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The comparison of the effects of yoga, TRX, and combined exercises on pain perception and lordosis angle in women with chronic low back pain and increased lordosis

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Abstract

Background: Chronic low back pain (LBP) is one of the most frequent causes of disability in women.

Aim: The main purpose of the current study was to compare the effects of yoga, TRX, and exercise-related combination programs on pain and lordosis in women with increased lordosis and LBP.

Materials and Methods: In this study, 40 women based on the study's criteria were included in the pre-intervention assessments and randomly divided into three experimental groups (yoga, TRX, and exercise-related combination programs) and control group. At this stage, the lordosis angle of participants was measured using a flexible ruler, and their pain was also measured via the Oswestry Disability Index. Furthermore, the experimental groups performed selected exercises for 60 min/session for three sessions/week for six weeks.

Results: Our results demonstrated that there was a statistically significant difference between the yoga, TRX, and exercise-related combination programs in lumbar lordosis (P= 0.003) and pain levels in women with LBP (P= 0.007). Also, lumbar lordotic angle showed a significant reduction only in the combined groups subsequent to the period (P= 0.003).

Conclusion: In conclusion, the current findings illustrated that exercise-related combination program than other modalities could be used as an exercise-related treatment method to ameliorate lordosis angle and pain in women with LBP.

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1. Introduction

Chronic low back pain (LBP) is one of the most common causes of disability in people of all ages, with approximately 80% of people experiencing at least one episode of LBP at some point in their lives [1]. Also, chronic LBP may have significant extra financial costs for treatment. Regarding the main causes of LBP, it has been presumed that spinal cord injuries, intervertebral disc injuries, ligament tear and neuromuscular dysfunctions may induce chronic LBP in susceptible individuals. It also causes many disorders in people's daily lives, reduced quality of life, as well as disabilities in daily work. Moreover, LBP can charge excess treatment costs like healthcare and hospital costs [2].

Regarding various causes of LBP, previous studies have also illustrated that lordosis- due to increased lumbar arch angle and pressure on the intervertebral discs, over long periods of time- may cause pain in this region [3]. However, it has been reported that maintenance of an ideal back posture and strong muscles are the main factors to avoid in such a situation [4]. According to the Kendall's recommendation, a good physical condition is believed to have a healthy appearance, preserving body balance and protection against injuries in various physical conditions, which means that a person can do the daily physical tasks for many hours without any pain [5]. In this case, balance problems and changing muscle length can lead to a number of abnormalities, including lordosis, or an increased lumbar arch that increases pressure on the intervertebral discs [6].

Concerning corrective exercise-related posture amelioration, it has been clarified that exercise as a good and non-invasive modality can probably decrease lordosis angle and treat low back pain [7]. Furthermore, yoga exercises as a non-invasive-related modality may play a role in treatment for reducing lordosis-induced disorders and improving LBP through maintaining the correct distance and high blood flow in the vertebrae and increasing flexibility as well as optimum muscle length [8, 9]. Besides, suspended exercise (TRX) can likewise improve lordosis and LBP through increasing muscular strength and flexibility in midsection muscles [10]. Therefore, because of the importance of exercise therapies in the treatment of lordosis and LBP on the one hand, and the variety of therapeutic exercises on the other hand, recognizing the best therapeutic exercise in the treatment of lordosis and chronic LBP still remains unrevealed [11]. Hence, we are supposed to reasonably compare the effects of yoga, TRX, and exercise-related combination programs on pain and lordosis in women with increased lordosis and chronic low back pain.

