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The impact of yoga and physical exercises on lumbar spondylosis: A comparative study

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Abstract
Through yogic practices and physical exercises, the study hopes to reduce the disability levels of lumbar spondylosis. We have chosen 120 Northern Indian patients with lumbar spondylosis impairment. These patients were referred to us by physiotherapists. They split up the 120 patients into 3 groups. Under the skilled direction of the yoga instructor, Group A received yogic practices, Group B received physical exercises, and Group C received control. The control group received no activities at all. With the VAS questionnaire, we evaluated the disability levels caused by lumbar spondylosis. Our results after three months show that both yogic practices had a substantial impact on lowering impairment levels. In a similar vein, the group that engaged in physical exercises activity showed a statistically significant change in VAS scores over time, suggesting that physical exercise is a useful tool for lowering impairment levels. Pharmaceutical treatments for non-communicable disorders like lumbar spondylosis are not very helpful in treating these conditions. Our yogic and physical activities, as well as other complementary and alternative medicine methods, contributed significantly to the reduction of lumbar spondylosis disability levels. Further investigation into the fundamental processes and enduring effects of these interventions will enhance the quality of life for those with impairments.

Keyword: Lumbar spondylosis, yogic practices, physical exercise, chronic low back pain

1. Introduction
A degenerative disorder of the lumbar spine that affects the intervertebral discs (IVDs) and surrounding vertebral bodies is called lumbar spondylosis. Osteophyte production and IVD degeneration are prominent features of lumbar spondylosis, a condition that causes chronic back discomfort and functional impairment [1].

A number of diseases, including osteoarthritis, intervertebral disc degeneration, past spinal traumas, and lumbar radiculopathy, are linked to chronic low back pain (CLBP) and lumbar spondylosis. With an estimated 14.9 million Americans practicing yoga, 21% of whom use it to treat neck and back pain, many turn to complementary and alternative medicine (CAM) for relief from the epidemic-level public health problem known as chronic low back pain (CLBP), which affects 70-85% of the population in the US [2, 3, 4].

Lower back pain brought on by spondylosis presents serious global clinical, social, economic, and public health issues. Across all demographics, modern lifestyles—marked by extended sitting, poor diet, inactivity, and high levels of stress—have a substantial impact on lumbar discomfort. These changes in lifestyle have led to a rise in the prevalence of lower back pain, with intervertebral disc prolapse being a particularly common cause. The L4-L5 and L5-S1 discs account for approximately 95% of lumbar disc herniations, which can develop abruptly or gradually as a result of repetitive motions. Creating successful treatment plans requires a thorough understanding of the disorder's underlying origins and clinical manifestations [5]. Lumbar spondylosis significantly impairs balance, daily activities, and patient well-being [6]. Osteoarthritis, intervertebral disc degeneration, prior spinal traumas, and lumbar radiculopathy are among the many diagnoses for chronic low back pain (CLBP), which is frequently combined with lumbar spondylosis [7].

Throughout the world, the main imaging technique used to diagnose lumbar spondylosis is plain film radiography (PFR) [8]. Studies indicate that between 6 and 8% of the general population may have lumbar spondylolysis [9]. Many research has looked at the effectiveness of different oral medications in treating degenerative low back pain, but a widely accepted

pharmacological treatment plan is still unattainable [10].

The Sanskrit root word "*yuj*," which means "to join" or "to unite," is where the word "yoga" comes from. It is the ultimate aim as well as a means of achieving the unification of body, mind, and soul. Yoga aims to achieve the fullest possible integration of the individual's identity [11].

In addition to physical health, yoga's tenets and practices—asanas, *dhyana*, *pranayama*, *yama*, and *niyama*—aim to promote inner calm, mental clarity, emotional stability, and spiritual development. Consistent yoga practice develops a balanced outlook on life, leading to enhanced wellbeing and self-awareness [12]. Many randomized controlled studies have examined the effectiveness of yoga in treating a variety of osteoarthritis syndrome [13], multiple sclerosis [14], bronchial asthma [15, 16] pulmonary tuberculosis [17], drug addiction [18], hypertension [19], irritable bowel syndrome [20], lymphoma [21], mild depression [22], these studies evaluated on Iyengar yoga, with reported positive outcomes.

Exercise is a vital part of a healthy lifestyle since it greatly improves fitness and general health. One particularly good form of moderate physical activity that promotes natural health is walking. Frequent exercises enhances intrinsic health and fitness and supports an active lifestyle [23]. A fundamental human right, well health is impacted by social, environmental, and individual variables. Regular exercise also improves mood, lowers stress, eases anxiety, and increases self-esteem, according to scientific research [24]. Exercise and yoga have several advantages, such as being low-cost, non-invasive, low-risk, and developing physical fitness without the need for medical supervision. These benefits encourage choice and compliance by appealing to patients who are hesitant or intolerant of medicine [25].

