Effects of yoga exercise combined with passive stretching on the flexibility and strength of female students

Efectos del ejercicio de yoga combinado con estiramiento pasivo sobre la flexibilidad y la fuerza de las estudiantes

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Abstract

Introduction: Exercise combining yoga with passive stretching (YPS) represents an alternative approach to enhancing health and physical fitness, particularly in terms of improving flexibility and muscular strength. However, there remains a scarcity of research investigating the effects of this combined exercise modality specifically within female student populations.
Objective: This study aimed to investigate the effects of a combined yoga and passive stretching program on the flexibility and muscular strength of female university students.
Methods: Twenty female students aged 18–22 from the Faculty of Science, Buriram Rajabhat University, participated in the study. All provided informed consent. Participants were randomly assigned into two groups: the experimental group (EXG; n = 10), which performed YPS training for eight weeks (three 60-minute sessions a week), and the control group (CG; n = 10), which received no training. Flexibility and both upper and lower body strength were assessed before the program, at week four, and at week eight.
Results: The experimental group demonstrated significant improvements in flexibility and muscular strength at both four and eight weeks compared to their baseline and the control group ($p < 0.05$).
Conclusions: YPS effectively enhanced flexibility and strength in female students, outperforming the absence of training. This integrated approach offers a practical and accessible option for improving physical health across various age groups.

Keywords

Yoga, passive stretching, flexibility, strength.

Resumen

Introducción: El ejercicio que combina yoga con estiramiento pasivo (YPS) representa un enfoque alternativo para mejorar la salud y la condición física, especialmente en términos de aumentar la flexibilidad y la fuerza muscular. Sin embargo, existe una escasez de investigaciones que examinen específicamente los efectos de esta modalidad combinada de ejercicio en poblaciones de estudiantes femeninas.
Objetivo: Este estudio tuvo como objetivo investigar los efectos de un programa combinado de yoga y estiramiento pasivo sobre la flexibilidad y la fuerza muscular en estudiantes universitarias.
Métodos: Participaron en el estudio veinte estudiantes universitarias de entre 18 y 22 años, pertenecientes a la Facultad de Ciencias de la Universidad Rajabhat de Buriram. Todas las participantes firmaron un consentimiento informado. Se asignaron aleatoriamente en dos grupos: el grupo experimental (EXG; n = 10), que realizó entrenamiento YPS durante ocho semanas (tres sesiones semanales de 60 minutos), y el grupo control (CG; n = 10), que no realizó ningún tipo de entrenamiento. Se evaluó la flexibilidad y la fuerza muscular de las extremidades superiores e inferiores antes del programa, en la semana cuatro y en la semana ocho.
Resultados: El grupo experimental mostró mejoras significativas en la flexibilidad y la fuerza muscular tanto en la cuarta como en la octava semana, en comparación con sus valores iniciales y con el grupo de control ($p < 0.05$).
Conclusiones: El enfoque YPS mejoró de manera efectiva la flexibilidad y la fuerza en las estudiantes, superando los resultados del grupo que no realizó entrenamiento. Este método integrado representa una opción práctica y accesible para mejorar la salud física en personas de diversas edades.

Palabras clave

Yoga, estiramiento pasivo, flexibilidad, fuerza.

Introduction

The World Health Organization (2006) defines health as "a complete state of physical, mental and social well-being and not merely the absence of disease or infirmity". Exercise is widely accepted as an effective way to enhance overall health, positively affecting both physical fitness and mental well-being (Kucuk and Livanelioglu, 2015). It helps improving body composition, muscle strength, and cardiorespiratory fitness, while its effects on muscle endurance, flexibility, and body composition (Bai et al., 2022; Gopal, 2014; Iqbal et al., 2024; Nontakhod et al., 2025). Recent studies consistently highlight that exercise plays an important role in maintaining good health and enhancing quality of life (Lim & Prak, 2019). Duggal et al. (2018) found that people who maintain regular physical activity throughout their lives often live longer with better overall health. Although many types of exercise are available, it is important to consider personal limitations to ensure safety, appropriateness, and the ability to maintain the activity long-term.

