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ASSOCIATION OF LUMBAR RADICULOPATHY WITH DYNAMIC BALANCE AND GAIT PARAMETERS IN ADULTS A CORRELATION STUDY

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ABSTRACT:

Objective: To determine the correlation and effects of Lumbar radiculopathy with gait parameters and dynamic balance measured on Time Up and Go test and Berg Balance Scale.

Methods: A correlational study was conducted in hospitals of the Islamabad/Rawalpindi.Population of 260 adult patients with signs and symptoms of Lumbar radiculopathy were included in the study. Patients resulting positive results on any 3 of the tests from SLR, Laseague, Sicard and Valsalva test. Patients were given a structured questionnaire and assessed for their positive response on inclusion criteria tests and their pain was recorded on NPRS using a structured questionnaire and was tested for their gait parameters by asking them to walk for 10 seconds noting their cadence, step length, stride length and step width with marked ink markers on their feet along with dynamic balance on BBS and TUG test.

Results: Significant results (p; 0.05) and correlation of Lumbar radiculopathy adversely affecting the gait parameters from healthy standards and also adversely affecting the dynamic balance as shown on BBS score and TUG test. With increasing NPRS rating, the dynamic balance was more disturbed as BBS score was lower and TUG time was higher to complete, and gait parameters were also more deviated from normal. The results additionally showed that Higher BMI of patients also rates higher ratings on NPRS, and higher BMI also adversely effects both dynamic balance and gait parameters.

Conclusion: higher NPRS ratings of the Lumbar radiculopathy patients have more negative effects on dynamic balance and gait parameters.

Keywords: Lumbar radiculopathy, Low back pain, Dynamic balance, Dynamic posture, BMI, Gait parameters.

INTRODUCTION:

Lumbar radiculopathy is the sensation of pain, tingling, numbness and muscle power loss usually caused by the compression of L4 or L5 nerves or S1, S2 and S3 nerves, or due to compression of the sciatic nerve itself with associated low back pain. The inflammation and compression of the nerve root or roots in the section of the neural foramen generally causes a widespread disorder known as radiculopathy. Usually, the reason behind radiculopathy is spondylosis and disc herniation.(1)In women 3.7 percent and in men 5.3 percent has been accounted to be the lifespan occurrence of lumbar radiculopathy. Painful symptoms of lumbar radiculopathy dissolves on its own in 23 to 48 percentage of patients owing to a prolapsed disc, however, other patient's symptoms may not resolves.(2)It is typically linked with numbness and an abnormal sensation all along the supply of the sciatic nerve. It is a frequent disorder accountable for disabilities related to work or occupation. (Iversen T, et al, 2011)(2).Balance can be affected by the sensory information acquired from the visual, somato-sensory, and vestibular systems. It is also affected by the motor responses that influence strength, coordination and joint range of motion or ROM).(3)

Multiple sources of integration are responsible for sustaining stability during movements in walking and standing, also re-establishing the balance subsequent sudden stumbles or instability. These integration sources are of the spatial information, which include visual, vestibular, proprioceptive, as well as cutaneous sensations from both external and internal frame of reference. It is suggested that amends in both motor and sensory systems affects the balance performance.(4)A study in which it was presented that some previously conducted studies have shown that patients with sciatica have poorer control over posture than healthy individuals and that postural control stays unchanged 3 months post lumbar discectomy in patients with sciatica. The goals of the current study mentioned were to evaluate that whether control of static balance is recovered in post-discectomy pain free patients in long-term after lumbar. 23 lumbar discectomy patients with residual pain, 15 pain free lumbar discectomy patients, and 72 healthy controls underwent unilateral stance tasks with eyes open and eyes closed. In the eyes open test category, no significant difference was noted between the postural sway of lumbar discectomy patients that were pain-free and control group of healthy individuals. While the balance of patients that were in residual pain category was significantly disturbed and away from normal than in the control healthy individuals. In analysing the closed eyes condition, the postural sway in both of the groups of lumbar discectomy patients was significantly disturbed and away from normal than in control healthy individuals. Patients seemed to start depending on visual compensatory input systems for responsible sensory-motor disorders, which are, however, helpfully effective in case of pain relief only.2024/1/26According to study in which deviations in gait parameters and postural control have been noted in the people with chronic low back pain. In more challenging standing positions patients with chronic low back pain have been found to have increased center of pressure displacements and velocities, indicating poor postural stability.(6)