For computer users who have chronic low back pain (CLBP), yoga and exercise are helpful. Yoga is especially good in lowering tension, anxiety, and depression as well as increasing spinal mobility [26]. Research has demonstrated that yoga provides longer-lasting advantages in enhancing functional skills and minimizing persistent low back pain than self-care books [27]. Ashtanga yoga emphasizes mental clarity, bodily well-being, moral and ethical behavior, and higher consciousness in order to foster spiritual development [28]. Research indicates that a rigorous yoga practice lasting a week can enhance quality of life (QOL) and spinal suppleness more successfully than specific physical therapy for chronic low back pain [29]. Back discomfort is frequent in Germany and may be associated with a social inferiority complex, indicating that educational level should be taken into account in future cross-regional studies [30]. Low back pain (LBP) has a significant financial impact in Australia, with lost productivity costing more than direct medical expenses. When compared to tax revenue and governmental spending, the estimated economic impact of almost nine billion dollars in 2000–2001 was noteworthy [31].

The primary goal of the study is to reduce the lumber spondylosis disability levels by using yogic practices and physical exercises activity.

2. Materials and Methods

This study used an experimental research design with a pre-test and post-test format to determine the impact of recommended therapies on participants who have been diagnosed with lumbar spondylosis. A crucial component of the research process is subject selection, which guarantees the study's relevance and generalizability to a larger population. We have chosen 120 Northern Indian patients with varying degrees of lumbar spondylosis impairment. These patients were referred to us by physiotherapists. Using the purposeful sampling method, the sample was chosen. They split up the 120 patients into 3 groups. Under the skilled direction of the yoga instructor, Group A received yogic practices, Group B received physical exercises, and Group C received control. The control group received no activities at all. Each group consisted of forty individuals. Randomization techniques were used for group allocation in order to reduce bias and guarantee similar baselines throughout groups. We used the VAS questionnaire to determine the impairment levels associated with lumbar spondylosis. Comparisons between and within groups were possible because to assessments conducted both before (pre-test) and after (post-test) of the intervention. Every subject received an individual administration of each test, and scoring was completed appropriately. In order to examine the information gathered from the Visual Analog Scale (VAS) [32], the following tests will be performed: Anova, paired sample, independent sample, frequency distribution, and range.

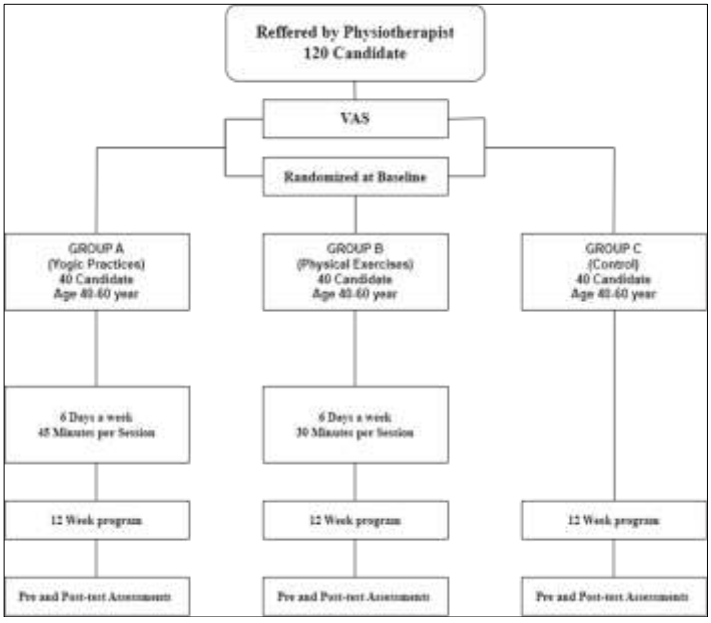

Fig 1: Research design

3. Results and analysis of the study

3.1 Combined analysis of VAS Scores over time across control, yogic practices, and physical exercises groups:

Table 1: VAS datasets for Yogic practices, Physical exercises and Control group with respect of time

Anova						
		Sum of Squares	**DF**	**Mean Square**	**F**	**SIG.**
Control Group	BETWEEN GROUP	1631.900	6	271.983	2.220	.041
	WITHIN GROUP	33441.400	273	122.496		
	TOTAL	35073.300	279			
Yogic Practices Group	BETWEEN GROUP	9458.721	6	1576.454	13.075	.000
	WITHIN GROUP	32916.650	273	120.574		
	TOTAL	42375.371	279			
Physical Exercise Group	BETWEEN GROUP	8359.771	6	1393.295	11.659	.000
	WITHIN GROUP	32623.225	273	119.499		
	TOTAL	40982.996	279			

The significant ANOVA result ($F = 2.220$, $p = 0.041$) suggests that there are differences in mean scores among the groups over time for the variable measured. This finding implies that the observed variations in mean scores are likely due to actual differences between the groups rather than random chance alone. Therefore, there is a strong indication that the groups in the study have distinct mean scores on the measured variable.

