

ORIGINAL ARTICLE

Effect of Yoga and Pilates exercises on lumbar spine physical parameters in healthy women

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Purpose: In this study, it was aimed to examine the physical effects of participation in a Yoga and Pilates-based exercise program on the endurance and flexibility of the spine to protect the health of the lumbar region in healthy women.

Methods: A total of 40 healthy women with a mean age of 41.62±6.91 years were included in the study. Participants were divided into two groups as Yoga and Pilates groups randomly. Both groups participated in an exercise program for 45 minutes a day, two days a week for 12 weeks. Sit and reach test was used to evaluate flexibility, and curl up, Static back endurance test and horizontal side bridge building test were used to evaluate endurance.

Results: When both exercise groups were compared before and after treatment, statistically significant difference was found in favor of post-treatment in all measurements ($p<0.001$). When the comparison was made between the groups, no significant difference was found between the groups in any parameter ($p>0.05$).

Conclusion: According to the results of our study, it was determined that both exercise types improved both flexibility and muscle endurance performance. However, it was seen that Yoga and Pilates exercises were not superior to each other in terms of flexibility and endurance. Both Yoga and Pilates exercise methods can be used safely to protect and improve general health and especially lumbar region health.

Keywords: Yoga, Pilates, Lumbar region.

Sağlıklı kadınlarda Yoga ve Pilates egzersizlerinin lumbar omurga fiziksel parametreleri üzerine etkisi

Amaç: Bu çalışmada, lumbar bölge sağlığı için önemli parametreler olan Yoga ve Pilates temelli bir egzersiz programına katılımın dayanıklılık ve esneklik performansını üzerine etkilerinin incelenmesi amaçlanmıştır.

Yöntem: Çalışmaya yaş ortalaması 41,62±6,91 yıl olan toplam 40 sağlıklı kadın dahil edildi. Katılımcılar rastgele Yoga ve Pilates grupları olmak üzere iki gruba ayrıldı. Her iki grup da 12 hafta boyunca haftada iki gün, günde 45 dakika egzersiz programına katıldı. Esnekliği değerlendirmek için otur ve uzan testi, dayanıklılığı değerlendirmek için mekik, statik sırt dayanıklılık testi ve yatay yan köprü kuma testi kullanıldı.

Bulgular: Her iki egzersiz grubu tedavi öncesi ve sonrası karşılaştırıldığında tüm ölçümlerde tedavi sonrası lehine fark bulundu ($p<0,001$). Gruplar arasında karşılaştırma yapıldığında hiçbir parametrede gruplar arasında fark bulunmadı ($p>0,05$).

Sonuç: Çalışmamızın sonuçlarına göre her iki egzersiz türünün hem esnekliği hem de kas dayanıklılık performansını iyileştirdiği belirlendi. Fakat Yoga ve Pilates egzersizlerinin esneklik ve dayanıklılık açısından birbirine üstün olmadığı görüldü. Genel sağlığı ve özellikle bel bölgesi sağlığını korumak ve iyileştirmek için hem Yoga hem de Pilates egzersiz yöntemleri güvenle kullanılabilir.

Anahtar Kelimeler: Yoga, Pilates, Lumbar bölge.

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A sedentary lifestyle means sitting for a long time while at work, in spare times and while moving, and the lack of physical activity together with this lifestyle causes many problems.¹ These problems negatively affect the quality of life, such as deterioration of posture, low back pain, and decreased strength and flexibility.^{1,2} Studies have shown that physical inactivity causes an increase in sedentary time in women, with women being less active than men.²

Yoga and Pilates, which are mind-body exercises, have been very popular in the literature in recent years because they reduce pain, strengthen core muscles, provide flexibility and relaxation. Both exercise methods are used separately, especially in women, to improve flexibility, provide muscle control and increase strength.³

Yoga targets many muscle groups to lengthen tense muscles and strengthen core muscles that are often underused.^{4,5} It is known that the yoga exercise program produces beneficial results in protecting and improving the health of the lumbar region, as well as minimizing the negative effects of conditions such as pain caused by health problems in the lumbar region. In a study, it has been shown that regular participation in Yoga exercise protects the health of the lumbar region and is effective in minimizing the negativities that accompany the problems that occur in the lumbar region.⁶