2. Materials and Methods

2.1. Participants

In the current study, which was an experimental research design, we included 40 women (age: 25-35 years) with lumbar hyper lordosis (lumbar lordotic angle, LLA) above 35 degrees. LLA is a perfect method to evaluate lumbar lordosis and its normal degrees can be determined as 20-45 degrees ± 1 SD [12], and chronic low back pain. After that, their information was completely collected by a qualified specialist using demographic forms and questionnaires to meet our inclusion criteria. Also, prior to participation, we asked all potential participants to sign the consent forms when they arrived to demonstrate their consent to participate in the study. Then, our subjects were selected by a simple randomization,

according to the inclusion criteria, and randomly divided into three experimental groups and one control group (n= 10 subject per group). Regarding the study's sample size, we allocated 10 participants per group, based on two tails, $\alpha<0.05$, EF≈0.9, as well as 1-β=0.8 factors, using G-Power Software (Heinrich Heine University Düsseldorf, Germany) [13]. In addition, all procedures of the present investigation have also been totally approved by the ethical committee of Imam Reza International University (ethical committee code number: 14907).

2.2. Intervention

The three experimental groups performed exercises for 6 continuous weeks, 3 sessions per week, and for 60 min per session. Our subjects executed the selected exercises following pain and lordosis angle measurements under the supervision of an expert specialist in the experimental groups. Each training session included: warming up (for approximately 10 min), main training section (for almost 40 min), and cooling down (about 10 min). Additionally, each training session in the three experimental groups involved four training units, but, regarding the combined exercise group, it was scrutinizingly accomplished as yoga, TRX, yoga, and TRX, respectively. According to the Osar Principles, we started the selected exercises in each session with a low threshold and progressed to a high threshold [14]. As well, based on the principle of progressive overload, the number of sets and the duration of the stretches were gradually increased during each interventional week [15]. The training protocols were visually and verbally learnt to the subjects during the 6 weeks of the study's interventions. However, following pain and lordosis angle measurements, the control group did not do any exercises during the intervention period, but the subjects of this group freely performed their daily activities.

In the current study, pain levels in LBP subjects were measured using the Visual Analog Scale (VAS), according to Shafshak and Elnemr (2020), described in detail elsewhere [16]. Likewise, it has been represented that the Cobb angle assessment has become the gold method in the assessment of sagittal spinal curvature as well as lumbar lordosis. In this study we measured lumbar curvature by using a spinal mouse, according to the procedures described in detail elsewhere [17]. In addition, body mass was assessed using a body composition monitor weighing scale (Omron Body Composition Monitor Weighing Scale; Model HBF-214; Lake Forest, IL, USA). Furthermore, subjects' height was visually estimated by an expert instructor and then measured with a roll-up measuring tape with a wall attachment (Seca, Model: 206, Hamburg, Germany).

2.3. Statistical analysis

Regarding statistical analysis, Shapiro-Wilk and Leven tests were used to determine the normality of the data and the homogeneity of variance, respectively. Also, a two-way ANOVA test was performed to measure the interaction of time (within group) × group (between groups) and the Bonferroni test was likewise used to compare between group differences. All data was analyzed by using SPSS software (software: SPSS 16.0 for Windows, SPSS Inc., USA). Statistical significance for comparison was set at $P<0.05$.

3. Results

Table 1 presents the general characteristics of subjects, including age, height, and

weight. Also, statistics in the experimental groups before and following the interventions are presented in Table 2. Table 2 compares statistics of the study's groups (group), time (within group) and group × time interaction for pain and LLA variables to separate the differences between groups before and after the intervention period. Our results demonstrated that following the intervention period, there was a statistically significant difference in pain variable (P= 0.001). In other words, pain perception in all experimental groups was significantly reduced following the interventional period (P<0.05). Besides, LLA showed a significant reduction only in the combined groups subsequent to the period (P= 0.003).

4. Discussion

The aim of the current study was to compare the effects of yoga, TRX, and exercise-related combination programs on pain and lordosis in women with increased lordosis and chronic low back pain. It has been contemplated that the postural muscles tend to become short and tight, but the phasic muscles tend to become weak and inhibited [18]. Inappropriate habits and poor postures may induce muscle imbalance and eventually lead to postural abnormalities [19].

