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Original Article

Effects of yoga on the intervention of levator ani hiatus in postpartum women: a prospective study

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Abstract. [Purpose] This study aimed to explore the application value of yoga intervention in early postpartum recovery of the levator ani muscle hiatus (LAH) area. [Participants and Methods] Females in natural labor from May 2020 to November 2020 in the Third People's Hospital of Sun Yat-sen University Ultrasound Research Center were prospectively included for a pelvic ultrasound examination. The control group received no intervention. The experimental group received 60-min yoga once a week from week 1 to week 12 postpartum. A pelvic ultrasound examination was performed on the week 6 and week 12 postpartum. The LAH area was measured at rest, during contraction and Valsalva maneuver. [Results] A total of 128 participants who met the inclusion criteria were selected and randomly assigned to the control group (n=66) and the experimental group (n=62) in pre and post intervention design. No significant differences were found in age, parity, body mass index, and fetal weight between the control and experimental groups. Further, no significant difference was observed in the LAH area between the control and experimental groups at rest, during contraction and Valsalva maneuver on the week 6 postpartum. However, the LAH area in experimental group significantly reduced at rest, during contraction and Valsalva maneuver on the week 12 postpartum. The differences of LAH area (date week 6 minus date week 12) in the control group at rest, during contraction and Valsalva maneuver were 0.12 ± 3.12 cm^2, 0.80 ± 2.29 cm^2, and 0.80 ± 4.22 cm^2, while in the control these were 1.95 ± 3.41 cm^2, 1.39 ± 1.91 cm^2, and 3.81 ± 5.49 cm^2, respectively. Compared with control group, the differences of LAH area significantly increased in experimental group at rest and during Valsalva maneuver. [Conclusion] Yoga intervention can help in the recovery of LAH.

Key words: Levator ani hiatus, Postpartum rehabilitation, Ultrasonic

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INTRODUCTION

The pelvic floor is mainly composed of levator ani muscle and fascia tissue, which is a supporting structure to close the pelvic outlet. It is anchored on the pelvic wall to support and protect the pelvic floor organs. Levator ani muscle plays an important role in maintaining normal pelvic floor structure and function; its morphological changes can cause changes in the location of pelvic floor organs[1, 2)]. The coordinated contraction and relaxation of the levator ani muscle are very important for the support of pelvic floor organs[3)]. The damage and weakening of its support function can increase the levator ani muscle hiatus (LAH) area, lead to the occurrence of pelvic floor dysfunction[4, 5)], and seriously affect the physical and mental health and quality of life of female patients. The morphological changes in the LAH area are closely related to pregnancy and delivery[6, 7)]. Studies have shown that[8, 9)], the puborectalis muscle in the levator ani muscle is the most vulnerable part in vaginal delivery, which can cause significant extension of pelvic floor fiber length. A large LAH area is closely related to pelvic organ

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prolapse caused by vaginal delivery[10, 11]. However, previous studies found that[12, 13] guiding postpartum women to contract levator ani muscle is the preferred method to improve pelvic floor dysfunction; the rehabilitation effect is significant during the early postpartum period[14]. Therefore, pelvic floor muscle active rehabilitation should be performed as soon as possible to improve pelvic floor function.

Many studies have been conducted on the treatment of postpartum pelvic floor muscle rehabilitation with electrical stimulation, biofeedback, and other instruments[15]; however, reports on the effect of yoga intervention on postpartum female pelvic floor muscle rehabilitation are limited[16, 17]. When discussing the evaluation method of treatment effect, it was found that the common imaging diagnostic techniques included pelvic floor ultrasound, computed tomography, and magnetic resonance imaging. Transperineal ultrasound can observe the structure and position of the pelvic floor in real time and dynamically[18, 19]; it is simple, practical, high definition, and noninvasive, and is widely used[20, 21]. This study used pelvic floor ultrasound to quantitatively evaluate the effects of yoga intervention on the LAH area in the early postpartum period and explore the application value of yoga intervention in the recovery of LAH, so as to provide a new method of exercise therapy for early postpartum pelvic floor muscle rehabilitation.

PARTICIPANTS AND METHODS

The study was approved by the ethics committee of Review Board of the Third Affiliated Hospital, Sun Yat-sen University (Zhongda Fushan Yilun 2020) (02-150-01). All participants were informed and written consent was obtained prior to data collection, and the rights of the participants were protected in accordance with the Helsinki Declaration. This is a prospective study. Participant flow diagram is shown in Fig. 1.

The females who gave birth naturally in the research center from May 2020 to November 2020 were recruited and divided into control and experimental groups. The clinical history, age, parity, and other related data of the puerpera were recorded.

The inclusion criteria were as follows: (1) age ≥18 years; (2) females with natural birth; (3) no history of pelvic surgery. The exclusion criteria were as follows: (1) females who received pelvic rehabilitation treatment; (2) nonstandard Valsalva movement or levator ani muscle co-activation; (3) females who could not cooperate with the completion of pelvic ultrasound examination.