Pilates is a type of exercise used to reduce back pain. The Pilates method is a technique that focuses on increasing lumbopelvic stabilization and improving posture, breathing, flexibility, increasing strength and providing muscle control. The Pilates approach provides active use of body muscles to stabilize the lumbopelvic region. There is evidence that Pilates is an effective approach to increase the strength of deep body core muscles.^{7,8}

In the literature, it is seen that Pilates and Yoga exercises protect and improve physical health as in other types of exercise. On the other hand, it is seen that the effects of exercise types on general physical functions are discussed in the studies in the literature, and it is striking that there are limited studies examining the effects of exercise on parts of the body. As a result of the literature review, it was seen that the studies investigating the effects of Pilates and Yoga

exercises on the lumbar region were limited.^{4,5,7} While one of these studies was a pilot study,⁴ the other two separately examined the effect of Yoga and Pilates exercises on low back pain in different conditions.^{5,7} As it is known, many health problems occur in the lumbar region, which is the center of gravity of the body, and studies^{9,10} show that 80-84% of people experience health problems related to the lumbar region at least once in their life. Although the factors that cause people to have health problems in the lumbar region vary, it is stated that the problems seen in the lumbar region, especially in industrialized countries, are serious public health problems.^{11,12} At this point, it is an important issue to conduct research on the effects of participation in exercise on the lumbar region in order to minimize the health problems in the lumbar region and to protect the health structure of the lumbar region. Although these two exercise methods are used separately in women in the literature, there is no such study as far as we know comparing Yoga and Pilates in middle-aged women before. The first hypothesis of this study was that the endurance and flexibility of the spine increase after Yoga and Pilates exercise programs; the other hypothesis was that Yoga is superior to Pilates in increasing the endurance and flexibility of the spine. Therefore, in this study, it was aimed to examine the effects of participation in a Yoga and Pilates-based exercise program on endurance and flexibility performance, which are important parameters for lumbar region health.

METHODS

Study design

In this study, the pre-posttest study model, which is widely used in experimental studies, was used. The performance tests of the individuals in the Yoga and Pilates exercise group were tested at both before and after the exercise programs. Differences between pre-posttest performance parameters were compared. Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Pamukkale University (decision no: 60116787-020/54315). Informed consent was obtained from all study

participants and assurances were given of the confidentiality of the information. The study was carried out in accordance with the Declaration of Helsinki.

Participants

This research was carried out in a Wellness Center in Denizli. Participants were divided into two groups as Yoga and Pilates groups by block randomization method according to body mass index (BMI).

Inclusion criteria were: Being in the 30-50 age range, no regular exercise habits, and ability to understand verbal and written information.

Exclusion criteria were: Having known physical, neurological, psychiatric, oncological, cardiovascular disease-causing functional disability, participating in any exercise or strength training in the last 3 months, pregnancy breastfeeding, and those with chronic low back pain.

Outcome measures

Sit and reach test: The sit and reach test was used to determine the flexibility performance of the individuals participating in the research. The test was performed using a sit-and-reach bench with a length of 35 cm, a width of 45 cm and a height of 32 cm. Before the test, the participants were visually shown how the test was administered. Participants tried to reach as far as they could on a tripod prepared in accordance with the procedure, the test was repeated twice for everyone, and the best test score obtained was recorded as cm.¹³

Curl up: It was done to determine the endurance levels of the muscles in the abdominal region.

1-Dynamic: In the initial phase of the test, the individual is in the supine position. The lower extremities are abducted approximately shoulder-width apart and the knees are in the semi-infected position. During the test, the participant's ankles were fixed by the researcher. The upper extremities are located on the opposite shoulders. The number of curl ups that the subjects were able to do in 1 minute was recorded, in which the participants were asked to flex their trunk and get up enough to touch their elbows and knees.¹⁴

2- Static: The time that the participant could maintain this position with the hips and knees at 90 degrees in a crossed position in front of the body was recorded with a chronometer.¹⁵

Static back endurance test: It was used to determine the endurance levels of the back muscles. In the initial phase of the test, the participant lay flat on the table with the pelvis, hips, and knees in the prone position, with the inguinal region at the end of the table. The ankles of the participant were fixed. He/she was asked to place his/her upper extremities next to the trunk. The length of time the participant could stay on a straight line in the horizontal position was determined by a stopwatch. The test was terminated when the participant fell from the horizontal position or could not maintain the current position. The test was continued for a maximum of 240 seconds.¹⁶

