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Effectiveness Of Jackknife Stretching On Hamstring Tightness With Low Back Pain Among Information Technology Professionals - Experimental Study

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Abstract
Background: *Hamstring muscles are located at the back of the thigh and the primary action of hamstring muscles is flexion of the knee. It is an effective self-stretching technique; it combines static and dynamic stretching and can be performed without any equipment.*
Methods: *For Jack-knife stretching, participants started in a full squat position, gripping both ankles. The subjects were instructed to extend their knees as much as possible while bringing their chest close to their thighs, holding this position for 10 seconds before returning to the starting position[6]. This sequence was repeated five times with a 10-second rest period between five repetitions, performed twice a week for two weeks.*
Results: *Results shows that Jack Knife stretching is very effective in reducing Hamstring Tightness and reduction in low back pain. There is a significant difference in pre and post-intervention scores of NPRS with P < 0.001 and QUEBEC scores with improved functional ability having P < 0.001*
Conclusion: *The study concludes that Jack Knife stretching is effective in reducing Hamstring Tightness and reduction in low back pain. It was also concluded that there is increased functional ability of the Hamstring muscle.*
Keywords: *Jack-knife Stretching, Active Knee Extension test, Low Back Pain, IT Professionals.*

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I. Introduction

Low back pain affects about 90% of individuals at some stage in their lives, with postural back pain being a significant public and occupational health concern, particularly prevalent in the information technology (IT) and business process outsourcing (BPO) sectors[1]. The rise of computer work has introduced a new category of occupational health issues known as computer-related problems. , IT professionals commonly spend extended periods seated in front of computers, leading to a sedentary lifestyle. This nature of their work can cause IT professionals to experience muscle tightness and discomfort, particularly in the hamstrings and lower back. In various epidemiological studies across India, approximately 76% of computer users have reported experiencing musculoskeletal discomfort[2]. Low back pain (LBP) is a prevalent global condition characterized by muscular tension, stiffness, or pain localized below the rib margin and above the inferior gluteal folds. Such pain arising without a known cause is called Non-specific LBP which amounts to 90-95% of cases and with an 18% prevalence rate[3].

Semi-membranous, semitendinosus, and both long and short heads of Biceps Femoris are the three muscles of hamstring[4]. Muscle tightness in the hamstrings is attributed to a decrease in the muscle's capacity to deform. Tightness of the hamstring is due to more flexion at the spine in the lumbar region during a slumped position[5]. This eventually leads to LBP, making it essential for IT professionals to address both issues.

During static hamstring stretching, tightness in the hip muscles is relieved by holding the hip flexion and/or knee extension position that elongates the hamstring muscles[6]. There are numerous methods to assess and aid in Hamstring stretching such as the PNF technique, Active Knee Extension stretching, Jack-knife stretching, etc. The AKET (Active Knee Extension Test) assesses hamstring tightness by measuring the angle formed by knee flexion following a full active knee extension while ensuring the hip remains stabilized at a 90-degree angle. This report, has focused on Jack-knife stretching and its fundamentals.

Jack-knife stretching is one of the effective and newly suggested static hamstring stretching methods In this stretching technique, you start by assuming a squat position, then reach down and grasp your ankles with both hands. Both short-term and long-term Jack-knife stretching has been demonstrated to improve hamstring flexibility.[6] Michelle Hamilton assessed Jack-knife stretching for improving hamstring tightness and found the

benefits of this stretch include improvement of blood flow to lower extremities, relaxation of a tight hamstring, and many other uses[7].This study was conducted on IT professionals to find the effectiveness of Jack-Knife stretching to counter Low Back pain and Hamstring tightness.

II. Methodology

This study was conducted among forty individual Information Technology (IT) Professionals, aged between 25 and 40 years, all of whom were male, working in various IT companies in and around Bengaluru. The study excluded individuals with a history of spinal surgeries, lower extremity surgeries, rheumatoid arthritis, and intervertebral disc prolapse (IVDP) and informed consent was taken from all the participants involved in the study. These IT professionals participated in Jack-knife Stretching exercises for a period of 2 weeks.

The Active Knee Extension (AKE) test and Finger-to-Floor Distance (FFD) test were used to measure hamstring flexibility, while the Numeric Pain Rating Scale (NPRS) and Quebec Back Pain Disability Scale were employed to assess pain levels. All subjects selected for the study had non-specific low back pain.

Procedure

Hamstring length test: AKE test.

During the AKE test, each subject's test leg was positioned at a 90-degree angle at the hip, while the other leg was supported on the table in a lying down position. The subjects were asked to extend their knee on the test side with a relaxed ankle position until they felt a maximum stretch and to hold the position for five seconds[6]. For familiarizing the movement a single repetition was performend by each subject. A second repetition was performed and at the end of five second holding period, an examiner monitored compensated lumbar extension movement with visual inspection and recorded the knee extension angle using a Goniometer at the end-range point of knee extension. We calculated the knee extension angle at the tibia position with respect to the line parallel to the examination table[6].