Yoga has been shown to positively impact both physical and mental health by improving posture, flexibility, muscle tone, cardiovascular function, and weight management, while also helping to reduce stress. It also contributes to improved static balance, functional independence, and overall quality of life (Baglan et al., 2024; Siqueira Rodrigues et al., 2011; Tyshchenko et al., 2024). Yoga, a low-impact and weight-bearing form of exercise, has been recognized for its benefits in improving muscle strength, balance, flexibility, core stability, and cardiovascular endurance (American College of Sports Medicine, 2013; Phoosuwan et al., 2021). Practicing yoga has also been shown to enhance muscular strength (Kanjirathingal et al., 2021), improve cardiovascular and pulmonary function (Balaji et al., 2019), increase respiratory efficiency, and reduce stress levels (Janphonak et al., 2025; Worapongpichet & Kamoltham, 2018). Consequently, yoga has gained recognition as a form of alternative medicine, offering benefits for both physical and mental rehabilitation (Nontakhod et al., 2024; Prathikanti et al., 2017; Sullivan et al., 2018).

Passive static stretching (PSS) involves applying an external force to hold a muscle in a stretched position, creating sustained tension. It provides the benefits of exercise without any physical stress (Cheng and Kujala, 2012; Nelson et al., 2021; Park, 2015). Stretching exercises help improve joint ROM, enhance dynamic balance, and lower the risk of injury by supporting the development of functional movement skills (Martin et al., 2022; O'Sullivan et al., 2009). Previous studies have examined muscle stretching and strengthening exercises such as provided benefits in improvement of ROM in the joint, muscle strength (Aladro-Gonzalvo et al., 2012; Curnow et al., 2009), muscle-tendon flexibility (Bishop et al., 2004), passive stiffness (Murphy et al., 2010), among other physiological changes due to stretching exercises (de Olivera et al., 2018).

Despite the importance of flexibility and strength for daily activities, especially among female students, there is limited research on the combination of yoga and passive stretching . Therefore, reviewing the existing studies on this topic is important to provide guidance for maintaining health and physical fitness across all age groups, ultimately supporting a better quality of life.

Method

Participants

The study recruited female students aged 18 to 22 years from the Faculty of Science at Buriram Rajabhat University who voluntarily agreed to participate. Participants were selected through a simple random sampling procedure by drawing lots, ensuring inclusion of only those without prior experience in yoga combined with passive stretching (YPS) and no medical contraindications for participation. Prior to enrollment, all individuals provided written informed consent after receiving comprehensive information regarding the study's objectives, procedures, risks, and the moderate-intensity nature of the YPS intervention. Additionally, participants completed the Physical Activity Readiness Questionnaire (PAR-Q) to evaluate their overall health status. From the initial pool, 20 participants were chosen for flexibility assessments. Flexibility scores were then ranked and participants allocated into groups using systematic random sampling to ensure comparable baseline flexibility levels between groups. This study protocol

was approved by the Human Research Ethics Committee of Buriram Rajabhat University (BRU: 002/2025).

The study included two sample groups: 1) the experimental group (EG), which participated in a combined yoga and passive stretching (YPS) program for eight weeks, with sessions conducted three times per week, each lasting 60 minutes; and

2) the control group (CG), which did not receive any form of training. All participants voluntarily provided written informed consent prior to participation.

The inclusion criteria required participants to be female students aged between 18 and 22 years who were in good physical condition, capable of performing light to moderate exercise, and free from any medical conditions that could interfere with participation in YPS. Exclusion criteria included individuals with pre-existing injuries or illnesses that might impair their ability to engage in the program, those who missed more than three training sessions, or those who withdrew before completing the intervention.

Procedure

Study Organization

Participants were randomly assigned to one of two groups: the experimental group (YPS, n = 10), which engaged in a combined yoga and passive stretching (YPS) program for eight weeks, performing sessions three times per week for 60 minutes each; and the control group (CG, n = 10), which did not participate in any form of exercise and maintained their regular daily routines. Measurements of flexibility, as well as upper and lower body muscular strength, were collected at three time points: prior to the intervention, after the fourth week, and upon completion of the eighth week.