Horizontal side bridging: It was used to determine the endurance levels of the spinal stabilizer muscles. In the initial phase of the test, the participant stands in a side-lying position with the lower extremities extended. The top foot was placed in front of the bottom foot for support. The participant made elevation on the forearm and ankle until the pelvis and trunk were in a horizontal position. During the test, attention was paid to ensure that the participant was on a straight line. The time that the participant could not maintain the position was determined in seconds with a stopwatch. Measurements were made for the right side of the participants because the dominant sides of all participants were right.^{17,18}

Interventions

Pilates and Yoga exercises were given to women by experienced and trained physiotherapists. The participants in both groups were given preliminary information about the purpose of the exercise program applied before the study and the physical activities to be performed within the scope of the exercise program. Individuals in the Pilates group participated in a 45-minute reformer Pilates exercise program twice a week for 12 weeks. All participants were informed about the reformer tool and the work program. Each session of the 12-week Pilates program applied in our study was started with horizontal costal breathing exercises and warm-up exercises applied on the mat for 5 minutes as a preliminary preparation. The exercises were initially performed as 6-8 repetitions. The degree of difficulty of the exercises was achieved by increasing the spring resistance and modifying the range of motion.^{19,20} The names of

the exercises applied to the reformer Pilates group are in Table 1.

Individuals in the Yoga group participated in a Yoga exercise program for 45 minutes a day, two days a week for 12 weeks. Each session of the 12-week Yoga program applied in our study started with 5 minutes of pranayama (breathing) exercises in classical Yoga as preliminary preparation, 5-10 minutes of warm-up-stretching movements, 20 minutes of sun salutation sets, followed by 20-30 minutes of dynamic Yoga asanas. The program was completed by applying savasana for 5-10 minutes.²¹ The exercises applied in the Yoga group are shown in Table 2.

No side effects or adverse events were experienced during the exercises in both exercise groups. All women completed the exercise program.

Statistical analysis

G-Power 3.1 program was used to calculate sample size. It was observed that the effect size obtained in the reference study²² was strong ($d:1.158$). As a result of the power analysis, we conducted for the study, using the effect size value calculated according to sit and reach test results in the reference study, it was calculated that 80% power could be obtained at the 95% confidence level when at least 22 participants (at least 11 participants for each group) were included in the study. Considering the risk of individuals leaving the study during follow up, it was planned to start the study with 40 participants (20 for each group). SPSS 22.0 program was used for the analysis of the data collected. Descriptive statistics were used to calculate the age and BMI values of the participants in the Yoga and Pilates group. The Kolmogorov-Smirnov test was used to examine whether the data conformed to the normal distribution. The Wilcoxon test was used to compare the measurement results between the in-group test and the post-test, while the Mann Whitney U analysis was used to compare the measurements taken in the pre-test and post-test between the groups because the data did not fit the normal distribution. $p < 0.05$ was accepted as a significant difference.

RESULTS

A total of 40 women (Group of Yoga $n:20$, group of Pilates $n:20$) with a mean age of

41.62 ± 6.91 years were included in the study. When the groups were compared in terms of age and BMI values, no statistically significant difference was found ($p > 0.05$, Table 3).

When both groups were compared before and after treatment, a statistically significant difference was found in favor of post-treatment in all measurements ($p < 0.05$, Table 4). When the comparison was made between the groups, there was no significant difference between the groups in any parameter before or after the treatment ($p > 0.05$, Table 4).

DISCUSSION

In this study, it was investigated whether Yoga and Pilates exercises in women influence flexibility and endurance, which are related to the health of the lumbar region. According to the results of the study, it was determined that both exercise programs provided a significant increase in flexibility and endurance parameters, which are physical performance indicators in women. In addition, when both exercise programs were compared in terms of flexibility and endurance, it was seen that the exercise programs were not superior to each other.

Endurance and flexibility are important components of physical fitness and activity. These components improve with different types of exercise methods.²³ One of these exercise methods are Pilates and Yoga, which are known as complementary exercise methods in the literature.