Generally, the factors that lead to hyper lordosis and LBP are associated with changes in body position and result in weakness or shortness of body muscles [20]. Also, previous studies illustrated that short muscles may induce abnormalities [21]. To combat the postural abnormalities-related muscle shortness, the latest and updated reports showed that the shortened muscles should be stretched and returned to the normal length and the weakened muscles should be strengthened [22]. In this regard, abdominal weakness is one of the factors that causes hyper lordosis and back pain, which causes weakness in the abdominal muscles and leads to back pain. Some investigational studies suggest that strengthening of abdominal muscles as well as rectus abdominis may ameliorate pelvic anterior tilt and reduce chronic LBP [1, 9, 11, 22].

Table 1. General characteristics of subjects including age, height and weight

Variable *	Groups	M±SD
Age	TRX	35.6 ± 2
	Yoga	32.7±3.2
	Combined	34.2±3.7
	Control	29.4±3.5
Height (cm)	TRX	166.6±5.5
	Yoga	164.1±2.7
	Combined	166.8±4.78
	Control	164.3±4.2
Weight (kg)	TRX	66.5±93.64
	Yoga	66.5±93.64
	Combined	69.9±1.32
	Control	65.5±34.03

* Based on mean ± Standard Deviation. TRX, suspended exercise.

Table 2. Statistical differences in pain and LLA variables following the interventional period

Variable	Groups	Interventional period (M±SD)		Group		Time		Group × Time		Between group comparison		95% confidence interval for difference [a]
		Pre-test	Post-test	F	P	F	P	F	P			
Pain (VAS)	TRX	16.7±2.23	8.5±3.9 *	4.3	0.007ǂ	33.4	0.001ǂ	4.6	0.005ǂ	Control	TRX ††	3.75±1.27
	Yoga	16.9±5.1	12.6±4.6*									
	Combined	16.9±2	8.6±5.1*								Yoga ††	1.28±1.27
	Control	16.6±3.6	16.5±4.08								Combined ††	3.8±1.27
LLA (Degree)	TRX	37.33±0.9	36.9±0.95 *	5.2	0.003 ǂ	1.2	0.263	0.2	0.87	Control	TRX	- 0.8±0.34
	Yoga	36.9±1.3	36.77±1.2 *									
	Combined	37.9±1.3	37.4±1.3 *								Yoga	- 0.5±0.34
	Control	36.3±0.53	36.3±0.5								Combined ††	- 1.33±0.34

Based on mean ± Standard Deviation.

[a] Adjustment for multiple comparisons: Bonferroni. TRX, suspended exercise

* A significant difference from pre-test to post-test

ǂ A significant difference compared to other groups

†† A significant difference compared to control group

The mean difference is significant at the 0.05 level.

In this study, abdominal exercises were performed by the TRX, yoga, and combined groups. However, there was a significant decrease in LLA only in the combined group. To specify this finding, it seems that the reduction in LLA in the combined group compared to the other groups was because of the significant effect of TRX on strengthening central muscles as well as abdominal muscles. Correspondingly, our findings revealed that pain perception was significantly more depressed in the experimental groups than in the control group. In other words, the recent finding was due to the large effect of TRX exercises on improving the strength of the abdominal and gluteal muscles.

Taken together, our findings were consistent with Gheitasi et al. (2019) [21], Ko et al. (2018) [12] and Khanzadeh, Mahdavinejad and Borhani (2020) [10]. They showed that TRX training can help to reduce LBP levels and LLA in similar patients. Concerning the yoga-induced decreased pain perception, our findings showed that pain level in comparison with the control group were significantly decreased, which was in agreement with findings of Simonet et al. (2020) [7], Goni (2018) [8], and Zhu et al. (2020) [1]. However, this finding in the yoga group showed less effect on pain and LLA than in other experimental groups. Consequently, the study's findings demonstrated that the current exercise treatment regimens had good effects on pain reduction in all experimental groups, while the combined group had the highest effect on pain reduction compared to other experimental groups. In this case, the main reason that may account for it can be discussed by the effectiveness of TRX exercises to increase core body strength as well as the abdominal muscles. In addition, the best effectiveness of these exercise-related modalities belonged to the combined group, which may partly be attributed to the efficiency of yoga exercises on lengthening the shortened muscles and the combined effect of TRX exercises on strengthening the gluteal and abdominal muscles.