Training Program

The combined yoga and passive stretching (YPS) program was implemented over a period of eight weeks, with sessions lasting 60 minutes, three times per week. Each session was structured into three distinct phases: (1) a 15-minute warm-up consisting of passive muscle stretching, (2) a 30-minute yoga practice phase focusing on a sequence of postures and controlled breathing, and (3) a 15-minute cool-down phase incorporating passive muscle stretching to promote recovery and flexibility.

Data analysis

SPSS version 25.0 (IBM Corp., Armonk, NY, USA) was employed for statistical analyses. Results are presented as mean ± standard deviation (SD). The distribution of the data was examined for normality using the Shapiro-Wilk test. To determine within-group differences in flexibility and muscular strength over time (pre-training, week 4, and week 8), a one-way repeated-measures ANOVA was conducted, followed by Bonferroni post-hoc adjustments. Additionally, independent sample t-tests were employed to compare between-group differences from baseline. All data met the assumption of normal distribution and were analyzed using a 95% confidence interval (CI). A p-value of less than 0.05 was considered statistically significant.

Results

The results indicated that, after four and eight weeks of participating in the combined yoga and passive stretching (YPS) program, the experimental group showed significantly greater improvements in flexibility and both upper and lower body strength compared to their baseline measurements and the control group ($p < 0.05$).

Table 1. Baseline characteristics in the control and experimental groups.

Parameters	CG (n = 10)	EXG (n = 10)	t	P-value
Age (year)	20.70 ± 0.82	20.50±0.53	0.647	0.526
Weight (kg)	58.80± 8.85	58.20±9.09	0.150	0.883
Height (cm)	1 62.50±6.84	1 63.70±5.38	-0.436	0.668
BMI (kg/m^2)	2 2.20±2.43	21.68±2.98	0.432	0.671

Description: CG; control group and EXG; experimental group; BMI; body mass index. Values are mean ± SD . $p > 0.05$ indicates no significant difference was found between the two groups for any variable.

Table 2. Mean changes in flexibility and muscular strength parameters in all two groups after a 4-week (MID) and an 8-week (POST) training period.

Parameters	Time	CG (n = 10)	EXG (n = 10)	t	P-value
		Flexibility			
Sit and reach test)cm(	PRE (week 0)	10.70 ± 3.27	10.80 ± 1.62		
	MID (week 4)	11.10 ± 3.73	15.00 ± 2.00		
	POST (week 8)	10.81 ± 3.50	19.80 ± 1.69		
	%Changes (MID vs. PRE)	3.74 ± 11.83	38.89 ± 20.19*)p = 0.001(	-5.133	0.001‡
	%Changes (POST vs. PRE)	1.03 ± 6.30	83.33 ± 20.20#)p = 0.001(	-12.643	0.001 Ω
	%Changes (POST vs. MID)	-2.61 ± 13.92	32.00 ± 18.57†)p = 0.001(	-4.611	0.001§
		Muscular strength			
Hand grip strength)kg/weight(	PRE (week 0)	0.54 ± 0.11	0.54 ± 0.12		
	MID (week 4)	0.55 ± 0.11	0.61 ± 0.13		
	POST (week 8)	0.54 ± 0.11	0.67 ± 0.12		
	%Changes (MID vs. PRE)	1.11 ± 2.36	12.48 ± 3.76*)p = 0.001(	-8.312	0.001‡
	%Changes (POST vs. PRE)	0.23 ± 3.72	24.63 ± 7.26#)p = 0.001(	-9.937	0.001 Ω
	%Changes (POST vs. MID)	-0.88 ± 2.79	10.81 ± 5.62†)p = 0.001(	-6.294	0.001§
Leg strength)kg/weight(	PRE (week 0)	1.21 ± 0.19	1.04 ± 0.28		
	MID (week 4)	1.21 ± 0.18	1.11 ± 0.34		
	POST (week 8)	1.19 ± 0.19	1.66 ± 0.41		
	%Changes (MID vs. PRE)	0.11 ± 2.16	7.14 ± 11.23	-1.753	0.111
	%Changes (POST vs. PRE)	-1.08 ± 2.66	60.02 ± 53.12#)p = 0.003(	-4.086	0.003 Ω
	%Changes (POST vs. MID)	-1.19 ± 2.00	49.36 ± 57.84†)p = 0.015(	-3.350	0.008§