Hamstring length test: FFD test.

FFD test was used to measure hamstring flexibility. While in the standing position, the subjects were asked to bend forward to the best of their ability and, they were asked to maintain an extended knee position, and the examiner measured the distance between the floor and the subject's fingers using inch tape.

Hamstring stretching protocol: Jack-knife stretching.

During jack-knife stretching, participants positioned themselves in a full squat and held onto both ankles. They were then instructed to extend their knees fully while bringing their chest close to their thighs and maintaining a grip on their ankles[6]. The subjects maintained a maximum knee-extension position for tens and then returned to the initial position this was repeated five times with a 10sec rest period between trials for 2 weeks.

Fig.1: Hamstring length test: AKE test
Fig.2: Hamstring length test: FFD test

Fig.3: Jack-knife stretching – Starting Position
Fig.4: Jack-knife stretching - Stretching Position

III. Results

The statistical analysis was done using SPSS 23.0. Descriptive statistics were presented using mean± standard deviation, Frequency, and percentage. Pre and Post comparison was done using paired t-test. t. A p-value less than 0.05 was considered statistically significant.

Table 1: Showing the age of the information technology professionals.

Age	Frequency	Percent
25-29	23	57.5
30-34	14	35
Above 35	3	7.5
Total	40	100

Among 40 professionals, majority of 23(57.5%) belonged to age group 25-29 years, 14(35%) belonged to 30-34 years, 3(7.5%) belonged to age group above 35 years. The average age was 29.10±4.13 years with minimum age of 25 years and maximum age of 38 years.

Table 2: Showing height of information technology professionals.

	Minimum	Maximum	Mean	Std. Deviation
Height	1.55	1.83	1.74	0.07

The average height of information technology professionals was 1.74±0.07 m. The minimum height was 1.55m and maximum height was 1.83m.

Table 3: Showing weight of information technology professionals.

	Minimum	Maximum	Mean	Std. Deviation
Weight	54.00	96.00	75.48	9.32

The average weight of information technology professionals was 75.48±9.23 kg. The minimum weight was 54kg and the maximum weight was 96kg.

Table 4: Showing BMI of information technology professionals.

	Minimum	Maximum	Mean	Std. Deviation
BMI	20.06	32.11	24.97	2.75

The average BMI of information technology professionals was 24.97±2.75. The minimum BMI was 20.06 and the maximum BMI was 32.11.

Table 5: Showing pre post comparison of NPRS.

NPRS	Mean	Std. Deviation	Enhancement	t value	p value
Pre	5.65	1.05	3.65	28.77	P<0.001
Post	2.00	1.06			

The average pre-NPRS score was 5.65±1.05 which decreased to 2.00±1.06 in the post-intervention. Based on this information, the intervention had a significant and positive effect on reducing pain, as evidenced by the statistically significant decrease in NPRS scores. A t-value of 28.77 is quite high, suggesting a substantial difference between the two groups (pre and postintervention), and a p-value less than 0.001 indicates an exceptionally low probability that this difference occurred by chance. Therefore, it can be concluded that the intervention led to a significant improvement in NPRS scores and a reduction in pain.

Table 6: Showing pre-post comparison of QUEBEC score.

QUEBEC SCALE	Mean	Std. Deviation	Enhancement	t value	p value
Pre	31.68	6.24	17.32	33.2	P<0.001
Post	14.35	4.91			

The average pre-QUEBEC score was 31.68±6.24 which decreased to 14.35±4.91 in the post intervention. Based on these results, the intervention had a substantial and statistically significant positive impact on QUEBEC scores. The high t-value of 33.2 suggests a significant difference between the pre-and post-intervention scores, and the exceptionally low p-value ($p<0.001$) further supports the conclusion that the intervention led to a significant improvement in QUEBEC scores.

Table 7: Showing pre-post comparison of AKE left score.

AKE_LEFT	Mean	Std. Deviation	Enhancement	t value	p-value
Pre	26.93	4.63	11.95	35.38	P<0.001
Post	14.98	3.83			

The average pre-AKE left score was 26.93±4.63 which decreased to 14.98±3.83 in the post intervention. In summary, these results underscore a significant and highly noteworthy enhancement in AKE left scores due to the intervention. The remarkably high t-value of 35.38 underscores a substantial difference between the scores before and after the intervention. Additionally, here the extremely low p-value ($p<0.001$) confirms the intervention's profound positive impact on AKE left scores.

Table 8: Showing pre-post comparison of AKE right score.

AKE_RIGHT	Mean	Std. Deviation	Enhancement	t value	p-value
Pre	27.43	5.67	12.72	29.11	P<0.001
Post	14.70	4.30			

The average pre-AKE right score was 27.43±5.67 which decreased to 14.70±4.30 in the post intervention. This change in scores, a decrease of 12.72 points, was highly significant, as evidenced by the remarkably high t-value of 29.11 and a p-value of less than 0.001. In simpler terms, the intervention had a substantial and statistically proven impact, resulting in a significant reduction in the participants' scores.

