocated to either prevention group or control group equally, using a randomized number sheet. The prevention group (n=38) was performed back extensor endurance training program three times in a week for 12 weeks. The control group (n=35) not performed any training program during these 12 weeks.

Endurance training program

The endurance training program was adapted from study of Moffroid et al with a protocol that has five level progressions.[10] The starting position for all levels of exercise is prone lying and pillow support given for the pelvis/upper thigh and lower leg/ankles and not fixed any straps. The five levels of exercise progressions are following: 1) Both hands are side by body and lifting head and trunk off the couch from neutral position to back extension. 2) Lifting off of the head and trunk from neutral position to back extension with hands placement over the head. 3) Lifting off the head and trunk from neutral position to back extension with hands elevated forward direction. 4) Lifting of head and trunk from neutral position to back extension, rising of contra lateral hand and leg from couch. 5) Lifting of head and trunk

from neutral position to back extension, rising of both arms and legs from couch.

The endurance training program starts from performing level 1. They should perform each level for 10 seconds hold time and 25 repetitions and a break of 3 seconds allowed in between the repetitions. After each level the subject progress to next level of exercise until performs level 5. Completion of all levels, subjects instructed to take rest for 10 minutes to observe for any pain or adverse effects. The subjects also instructed, if any discomfort or pain while training performance, they could stop immediately. This training program carried out 3 times per week and continued for 12 weeks.

Outcome measures

Each subject from both groups was evaluated with Biering-Sorensen test after 12 weeks. Prevalence of back pain and intensity of pain evaluated using 100 mm visual analog scale (VAS). It has the scores from 0 to 100 mm, where 0 is 'no pain' and 100 is 'maximum pain'. All subjects were explained about visual analog scale and handed over with a hard copy of it to mark accordingly about any back pain experienced after 12 weeks' duration.

Data analysis

The collected data was analysed statistically by JASP 2.1.0. Descriptive statistics of mean and standard deviation used to summarize subjects' anthropometric measurements and PHT score from Biering-Sorensen test. Independent t-test used to compare the mean difference value between control and prevention group. A paired t-test is used to detect significance between PHT score within the group. Linear regression test carried out to predict the impact of PHT score on back pain incidence. Study results were evaluated at 95% CI and $p<0.05$.

RESULTS

The physical characteristic variables of subjects from both groups are presented in Table 1. Independent t-test revealed that there is no significant statistical difference in physical characteristics of both the groups.

Table 1: Physical characteristics and PHT scores of both the groups.

Variables	Control group (n=35) mean±SD	Prevention group (n=38) mean±SD	P value
Age	30.8±5.5	31.5±5.0	0.50
Height	1.7±0.08	1.6±0.06	0.57
Weight	73.7±11.7	67.5±13.7	0.13
BMI	25.4±4.1	24.6±5.03	0.33
PHT	56.6±24.6	63.2±24.7	0.25

BMI- Body mass index; PHT- Position hold time

Table 2: Pre and post PHT score of both the groups.

PHT score	Pre- score	Post- score	P value	Mean difference
Control group (n=35)	56.6±24.6	46.3±27.47	0.06	10.3
Prevention group (n=38)	63.2±24.7	111.6±22.6	0.00*	48.4

*P<0.05

Table 3: Comparison of paired t-test and regression analysis results between both the groups.

	Control group (n=35)						Prevention group (n=38)					
	R	r^2	t	CI (95%)		P value	r	r^2	t	CI (95%)		P value
				Lower	Upper					Lower	Upper	
PHT score	-0.415	0.172	-2.62	-0.013	-0.001	0.0131*	-0.002	0	-0.14	-0.01	0.01	0.89

PHT- position hold time; *p<0.05

Table 4: Back pain incidence rate and severity.

	N	Back pain (n)	Back pain (%)	P value	Pain intensity (%)		
					Mild	Moderate	Severe
Control group	35	18	51.4	0.0004*	22.2	44.5	33.3
Prevention group	38	6	15.7		66.6	33.3	0

*p<0.05

The mean PHT scores of subjects in two groups were compared before and after training program (Table 2). The position hold time was significantly higher in prevention group after training period ($p<0.05$; mean difference 48.4). Whereas, the control group does not show any significant difference in pre and post PHT scores.

Regression analysis discovers that there was an inverse relationship between PHT score and back pain incidence rate for both the groups (r=- 0.415 and -0.02 for control group and prevention group respectively). A rejected null hypothesis ($p=0.013$) in control group indicates statistically significant association between low scores of back endurance and back pain incidence rate (Table 3). The back pain incidence rate was 51.4% in control group and 15.7% in prevention group (Table 4).

DISCUSSION

There are few previous studies on back endurance assessment and training programs on subjects already present with back pain.[4,5,11-13] But our study focused on subjects with low back endurance who were already at risk of future back pain. There was no significant difference between control and prevention groups in terms of age, height, weight, BMI and PHT. So any difference in outcomes between the groups could be largely ascribed to training program.

Comparison of PHT score within groups after 12 weeks revealed no significant difference in control group. But in prevention group, PHT score significantly improved with endurance training program. This outcome of the study is comparable with other studies and provides good evidence for the effectiveness of endurance training program on trunk extensor muscle PHT.[14-18]

Many previous studies focused and proved that the endurance training program was definitely one of the treatment tools for back pain.[19-24] But this study assessed effect of endurance training on back pain incidence rate. The results of our study showed approximately 35% higher back pain incidence rate in control group (51.4%) compared to prevention group (15.7%). There was significant difference in incident rate from both groups. These results revealed that back endurance training program greatly effective in prevention of back pain incidence rate. At the same time the reported pain intensity in prevention group was lesser than control group.

Our study findings support that back muscle endurance measurement (PHT) could be an effective screening tool to predict future back pain occurrence in computer users. It is advisable to perform periodical PHT screening for computer users in order to filter out risk category to implement early preventive measures.

A limitation of our study was non-stratified randomization. No sub groups classified on gender base. The gender difference has been identified to be a possible confounding factor in back extensor muscle endurance assessment. Another limitation was subjective assessment of pain incidence rate and possibility of subjective bias.

CONCLUSION

No study so far has focused on back extensor endurance and impact on back pain incidence rate. Our research protocol through measurement of back muscle endurance has been tried to find relation with back pain occurrence. Our pilot study results conclude that extensor endurance training program is more effective in prevention of back pain among high-risk desk computer users. Further studies with large sample size required to evaluate these findings. More studies also required to incorporate back endurance assessment and training in work place preventive healthcare programs.

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