Description: *Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POST vs. PRE(,† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05)%Changes MID vs. PRE), Ω Significant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)

Figure 1. Changes in the sit and reach test before (PRE), after 4 weeks (MID), and after 8 weeks (POST) of the training period. Values are present as mean ± SD. *Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POST vs. PRE(,† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05)%Changes MID vs. PRE), ΩSignificant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)

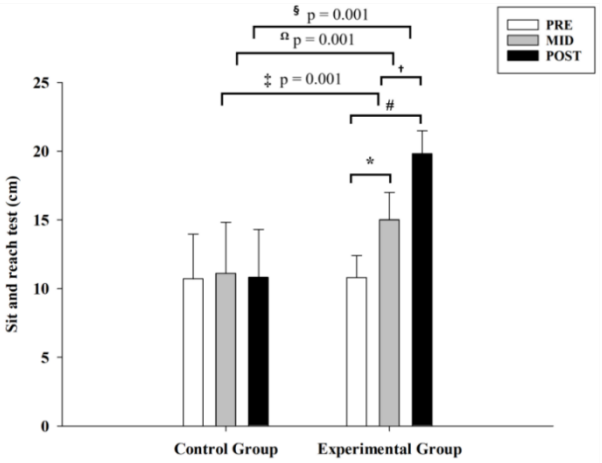


Figure 2. Changes in the handgrip strength test before (PRE), after 4 weeks (MID), and after 8 weeks (POST) of the training period. Values are present as mean ± SD. *Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POST vs. PRE(,† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05) %Changes MID vs. PRE), ΩSignificant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)

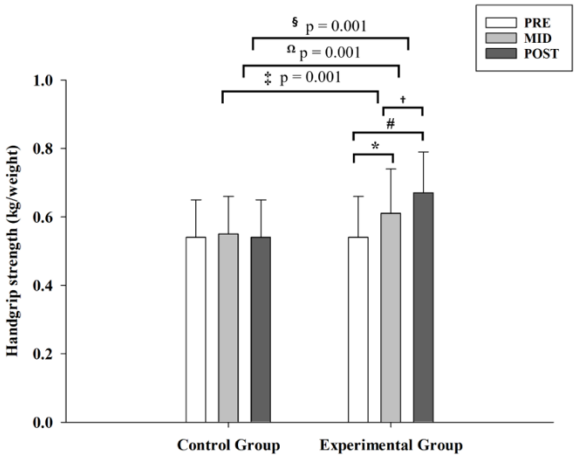
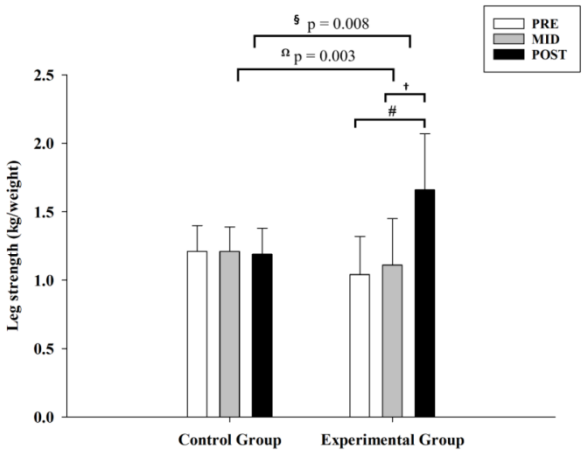


Figure 3. Changes in the leg strength test before (PRE), after 4 weeks (MID), and after 8 weeks (POST) of the training period. Values are present as mean ± SD. *Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POST vs. PRE(,† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05)%Changes MID vs. PRE), ΩSignificant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)