A comparison was done between patients with symptomatic lumbar stenosis radiculopathy and non-symptomatic patient group for balance on berg balance scale and device assisted balance scale. The symptomatic group had higher balance deficits with lower scores.(7) Patients with chronic low back pain have shown decreased speed, decreased stride time, and decreased stride length. This is due to the altered proprioceptive feedback.(8)Balance is very important for locomotor system, normal functioning and to carry out daily living activities. Pain and impairments in proprioception predispose an individual to abnormal functional patterns and balance compromise. The study will help identify the effects of pain due to lumbar radiculopathy on the gait parameters and dynamic balance which will serve as a foundation on which the treatment programs can be designed and implemented in the population under study. The purpose of study was to determine the association of lumbar radiculopathy with dynamic balance and determine the association of lumbar radiculopathy with gait parameters.

METHODS:

It was a correlation study conducted from September 2018 to December 2018 in clinical settings of Rawalpindi, Islamabad hospitals. A sample size 260 participants using the EPITOOLS sample size calculator and a non-probability, simple convenient sampling technique was used. All participants signed the informed consent form. Research Permission was taken from ethical research Committee to conduct the study. Adults (male and female) with clinical signs and symptoms of lumbar radiculopathy with any 3-positive test (Positive SLR test, Positive sicard test, Positive lasegue's test, Positive Valsalva test) were included. Adults with traumatic nerve injury and neuropathies were excluded. Patients were analysed for gait and dynamic parameters. Numeric Pain Rating Scale, Body Mass Index, gait parameters, Berg Balance Scale score and Time Up and Go test time were used.

After selecting the Lumbar radiculopathy patients according to inclusion criteria of any positive 3 tests out of SLR,Laseague, Sicard and valsalva, they were given the questionnaire and were asked to walked a distance for 10 seconds to note their gait parameters and then were assessed for dynamic balance on BBS and TUG test. Patients were asked to perform the protocol as per the berg balance scale and timed up and go test to assess their balance. For gait parameters ink marks on the feet of patients were marked to measure the step and stride length with measuring tape and cadence were be measured noting the time.

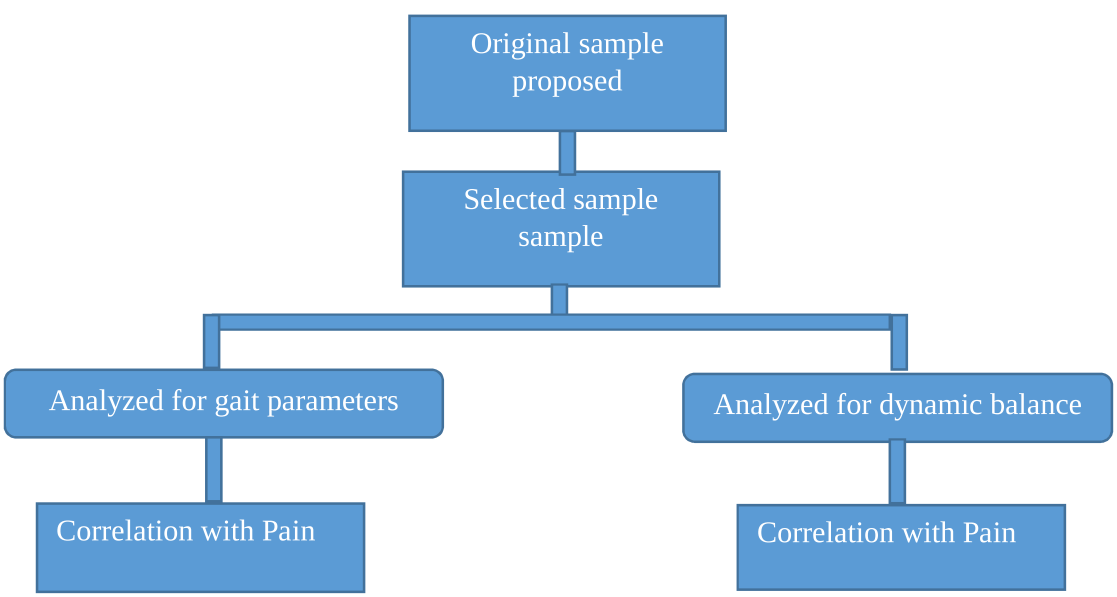

Figure 1: Consort Diagram

Analysis:

Data was analyzed on SPSS 17. Descriptive analysis of variables was done. The test of normality was applied to all variables to assess the normality. The decision of applying parametric or non-parametric test was made on the basis of Shapiro Wilk test value. The data was not normally distributed as p value was less than 0.05.On the basis of normality test, non-parametric correlation spearman test was applied for correlational statistics. The NPRS rating of lumbar radiculopathy patients was correlated with BMI, gait parameters, BBS score and TUG test time.