Based on the ANOVA findings ($F = 13.075$, $p = 0.001$), there are significant differences in mean scores among the groups over time for the variable measured in the VAS datasets for the Yogic Practices group. This suggests that the0 observed variations in mean scores are likely due to genuine differences between the groups rather than random variability alone. Therefore, it is highly probable that the group means differ significantly from each other with respect to the measured variable.

According to the ANOVA findings ($F = 11.659$, $p < 0.001$), there are substantial differences in mean scores among the groups over time for the variable measured in the VAS datasets for the Physical Exercises group. This statistical significance suggests that the variations in mean scores are likely attributable to genuine differences between the groups rather than random fluctuations alone. Hence, it is highly probable that the group means differ significantly from each other concerning the measured variable.

3.2 Combined analysis of factors impacting the dependent variable across control, yogic practices, and physical exercises groups

Table 2: Comparison of all groups

Dependent Variable: Data					
Source	**Type III Sum of Squares**	**DF**	**Mean Square**	**F**	**SIG.**
Corrected Model	50910.095[a]	20	2545.505	21.062	.000
Intercept	2267513.630	1	2267513.630	18762.071	.000
Group	31459.702	2	15729.851	130.153	.000
Time	16164.795	6	2694.133	22.292	.000
Grouptime	3285.598	12	273.800	2.265	.008
Error	98981.275	819	120.856		
Total	2417405.000	840			
Corrected Total	149891.370	839			

a. R Squared = .340 (Adjusted R Squared = .324)

3.2.1 Overall Significance: The overall model is highly significant with an F-value of 21.062 and a p-value less than 0.001, indicating that the model as a whole explains a significant amount of variance in the dependent variable.

Based on the ANOVA findings ($F = 21.062$, $p < 0.001$), there are significant differences in mean scores between the groups (GROUP) and significant changes over time (TIME) for the variable measured (DATA). The significant interaction effect (GROUP_TIME) indicates that the effect of groups on the dependent variable varies across different time intervals. These results provide valuable insights into how different groups and time points impact the dependent variable, highlighting the dynamic nature of the relationships under study.

3.2.2 Visual Representation

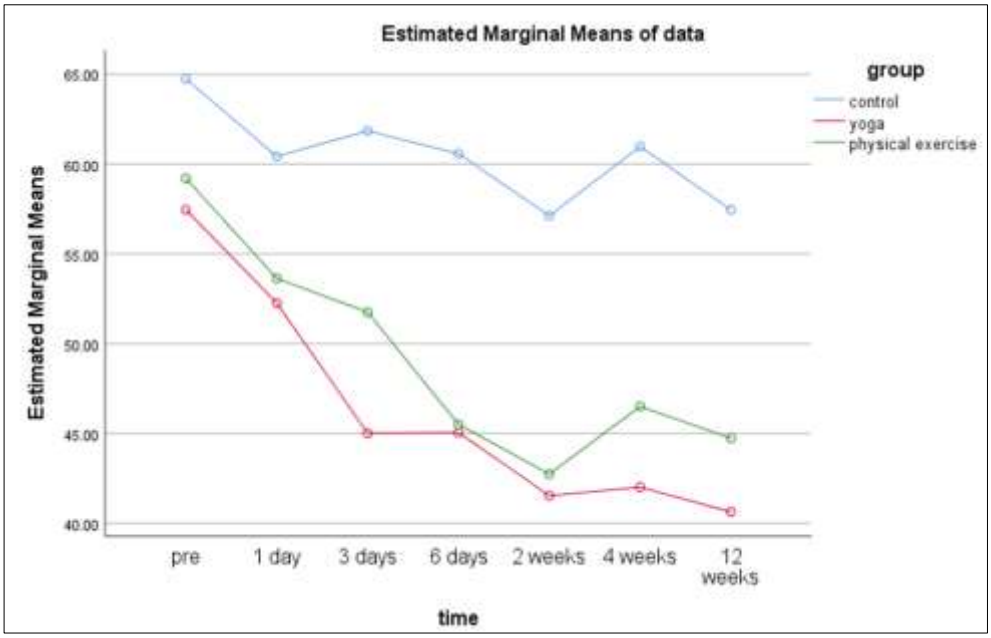

Fig 2: Estimated Marginal Means of all groups

This analysis is based on the data presented in 'Table 2: Comparison of all groups' and is illustrated in 'Figure 2'.