Our study has several limitations that one of the eminent study's restrictions was Covid-19 pandemic in Iran, which limited the authors' recall of more participants. Also, we unbaled to control daily physical activities of the study's subjects due to the above mentioned reason.

5. Conclusion

In conclusion, our results showed a significant reduction in LLA and pain in the combined group compared to the TRX and yoga groups. Take these findings into account: yoga exercises ameliorate pain and LLA by improving flexibility and increasing muscle length on the one hand, while TRX exercises, on the other hand, result in improving the core body as well as abdominal muscle strength and endurance.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

S.T.: Conceptualization, investigation, writing–original draft, A.A., G.B.; and S.A.: supervision and contribution to review the manuscript; S.A. writing–review & editing. All authors contributed to the original idea, study design.

Ethical considerations

All the procedures of the present investigation have also been totally approved by the ethical committee of Imam Reza International University (ethical committee code number: 14907). The

author has completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

References

[1] Zhu F, Zhang M, Wang D, Hong Q, Zeng C, Chen W. "Yoga compared to non-exercise or physical therapy exercise on pain, disability, and quality of life for patients with chronic low back pain: A systematic review and meta-analysis of randomized controlled trials". *PloS one*. 2020; 15(9): e0238544. doi: 10.1371/journal.pone. 0238544 ..PMID: 32870936. PMCID: PMC7462307.

[2] Akodu AK, Akindutire OM. "The effect of stabilization exercise on pain-related disability, sleep disturbance, and psychological status of patients with non-specific chronic low back pain". *The Korean Journal of Pain*. 2018; 31(3): 199. doi: 10.3344/kjp.2018.31.3.199. PMCID: PMC6037811. PMID: 30013734.

[3] Jung KS, Jung JH, In TS. The effects of cross-legged sitting on the trunk and pelvic angles and gluteal pressure in people with and without low back pain. *International Journal of Environmental Research and Public Health*. 2020; 17(13): 4621. doi: 10.3390/ijerph17134621. PMID: 32605016 PMCID: PMC7370107.

[4] Ito T, Sakai Y, Ito Y, Yamazaki K, Morita Y. "Association between back muscle strength and proprioception or mechanoreceptor control strategy in postural balance in elderly adults with lumbar spondylosis". *Healthcare*. 2020. 8(1): 58. doi: 10.3390/healthcare8010058. PMCID: PMC7151025. PMID: 32164248.

[5] Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. "What low back pain is and why we need to pay attention". *The Lancet*. 2018; 391(10137): 2356-67. PMID: 29573870. doi: 10.1016/S0140-6736(18)30480-X.

[6] Cherepov E, Epishev V, Terekhina E. "Effects of modern fitness technologies on physical qualities in students with locomotor disorders". *Minerva Ortopedica e Traumatologica*. 2018; 69(3): 43-8. doi: 10.23736/S0394-3410.18.03879-1.

[7] Simonet E, Winteler B, Frangi J, Suter M, Meier ML, Eichelberger P, et al. "Walking and running with non-specific chronic low back pain: What about the lumbar lordosis angle?" *Journal of Biomechanics*. 2020; 108: 109883.

[8] Goni MO. "Treatment of common postural deformities through yoga". *International Journal of Social Science and Economic Research*. 2018; 3(8).

[9] Patil NJ, Nagaratna R, Tekur P, Manohar P, Bhargav H, Patil D. "A randomized trial comparing effect of Yoga and exercises on quality of life in among nursing population with chronic low back pain". *International Journal of Yoga*. 2018; 11(3): 208–214. PMCID: PMC6134737. PMID: 30233114. doi: 10.4103/ijoy.IJOY_2_18.

[10] Khanzadeh R, Mahdavinejad R, Borhani A. "The effect of suspension and conventional core stability exercises on characteristics of intervertebral disc and chronic pain in office staff due to lumbar herniated disc". *Archives of Bone and Joint Surgery*. 2020; 8(3): 445. doi: 10.22038/abjs.2019.40758.2102. PMCID: PMC7358225. PMID: 32766406.