RESULTS:

There were 260 participants in this study of which there were 117 males and 143 females. Out of 260, 227 participants were radiologically diagnosed and 33 did not under go any radiological imaging. The mean age was 43.6 ±6.49.The mean pain rating on NPRS, Steps per minute, Step length of the involved leg, step length of the uninvolved, stride length of the involved leg, step width, time of timed up and go test and berg balance total score were measured. (Table 1)

Table 1: showing the means and standard deviations of the variables

Variables	**Mean**	**Standard deviation**
Age	43.6	6.49
Height	5.53	0.22
Body weight	74.8	5.38
BMI	25.1	1.9
NPRS	5.88	1.33
Cadence	75.4	8.4
Step length of involved leg	12.9	1.15
Step length of uninvolved leg	14.07	0.67
Stride length	25.04	3.8
Step width	3.5	0.5
BBS score	42.7	6.7
TUG time	12.9	0.73

For correlational results, non-parametric spearman correlation test was applied on the basis of non-normal data as tested by normality test. There was a positive correlation between NPRS and TUG test (r= +0.758 p= 0.02). Hence, higher the ratings on NPRS, higher is the time taken by the patient to complete the TUG test and greater the risk of fall (Fig 2). Correlation coefficient between NPRS and BBS score was negative (r = - 0.735) with a significant p value (p= 0.03). (Fig 3)

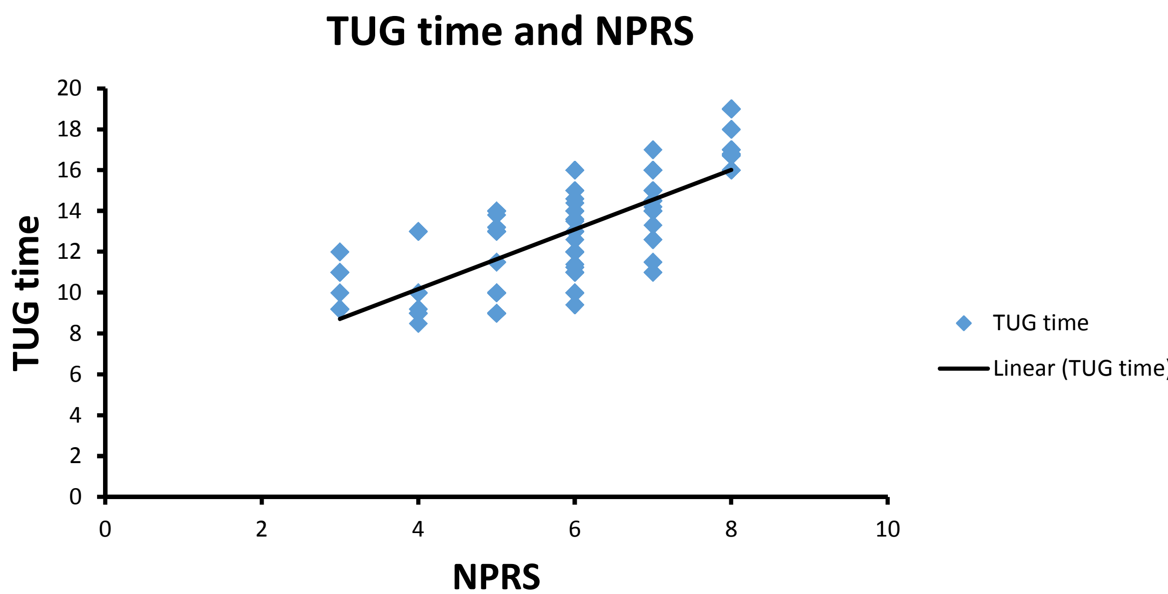

Figure 2: Showing positive correlation between NPRS and TUG. (NPRS= Numeric pain rating scale, TUG = Timed up and Go