3.2.3 Statistical Insights: Figure 2 visually captures the significant changes observed in the control group over time compared to the yoga group.

3.2.4 Control Group Dynamics: The graph in Figure 2 shows relatively stable estimated marginal means for the control group across the study's time points. In contrast, the yoga group exhibits minimal changes in estimated marginal means over the same period.

3.2.5 Graphical Representation: Figure 2 echoes the statistical insights provided in Table 2, emphasizing the stability of the control group's outcomes and the lack of significant changes in the yoga group.

3.2.6 Effect of Yoga: By contrasting the trajectories of estimated marginal means between the control and yoga groups, Figure 2 underscores the absence of pronounced changes in the yoga group compared to the control group.
Figure 2 serves as a graphical representation that supports earlier statistical findings, illustrating the stability of estimated marginal means in the yoga group compared to the control group over time. This visual representation enhances our understanding of how the interventions influence the measured variable.

4. Descriptive statistics of Control and Yogic practices group

Table 3: Descriptive statistics of Control and Yogic practices group

Group Statistics					
		N	**Mean**	**Std. Deviation**	**Std. Error mean**
CONTROL_YOGIC PRACTICES_DATA	Control group	280	60.4500	11.21208	.67005
	Yogic practices group	280	46.2714	12.32408	.73650

4.1 Mean Scores: The Control group shows a higher average score on the variable compared to the Yogic Practices group.

4.2 Standard Deviation: The Yogic Practices group exhibits a slightly higher standard deviation than the Control group, indicating greater variability in scores within the Yoga group.

4.3 Standard Error Mean: The standard error mean is slightly higher for the Yogic Practices group compared to the Control group, suggesting slightly less precision in the sample mean estimation for the Yoga group.

These statistics provide insights into the distribution and variability of scores within each group. The Control group shows higher average scores and slightly lower variability compared to the Yogic Practices group. These findings are crucial for understanding the differences in outcomes between the two groups and interpreting the results of subsequent analyses.

5. Comparison of Control and Yogic practices group by t-test

Table 4: Comparison of Control and Yogic practices group by t-test

t	**DF**	**Sig. (2-tailed)**	**Mean difference**	**Std. Error difference**	**95% confidence interval of the difference**	
					Lower	**Upper**
14.240	558	0.000	14.17857	0.99569	12.22281	16.13434
14.240	553.084	0.000	14.17857	0.99569	12.22277	16.13438

These results suggest that there is a substantial and statistically significant difference in the variable of interest between the Control and Yogic Practices groups. The Control group shows significantly higher mean scores compared to the Yogic Practices group. This finding underscores the effectiveness of these statistical tests in detecting differences between groups, providing valuable insights into the outcomes of the study.

6. Descriptive statistics of Yogic practices and Physical exercise group

Table 5: Descriptive statistics of Yogic practices and Physical exercises group

Group Statistics					
		N	**Mean**	**Std. Deviation**	**Std. Error mean**
YOGIC_PHYSICAL_DATA	Yogic practices group	280	46.2714	12.32408	.73650
	Physical exercises group	280	49.1464	12.11992	.72430

6.1 Mean Score: The Physical Exercises group has a higher mean score compared to the Yogic Practices group.

6.2 Standard Deviation: The Physical Exercises group also exhibits a slightly higher standard deviation compared to the Yogic Practices group, indicating that responses in the Physical Exercises group are more dispersed from the mean.

6.3 Standard Error Mean: The standard error of the mean is slightly higher for the Yogic Practices group compared to the Physical Exercises group, suggesting slightly less precision in estimating the sample mean for the Yogic Practices group.

These descriptive statistics provide insights into the distribution and variability of the variable of interest across the Yogic Practices and Physical Exercises groups. The higher mean score in the Physical Exercises group indicates potentially different impacts or outcomes related to the type of intervention. These findings are crucial for understanding and interpreting the results of the study, highlighting differences between the groups that may influence further analysis or conclusions.