[11] Grabara M, Szopa J. "Effects of hatha yoga exercises on spine flexibility in women over 50 years old". *Journal of Physical Therapy Science*. 2015; 27(2): 361-5.

[12] Ko KJ, Ha GC, Yook YS, Kang SJ. "Effects of 12-week lumbar stabilization exercise and sling exercise on lumbosacral region angle, lumbar muscle strength, and pain scale of patients with chronic low back pain". Journal of Physical Therapy Science. 2018; 30(1): 18-22. doi: 10.1589/jpts.30.18. PMID: 29410558. PMCID: PMC5788767.

[13] Abbasian S, Ravasi AA. "The effect of antecedent-conditioning high-intensity interval training on BDNF regulation through PGC-1α pathway following cerebral ischemia". *Brain Research*. 2020; 1729: 146618. DOI: 10.1016/j.brainres.2019.146618 PMID: 31866362.

[14] Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. "The physical activity guidelines for Americans". *Jama*. 2018; 320(19): 2020-8. doi: 10.1001/jama.2018.14854.

PMID: 30418471 PMCID: PMC9582631.

[15] La Scala Teixeira CV, Evangelista AL, Pereira PEdA, Silva-Grigoletto D, Marzo E, Bocalini DS, et al. "Complexity: a novel load progression strategy in strength training". Frontiers in Physiology". 2019; 10: 839. 10.3389/fphys.2019.00839.

[16] Shafshak TS, Elnemr R. "The visual analogue scale versus numerical rating scale in measuring pain severity and predicting disability in low back pain". *Journal of Clinical Rheumatology: Practical Reports on Rheumatic & Musculoskeletal Diseases*. 2021 Oct 1;27(7): 282-285. doi: 10.1097/RHU.0000000000001320. PMID: 31985722.

[17] Russell BS, Muhlenkamp-Wermert KA, Hoiriis KT. "Measurement of lumbar Lordosis: a comparison of 2 alternatives to the cobb angle". *Journal of Manipulative and Physiological Therapeutics*. 2020; 43(8): 760-7. doi: 10.22098/JAST.2022.1405.

[18] Bayattork M, Seidi F, Minoonejad H, Andersen LL, Page P. "The effectiveness of a comprehensive corrective exercises program and subsequent detraining on alignment, muscle activation, and movement pattern in men with upper crossed syndrome: protocol for a parallel-group randomized controlled trial". *Trials*. 2020; 21(1): 1-10. doi: 10.1186/s13063-020-4159-9.

[19] Alsufiany MB, Lohman EB, Daher NS, Gang GR, Shallan AI, Jaber HM. "Non-specific chronic low back pain and physical activity: A comparison of postural control and hip muscle isometric strength: A cross-sectional study". *Medicine*. 2020; 99(5):e18544. doi: 10.1097/MD.0000000000018544.

[20] Romeyke T, Stummer H. "Evidence-based complementary and alternative medicine in inpatient care: take a look at Europe". *Journal of Evidence-Based Complementary & Alternative Medicine*. 2015; 20(2): 87-93. PMID: 25404750. doi: 10.1177/2156587214555714.

[21] Gheitasi M, Bayattork M, Miri H, Afshar H. "Comparing the effect of suspended and non-suspended core stability exercises on static and dynamic balance and muscular endurance in young males with down syndrome". *Physical Treatments-Specific Physical Therapy Journal*. 2019; 9(3): 153-60. doi: 10.32598/ptj.9.3.153.

[22] Lau C, Yu R, Woo J. "Effects of a 12-week hatha yoga intervention on cardiorespiratory endurance, muscular strength and endurance, and flexibility in Hong Kong Chinese adults: A controlled clinical trial". *Evidence-Based Complementary and Alternative Medicine*. 2015; 958727. PMCID: PMC4475706. PMID: 26167196. doi: 10.1155/2015/958727.