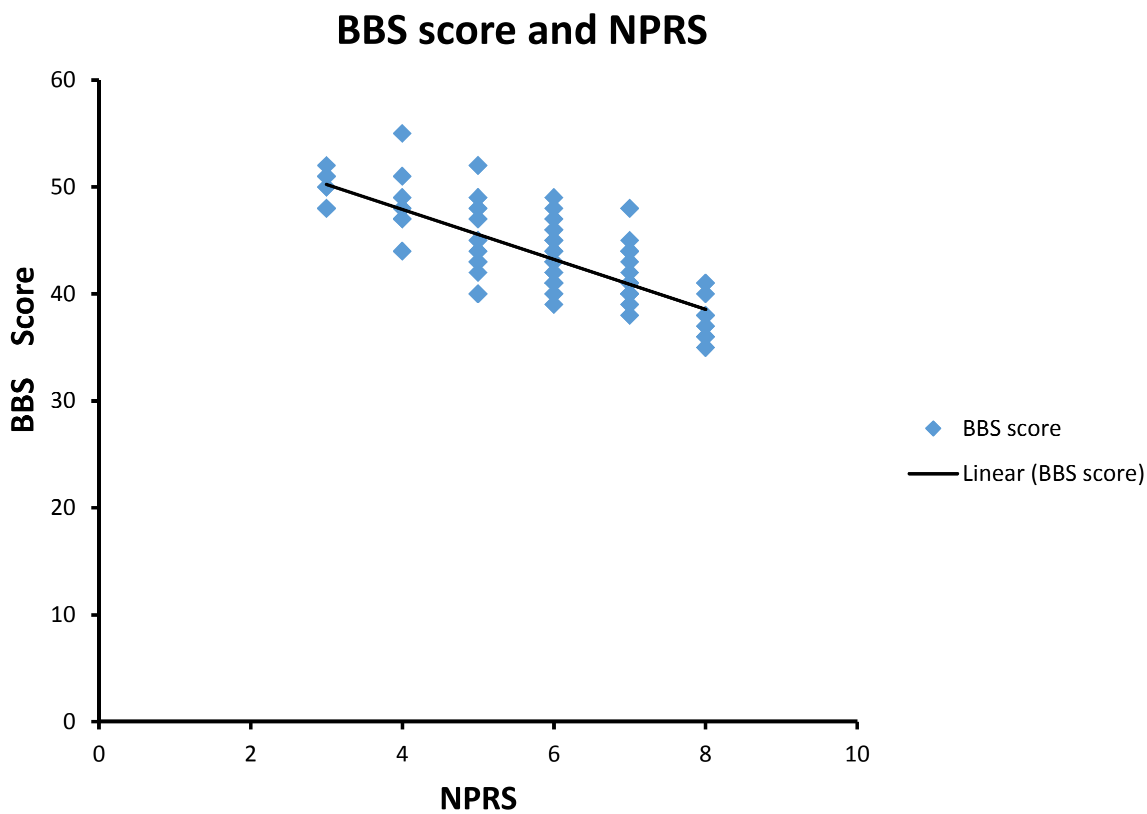

Figure 3: Showing negative correlation between NPRS and BBS. (NPRS= Numeric pain rating scale, BBS= Berg balance scale)

Correlation coefficient between NPRS and Steps per minute score, Step length of involved leg, Step length of uninvolved leg, Stride length, Step width, BMI was measured (Table 2)

Between TUG test time and steps per minute, step length of involved leg, step length of uninvolved leg, stride length, step width, Correlation coefficient were positive and negative with a significant p value (p= 0.00). (Table 2)

Correlation coefficient between BBS score and step width, BMI, steps per minute, TUG test time, steps per minute, step length of the involved leg, step length of the uninvolved leg and BBS score, stride length was mentioned. (Table 2)

Between BMI and step length of involved leg, step length of uninvolved leg, stride length, TUG test, step width, Correlation coefficient were positive and negative with a significant p value (p= 0.00). (Table 2)

Table 2: showing the relationship between NPRS TUG BBS BMI with different variables

	Variables	r value	P value
NPRS	Step length of involved leg	- 0.638	0.00
	Step length of uninvolved leg	- 0.350	0.00
	Stride length	- 0.623	0.00
	Step width	+ 0.702	0.00
	Steps per minute score	- 0.712	0.00
	BMI	+0.29	0.00
TUG	Step length of involved leg	- 0.832	0.00
	Step length of uninvolved leg	- 0.584	0.00
	Stride length	- 0.816	0.00
	Step width	+0.787	0.00
	BBS	-0.72	0.00
BBS	Step length of involved leg	+0.70	0.00
	Step length of uninvolved leg	+0.446	0.00
	Stride length	+0.68	0.00
	Step width	-0.72	0.00
	Steps per minute score	+0.84	0.00
	BMI	- 0.413	0.00
	Step length of involved leg	-0.358	0.00
	Step length of uninvolved leg	-0.366	0.00
	Stride length	-0.339	0.00