7. Comparison of Yogic practices and Physical exercises group by t-test

Table 6: Comparison of Yogic practices and Physical exercises group by t-test

t	**DF**	**Sig. (2- ailed)**	**Mean difference**	**Std. Error difference**	**95% confidence interval of the difference**	
					Lower	**Upper**
-2.783	558	0.006	-2.87500	1.03298	-4.90401	-0.84599
-2.783	557.844	0.006	-2.87500	1.03298	-4.90401	-0.84599

These findings suggest that there is a significant difference in the variable of interest between individuals practicing Yogic exercises versus those engaging in Physical exercises. The lower mean score in the Yogic Practices group compared to the Physical Exercises group highlights potential differences in outcomes or impacts of these interventions on the measured variable.

8. Descriptive statistics of control and physical exercise group

Table 7: Descriptive statistics of Control and Physical exercises group

Group Statistics					
		N	**Mean**	**Std. Deviation**	**Std. Error mean**
CONTROL_PHYSICAL_DATA	Control group	280	60.4500	11.21208	.67005
	Physical exercises group	280	49.1464	12.11992	.72430

8.1 Mean Scores: The Control group has a higher mean score of compared to the Physical Exercises group. This indicates that, on average, participants in the Control group scored higher on the measured variable compared to those in the Physical Exercises group.

8.2 Standard Deviation: The Physical Exercises group exhibits a higher standard deviation than the Control group. This suggests that there is greater variability in responses within the Physical Exercises group, indicating more spread-out data points around the mean compared to the Control group.

8.3 Standard Error Mean: The standard error mean provides an estimate of how much the sample mean is likely to vary from the true population mean. For both groups, the standard error mean is relatively small compared to their respective means, indicating a reasonable precision in estimating the population mean from the sample mean.

The Control group shows a higher mean score on the measured variable compared to the Physical Exercises group. The Physical Exercises group exhibits higher variability in their responses, suggesting that the effects of physical exercise on the measured variable may vary widely among individuals.

9. Comparison of control and physical exercise group by t-test

Table 8: Comparison of Control and Physical exercises group by t-test

t	**DF**	**Sig. (2-tailed)**	**Mean difference**	**Std. Error difference**	**95% confidence interval of the difference**	
					Lower	**Upper**
11.456	558	0.000	11.30357	0.98670	9.36547	13.24168
11.456	554.651	0.000	11.30357	0.98670	9.36544	13.24170

These results confirm that there is a significant difference in the measured variable between the Control and Physical Exercises groups. The Control group shows higher scores on average compared to the Physical Exercises group, indicating that the intervention of physical exercise has a noticeable impact on the dependent variable as compared to the control condition.

This statistical evidence supports the findings from descriptive statistics and graphical representations, providing robust evidence of the effect of physical exercise on the measured variable within this dataset.

10. Discussion

The findings of this study demonstrate the significant impact of yogic practices and physical exercise interventions on the measured variable, compared to the control group. The findings demonstrate that during the study's time points, both the yoga and physical activity groups saw significant decreases in estimated marginal means, with yoga showing a more dramatic benefit. The control group, on the other hand, showed minimal changes over the same period.

The statistical analysis revealed significant differences in mean scores between the groups, with the yoga group showing lower mean scores compared to both the control and physical exercise groups. The physical exercise group also showed lower mean scores compared to the control group, but higher mean scores compared to the yoga group.

These findings suggest that yogic practices and physical exercise interventions have a beneficial impact on the measured variable, with yogic practices having a stronger impact. The results support the hypothesis that yogic practices and physical exercise can lead to significant improvements in the measured variable, compared to control conditions.

The study's findings have important implications for the development of interventions aimed at improving the measured variable. Yogic practices and physical exercise programs can be considered as valuable additions to traditional treatments, offering a holistic approach to improving outcomes. The results also highlight the potential benefits of yogic practices and physical exercise for improving overall well-being and quality of life.

11. Conclusion

In conclusion, strong evidence supporting the beneficial effects of yoga and physical exercise interventions on the assessed variable is shown in this study. The findings suggest that yoga, in particular, has a pronounced impact on reducing the measured variable, compared to both control and physical exercise conditions.

The results of this study have important implications for the development of interventions aimed at improving the measured variable. As non-pharmacological means of enhancing results, yogic practices and physical exercise regimens might be regarded as beneficial supplements to conventional therapies.

The modest sample size and restricted generalizability of the study underscore the need for additional research to validate these results and investigate the underlying mechanisms via which physical exercise and yogic practices work.

Overall, this study indicates the potential benefits of yoga and physical exercise for improving the measured variable, and provides a foundation for future research in this area. The findings suggest that these interventions may be useful additions to traditional treatments, offering a non-pharmacological approach to improving outcomes

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