Table 9: Showing pre post comparison of FFD.

FFD	Mean	Std. Deviation	Enhancement	t value	p value
Pre	17.65	5.92	13.45	19.71	P<0.001
Post	4.20	3.81			

The average pre-FFD score was 17.65±5.92 cm which decreased to 4.20±3.81 cm in the post intervention. This represents a significant reduction of 13.45 cm in the measured variable. The statistical analysis produced a t-value of 19.71, indicating a highly significant difference between the pre-and post-

intervention measurements. The p-value is less than 0.001 ($p<0.001$), underscoring the strong statistical significance of the observed change.

IV. Discussion:

The present study is conducted to find out the effects of Jack-Kinfe Stretching among IT Professionals with Hamstring Tightness and Low back pain. The result of this study supports the hypothesis that there is an improvement in hamstring flexibility and a reduction in low back pain. There is a significant difference in pre and post-intervention scores of NPRS with $P < 0.001$, also there is a statistical difference found in pre and post-values of QUEBEC scores with improved functional ability having $P < 0.001$. The study likely found that IT professionals who incorporated jackknife stretching exercises into their routine experienced a reduction in pain, as indicated by lower NPRS scores post-intervention, and improvement in hamstring flexibility, as indicated by increased AKE measurements and improved FFD.

A Study was conducted by Koichi Sairyo on tight hamstring muscles over the span of 4 weeks by using jack knife stretching. Parameters included in this study were Pelvis forward inclination angle (PFIA) and Finger-to-floor distance (FFD). Before intervention, FFD was 14.1 ± 6.1 cm, and by the end of 4 weeks, it had decreased to -8.1 to 3.7 cm. Which indicated the gain of hamstring flexibility by 22cm. Before the experiment, PFIA was 50.6 ± 8.2 and after the intervention was given it was 83.8 ± 5.8 degrees. The outcomes of this study were significant ($p<0.05$) when before and after the experiment differences were compared which concluded that jack knife stretching is helpful in improving the flexibility of tight hamstrings[13].

Michelle Hamilton conducted a study to compare the standing jack knife stretching and seated jack knife stretching for hamstrings which included seventeen youths between the age of 8-18 years with back pain, Youths performed the 2 sets of stretching twice a day for 4 weeks. One set consisted of five repetitions of jackknife stretch holding it for 5 seconds and FTF forward was done to establish a flexibility baseline which concluded standing jackknife stretch has better hamstring flexibility[12].

Amruta Kabra et al. conducted a study on individuals with hamstring tightness using Jackknife stretching and PNF stretching and the effects of the two stretching on an individual due to this stretching. The value of mean ± SD before intervention is 34.86 ± 9.28 and after the intervention is 46.8 ± 9.60 in the PNF Group and the same for active knee extension is 31.43 ± 8.47 pre-intervention and 49.8 ± 10.7 for 2 weeks post-intervention which was conducted by independent t-test in Jack-knife Group. Finger to Floor test for PNF Group, pre-intervention mean ± SD is 17.16 ± 6.47 and post-intervention is 9.19 ± 3.65. For the Jack-knife Group mean± SD for pre-intervention and post-intervention is 17.96± 6.49 and 7.43±6.22, respectively. This study concludes that both Jack-knife and PNF stretching are equally effective in improving the flexibility of a tight Hamstring. Jack-knife stretching showed an immediate effect on Hamstring tightness compared to PNF stretching[7].

There may be limited scientific research specifically addressing the effectiveness of Jack-knife stretching in certain populations or conditions, which can make it challenging to draw concrete conclusions about its benefits. Not all individuals will experience the same benefits from Jack-knife stretching. Factors such as age, flexibility, and existing medical conditions, musculoskeletal issues can influence the effectiveness of this stretching exercise. Like most stretching exercises, the benefits of Jack-knife stretching may take time to become noticeable. It is not a quick-fix solution for immediate pain relief or flexibility improvement. While stretching can help alleviate some pain, it may not be a guaranteed method for pain relief, especially in cases of chronic or severe pain. If done improperly, jackknife stretching can lead to overstretching and potentially cause injury, particularly in individuals who are not familiar with the proper technique. The FFD test primarily measures the distance reached by the fingertips during forward bending. While it provides a general assessment of flexibility, it does not specifically measure low back flexibility. The movement also involves multiple muscle groups and joints. The AKE test primarily measures hamstring flexibility, but it does not isolate the hamstrings. Other muscles and factors, such as hip joint flexibility, can affect AKE results, making it less specific for hamstring flexibility.

V. Conclusion:

The study concludes that Jack Knife stretching is significantly effective in reducing Hamstring Tightness and reducing low back pain in IT Professionals. It also concluded that there is increased functional ability of the Hamstring muscle incorporating this into the routine will be a valuable strategy for IT professionals seeking to enhance their Hamstring Flexibility and alleviate Lower back pain.

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