Yoga is expressed as a means of "self-movement" of the nervous system and spine and extremity joints at the same time with its static-dynamic processes. In general, Yoga practice is performed slowly and gradually in a closed kinetic chain (certain poses or static postures), which may include active stretching, isometric muscle contractions, increasing concentration, and appropriate breathing patterns.⁸ Therefore, many physical dysfunctions can be relieved, and the flexibility of the body can be improved with the practice of Yoga. There are different methods for assessing flexibility in the literature. One of these methods, the sit and reach test, has been frequently used in the literature to evaluate flexibility. This test is also used in studies involving Yoga intervention.²⁴ It has a simple procedure, is easy to administer,

Table 1. Pilates exercises.

1- Footwork Series	2- Short Box Twist
3- Running	4- Short Box Tree
5- Pelvic Tilt	6- Elephant
7- Leg Circles	8- Long Stretch
9- Frog	10- Up Stretch
11- Knee Stretch	12- Down Stretch
13- Knee Stretch Arched	14- Tendon Stretch
15- Knee Stretch Knees Off	16- Semi Circles
17- Scooter	18- Side Splits
19- Single Leg Stretch	20- Front Splits
21- Single Straight Leg Stretch	22- Thigh Splits
23- Hundred	24- Short Spine Massage
25- Coordination	26- Long Box Swan
27- Stomach Massage Round	28- Long Box Pulling The Straps
29- Stomach Massage Hands Back	30- Long Box T Pull
31- Stomach Massage Reach	32- Long Box Backstroke
33- Stomach Massage Twist	34- Long Box Teaser
35- Short Box Round	36- Long Spine Massage

Table 2. Yoga exercises.

1- Virabhadrasana	2- Eka pada Rajakapotosana
3- Navasana	4- Eka pada Rajakapotosana 2
5- Ardha Matsyendrasana	6- Shavasana
7- Anjaneyasana	8- Padmasana
9- Baddha Konasana	10- Bakasana
11- Virasana	12- Bidalasana
13- Dandasana	14- Janu Sirsasana
15- Balasana	16- Chaturanga Dandasana
17- Purvottanasana	18- Adho Mukha Svanasana
19- Ananda Balasana	20- Plank Pose
21- Bhujangasana	22- Anantasana
23- Bitilasana	24- Supta Padangusthasana
25- Salambhasana	26- Matsyasana
27- Ardhattansana	28- Utkatasana
29- Agnisthambasana	30- Parsvottanasana
31- Vasisthasana	32- Setu Bandha
	33- Pavanamuktasana

Table 3. Demographic characteristics of the Yoga and the Pilates groups.

	Yoga Group	Pilates Group	p
	Mean±SD	Mean±SD	
Age (years)	39.75±5.84	43.5±7.99	0.139
Height (cm)	164.9±4.52	164.7±5.98	0.532
Body weight (kg)	62.4±10.14	63.15±10.36	0.807
Body mass index (kg/m ²)	22.85±2.84	23.27±3.59	0.946

Table 4. Pre-test and post-test results in the Yoga and the Pilates groups.

	Yoga Group		p	Pilates Group		p
	Pre-test Mean±SD	Post-test Mean±SD		Pre-test Mean±SD	Post-test Mean±SD	
Sit-reach test	-2.75±1.02	3.9±1.14	<0.001	-0.05±1.09	6.6±1.02	<0.001
Dynamic curl up	30.2±2.37	35.35±2.51	0.010*	31.05±2.48	34.95±2.71	<0.001
Static curl up	46.3±3.85	52.15±4.48	<0.001	48.8±3.86	54.65±4.43	<0.001
Static back endurance	26.45±3.13	31.6±3.32	<0.001	30.7±3.74	38.4±4.3	<0.001
Static endurance lateral bridge	18.4±2.04	23.85±2.93	<0.001	21.15±2.8	27.1±3.4	<0.001

*p<0.05.

Table 5. Comparison of Pre and posttest values between the Yoga and the Pilates groups.