BMI	Step width	+0.276	0.00
	Steps per minute score	-0.341	0.00
	TUG	+0.228	0.00

DISCUSSION:

Recent study was a correlational study consisting of 260 patients with lumbar radiculopathy. These patients were tested for their gait parameters and dynamic balance on Berg balance scale and Timed up and go test in a clinical setting. The data was analyzed by the pearson correlation between their NPRS rating and gait parameters and between their NPRS and dynamic balance on BBS score and TUG time. The results of current study showed that there is a correlation between NPRS rating with gait parameters and dynamic balance which are altered negatively compared to healthy standards. The Study results have shown that with increasing NPRS ratings, the time taken by the patients with lumbar radicular pain to complete to the TUG increased and the scores on BBS were lower, both of the scenarios indicating disturbed dynamic balance and altered proprioception. This finding is in line with the previous study done by Bouche K(et.al) in 2005 which concluded that the balance and dynamic posture in patients with lumbar radicular pain was significantly worse compared to pain free control group.(5)

The above stated finding of disturbed dynamic balance also is in line with the previous study conducted by Claudine JC et.al in 2006 which concluded that patients with Lumbar pain have a decreased capability for adapting coordination of trunk and pelvis and Erector Spinae muscle activity to changes in speed. Disturbed control and coordination of muscles may lead to unexpected loss of balance(9)

The alteration in dynamic balance shown by results of this study was due to reduced sensitivity and proprioception in the foot secondary to nerve compression or irritation arising from the lumbar spine leading to altered afferent inputs resulting in improper afferent feedback to control mechanisms and altered peripheral proprioception or altered central processing of the proprioception as demonstrated in the results of a studies “Deficits in foot skin sensation are related to alterations in balance control in chronic low back patients experiencing clinical signs of lumbar nerve root impingement” done by Lydia R.frost(et.al) in 2015 and “Changes in coordination of postural control during dynamic stance in chronic low back pain patients” by R.della Volpe(et.al) in 2005.(10, 11)

The results also showed that with increasing NPRS, the gait parameters step length, stride length and cadence reduced than the normal healthy standard, while the step width increased than normal healthy standard. All these alterations suggest the increasing radicular pain negatively affecting the gait parameters. These gait parameters were also altered by the increasing BMI. This finding is in the line with the results of the study conducted by Veronica cimolin(et.al) in 2011 which concluded that Low back pain and Obesity are associated with alterations in the gait pattern and mechanisms. The knee and ankle strategy in these patients were altered compared to healthy individuals.(12)

In a study Efficacy of the Star Excursion Balance Test in Detecting Reach Deficits in Subjects with Chronic Low Back Pain conducted in 2014 by Deepak Chhabra et.al, it was shown that the lower back ache is related with weakness of paraspinal and other trunk muscles and with disturbances in coordination of low back muscles. This deficit in muscles strength and coordination results in poor postural stability, neuromuscular control and balance in patients with low back pain.(8)

In a previous study, 8923 women and 6293 men complained lower back ache. In both genders, the results showed that a higher BMI was suggestively associated with a higher prevalence of lower back pain. This study based on large population established that high BMI is associated with an increased prevalence of lower back pain. The results of this study is in line with results of recent study which showed that with increasing BMI, the patients reported higher rating of pain on NPRS.(13)

A study was conducted on both gender male and female of working class who had previously experienced low back pain. The results of the study concluded that professional adults having previous low back pain who had higher BMI and low level of physical activity had predicted chances of developing sciatic pain. This stands in line with the results of current study which showed by results that patients who reported higher ratings of pain on NPRS had higher BMI.(14)

The alterations in the gait parameters and pattern in patients with lumbar pain with radiculopathy as well with increased BMI is due to the fact that pain and increased mass effects body shape and joint normal physiology and range of motion influencing gait. A neuromodulation occurs that causes disturbances in gait mechanics and parameters. These patients with low back pain were found to have difficulties in modulation of trunk and pelvis coordination, mainly on the transverse plane, and activity of erector spinae erector spinae velocity perturbations. The combined effect of higher BMI and low back pain had an effect on the gait more severely. These patients were found to have a lesser dynamic stability during the gait, a longer stance duration and reduced speed and smaller step length when compared to healthy individuals, and a lesser physiological knee and ankle strategy.(12)

The current study incorporated following limitations: The numbers of patients originally proposed to be 347 were reduced to 260 due to time limit and lack of patient availability. Pre-disposing factors including bone health, calcium and vitamin D levels were not ruled out Patient's occupation and extent of physical activity were not ruled out.