Discussion

The present study aimed to examine the effects of a yoga exercise program combined with passive stretching (YPS) on flexibility and muscular strength in female students, with assessments conducted at baseline, after 4 weeks, and after 8 weeks of training. The results revealed that participants in the YPS group showed significantly greater improvements in both flexibility and muscle strength compared to the control group, suggesting that these enhancements may be attributed to the effects of the YPS intervention. These findings are in line with a study by Parmamik et al. (2025), which investigated the yogic practices as a complementary approach to physical fitness. Moderate improvements in muscle strength, balance, mobility, and flexibility have been reported with regular yoga practice (Shin, 2021). Yoga postures often activate several muscle groups, which can contribute to overall strength development (Sivaramakrishnan et al., 2019). An 8-week yoga program also led to significant gains in muscular strength and endurance among players, highlighting yoga's effectiveness in enhancing physical performance across various populations (Singh et al., 2015). Similarly, Lopez-Fuenzalida et al. (2025) found that twelve sessions of Kundalini Yoga (KY) conducted over six weeks led to significant improvements in cardiorespiratory fitness (CRF) and health-related quality of life (HRQoL) among physically inactive university students. In addition, regular yoga practice over several weeks was shown to significantly

enhance muscular endurance and flexibility, reinforcing the connection between yoga and overall physical fitness (Kame, 2018).

Moreover, several studies have highlighted the positive impact of yoga on flexibility in college students. Raja and Balaji (2024) reported that students in the yoga group experienced significantly greater improvements in flexibility compared to those in the control group. Supporting these results, Polsgrove et al. (2016) found that students who took part in a structured yoga program showed greater gains in flexibility than their peers who did not practice yoga. These findings suggest that the structured and dynamic nature of yoga may be more effective for improving flexibility than traditional warm-up exercises. Both yoga and Pilates have been associated with improvements in physical, mental, and social well-being, as well as increased balance, strength, and flexibility, while also promoting relaxation and mental clarity. By supporting overall fitness and health, they contribute to a better quality of life (Borah et al., 2024; Nontakhod et al., 2022; Park & Lim, 2019; Saetae et al., 2018). Yoga, in particular, is a multimodal practice that targets both muscular strength and flexibility (Jangphonak et al., 2025). Together, these studies underscore the value of yoga as an effective method for enhancing flexibility and strength, especially among female students.

Research on stretching various muscle groups has shown significant improvements in joint range of motion (ROM) after 3 to 6 weeks of consistent training (Knudson, 2006). Similarly, our findings are supported by Genc et al. (2022), who examined the impact of hamstring stretching delivered through telerehabilitation and home-based exercise programs. It was found that an eight-week intervention led to positive changes in both passive and active ROM. In addition, Takeuchi and Nakamura (2020) assessed the effects of 20-second static hamstring stretches in healthy individuals. The results indicated that even 20-second static hamstring stretches can increase hip joint ROM. Stretching helps reduce muscle tension, enhancing range of motion and movement efficiency includes improvement at the level of range of motion in the upper and lower limbs (Nakamura et al., 2024; Sanchez Moreno et al., 2022).

This study is subject to certain limitations that warrant consideration. Firstly, the sample size was relatively small, consisting of only 20 participants, which may restrict the extent to which the findings can be generalized to a wider population. Secondly, the study population was limited to female students aged 18–22 years, thus the results may not be applicable to other age groups or to male participants. Furthermore, all participants were healthy individuals, a factor that could have influenced the observed improvements in flexibility and muscular strength. Future research is encouraged to explore the long-term effects of yoga combined with muscle stretching on overall health and physical fitness across diverse populations, in order to better inform health promotion strategies for individuals of all ages.

Conclusions

The findings of this study indicate that a yoga exercise program integrated with passive stretching (YPS) significantly enhances flexibility and muscular strength among female students, demonstrating greater effectiveness than yoga training alone. These results support the hypothesis that the combination of yoga and passive stretching yields synergistic benefits in improving physical function. Consequently, the YPS program may be regarded as a viable and accessible exercise approach for promoting overall health and physical fitness across various age groups.

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Human research ethics

This research was approved by the Human Research Ethics Committee of Buriram Rajabhat University (BRU: 002/2025).

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