	Pre-test			Post-test		
	Yoga Group Mean±SD	Pilates Group Mean±SD	p	Yoga Group Mean±SD	Pilates Group Mean±SD	p
Sit-reach test	-2.75±1.02	-0.05±1.09	0.097	3.90±1.14	6.60±1.02	0.142
Dynamic curl up	30.20±2.37	31.05±2.48	0.850	35.35±2.51	34.95±2.71	0.828
Static curl up	46.30±3.85	48.80±3.86	0.616	52.15±4.48	54.65±4.43	0.561
Static back endurance	26.45±3.13	30.70±3.74	0.323	31.60±3.32	38.40±4.30	0.256
Static endurance lateral bridge	18.40±2.04	21.15±2.80	0.745	23.85±2.93	27.10±3.40	0.674

*p<0.05.

requires minimal skill training to perform, and the equipment required to perform the test is affordable, used to assess flexibility in lower-back problems.^{25,26} In a study, the increase obtained with this test after Yoga intervention²² was found to be like the increase obtained in this study.

The literature also reported that Yoga improves muscular endurance. These studies focused especially on upper extremity and abdominal muscular endurance.^{21,27,28} In one of these studies, it was reported that a significant improvement was achieved in the curl-up test, which we used in our study after the 12-week Yoga program. In the study of Lau et al., curl up measurement values increased after Yoga intervention as in our study.²¹ In another study, it was reported that Yoga increased back endurance.²⁹ Spinal stabilization is provided as the abdominal and spine stabilizer muscles are strengthened during the performance of Yoga poses.^{29,30} Therefore, an increase in spinal

stabilizer endurance is an expected result in this study.

It is well known in the literature that the Pilates improves flexibility. Pilates increase muscle strength and flexibility by gradually strengthening the muscles, cartilage, and connective tissue of the trunk segment. In a study conducted in postmenopausal women, flexibility increased after Pilates compared to the sit and reach test.³¹ In other study, flexibility increased after Pilates in female volleyball players.³² Findings of our study on flexibility Lee et al. 's study shows similarity with the flexibility scores.

Pilates includes many abdominal exercises, so it is expected to improve abdominal endurance. Like our study, in a different study that included healthy individuals, abdominal endurance increased according to the curl-up test.³³ Both abdominal and back endurance increased after 6 weeks of Pilates exercises in patients who experienced pain due to disc herniation. Our study was like other studies in

terms of abdominal and back endurance development. Since Pilates includes exercises that provide spinal stabilization, it is an expected result to increase spinal stabilization endurance.

In this study, there was no difference before the intervention in terms of flexibility and endurance in the Yoga and Pilates group, and there was no difference after the intervention. According to this result, it was seen that both exercise methods were not superior to each other in terms of flexibility and endurance. There are few studies in the literature comparing Yoga and Pilates. Lim et al. was found that Pilates was superior to Yoga in terms of feeling better about health-promoting lifestyle elements and physical and mental fitness.³⁴ On the other hand, Uluğ et al. stated that there was no difference between the groups in terms of pain, disability, depression and quality of life in individuals with neck pain.³⁵ There may be no difference between two exercise programs because both Yoga and Pilates have different movements that will improve flexibility and endurance, and our study was conducted only on sedentary women. Future studies may compare these two exercise methods on different cases, such as postmenopausal women with low back and neck pain. In Pilates and Yoga exercises, many muscle masses in the body, especially large muscle groups, are included in the exercise. According to this information, studies can be conducted on the effects of Pilates and Yoga exercises on different motor characteristics (balance, agility, strength, etc.).

One of the strengths of our study is that, unlike the literature, the duration of our exercise programs is 12 weeks. Generally, an 8-week program was applied in the studies. In addition, this study is the first to compare Yoga and Pilates in terms of flexibility and endurance in women.

Limitations

This study has several limitations. One of them is that there were no interim evaluations of the study, so it is not known from which week the development of flexibility and endurance began. Another limitation is that the results cannot be generalized since the study was conducted in healthy women of a certain age. Finally, it is a fact that we cannot give the long-term results of the groups. In future studies

comparing Yoga and Pilates, both interim results and long-term results can be examined.

Conclusion

According to the results of our study, it was determined that both exercise types improved both flexibility and muscle endurance performance. Both Yoga and Pilates exercises can be used safely to protect and improve general health and especially lumbar region health. There is a need for studies in which the effects of Yoga and Pilates exercise on the functional structure of younger and older people, who are not included in the middle-aged female group, are also included in our study.

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