CONCLUSION:

Recent study by the results concluded that higher the BMI, more is the pain experienced by patients and there is a significant correlation of Lumbar radiculopathy with gait parameters and dynamic balance. The Lumbar radiculopathy pain disturbs normal gait parameters from the healthy standard and also disturbs the dynamic balance which may contribute to a possibility of all in the affected population. The higher the pain on NPRS ratings, more disturbances in balance and deviation of gait parameters from normal.

Author's Contribution

AS: drafted the work, interpretation of data for the study and acquisition of data for the study

MT: design of the study, analysis of the data for the study and revised it critically for important intellectual content

MS: substantial contributions to the conception, interpretation of data for the study.

AS, MT,: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

The study was conducted from September 2018 to December 2018 in clinical settings of Rawalpindi Islamabad and Gujjar Khan (Ref No: RIPHAH)/RCRS/REC/LETTER-00395).

Consent Statement

Informed consent was obtained from Participant involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Acknowledgement

None to declare.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; orin the decision to publish the results.

Disclaimer: None.

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APPENDICES:

Patient Data Questionnaire

Patient name: ___________________________ age : ___________

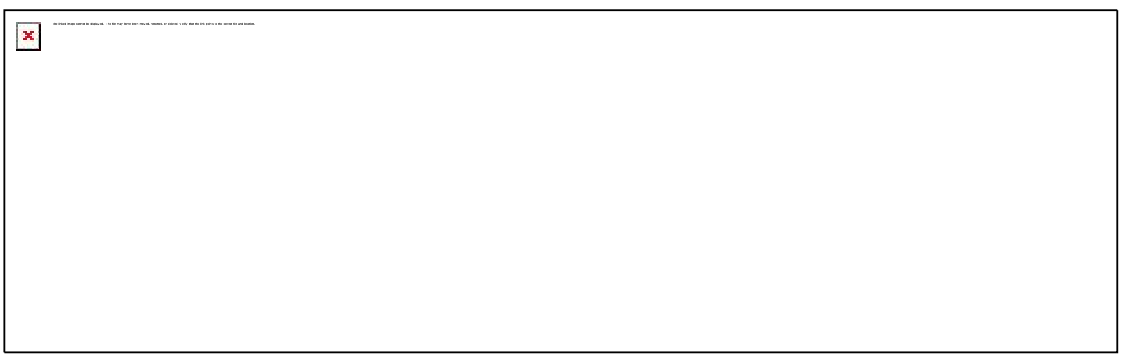
Gender : M/F

Contact number : ____________________________

Please answer the following questions :

1. Are you having back pain ? Yes/No
2. Are you having pain in buttock region ? Yes/No
3. Are you having pain at the back of your thigh/thighs ? Yes/No
4. Are you having uncomfortable feeling in back of your thigh/thighs ? Yes/No
5. Are you having numbness, tingling and pain travelling at the back your thigh to foot? Yes /No

- Rate your pain according to the severity on numeric pain rating scale



Tests :

i. SLR test :

ii. Laseague test :

iii. Sicard test :

iv. Valsalva test :

Gait parameters:

- Kindly walk for one minute

a. Cadence:
b. Step length:
c. Stride length:
d. Step width:

Timed up and go test :

- When you are instructed kindly get up from chair and walk the distance, Turn around and come back to sit.

Time taken to complete the task : _______________

Interpretation: ____________________

BERG BALANCE SCALE

Balance Item Score (0-4)

1. Sitting unsupported _______
2. Change of position: sitting to standing _______
3. Change of position” standing to sitting _______
4. Transfers _______
5. Standing unsupported _______
6. Standing with eyes closed _______
7. Standing with feet together _______
8. Tandem standing _______
9. Standing on one leg _______

10. Turning trunk (feet fixed) _______

11. Retrieving objects from floor _______

12. Turning 360 degrees _______

13. Stool stepping _______

14. Reaching forward while standing _______

TOTAL (0–56): _______