GE Voluson E8 (GE Corporation of America, Fairfield, CT, USA) ultrasonic diagnostic instrument was used, equipped with a 4–8 MHz convex array integration probe (RAB4-8-D/RM6C/RAB6-D), the volume Angle is set at 85°. Before an

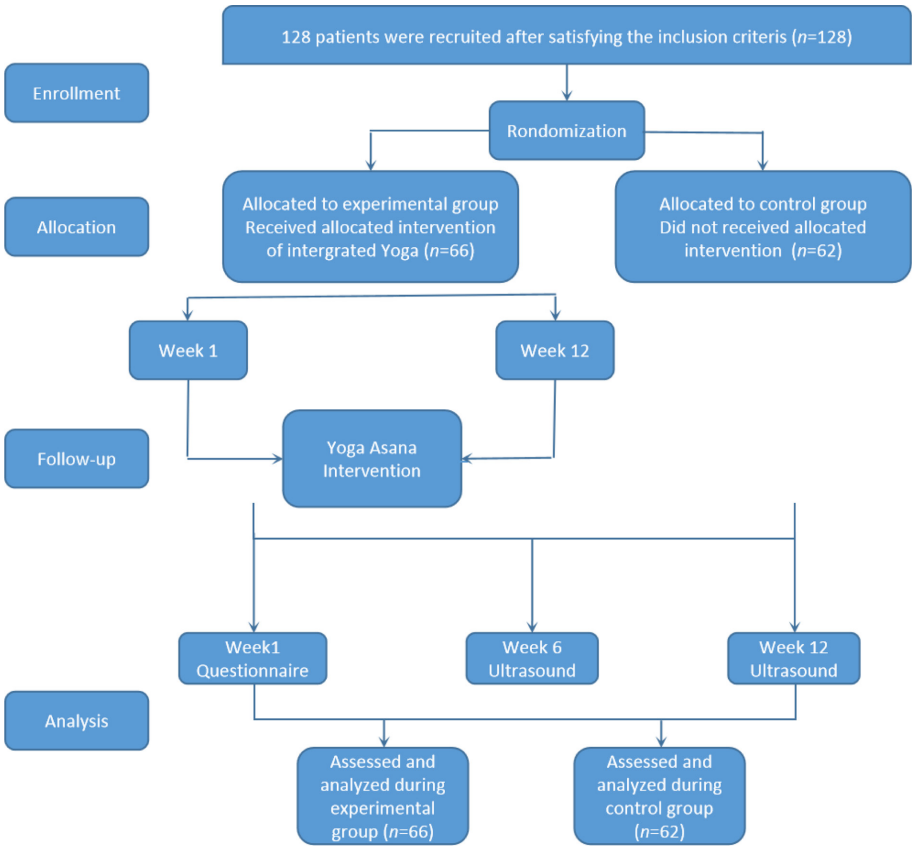

Fig. 1. Participant flow diagram.

examination, the patient emptied his stool, took the lithotomy position of the bladder, and laid on the examination table. The probe was placed vertically between the perineal labia majora of the client, with the probe indicating point pointing upward to the ventral side of the client, and the median sagittal scan was performed. Effective Valsalva action criteria: 1) Duration ≥6 s; 2) Enlargement of the LAH; 3) Pelvic organs move dorsally and caudally. In the Valsalva process, the pubic symphysis, the internal orifices of the urethroa and the anal canal should always be visible, otherwise, it is considered as missing target. If there is target missing target or co-activation of the LAH muscle, it is considered as non-standard image retention.

Valsalva process should be repeated for 3 times, and the one with the greatest drop of pelvic organs was selected for measurement. Excessive pressure on the probe should be avoided to affect the full movement of pelvic organs during collection. The volume data of all centers were measured by 2 physicians with at least 3 years of pelvic floor ultrasound experience in the multi-center responsible unit, and the 4D View Version 10.0 software (GE Healthcare System) was used for offline analysis. The LAH area was measured at rest, during contraction and maximum Valsalva maneuver (Figs. 2 and 3).

The females in the experimental group were treated with yoga rehabilitation exercise, mainly to activate the inner core muscle group and enhance the pelvic floor muscle strength, combine with breathing exercises: once a week, 60 min each time, 3–5 groups/time, medium and low intensity (shown in Fig. 4).

The statistical description and t-test were completed using SPSS statistical software (version 26.0, IL, USA). The measurement data followed a normal distribution, and the variables were represented as mean ± SD. The independent-sample t-test was used for comparison. If the data did not follow a normal distribution, they were represented as M (*P*25, *P*75), and the Mann–Whitney *U* test was used. P<0.05 indicated a statistically significant difference.

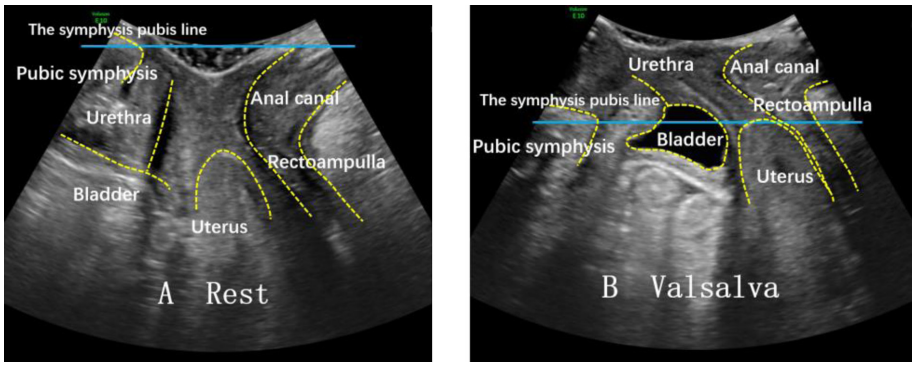

Fig. 2. (A) Image A is an ultrasound image in the resting state. (B) Image is an ultrasound image in the Valsalva state, during which a midsagittal view of the pelvic floor is maintained. The structures shown from left to right are: the symphysis pubis, urethra and bladder, anal canal and ampullary rectum.

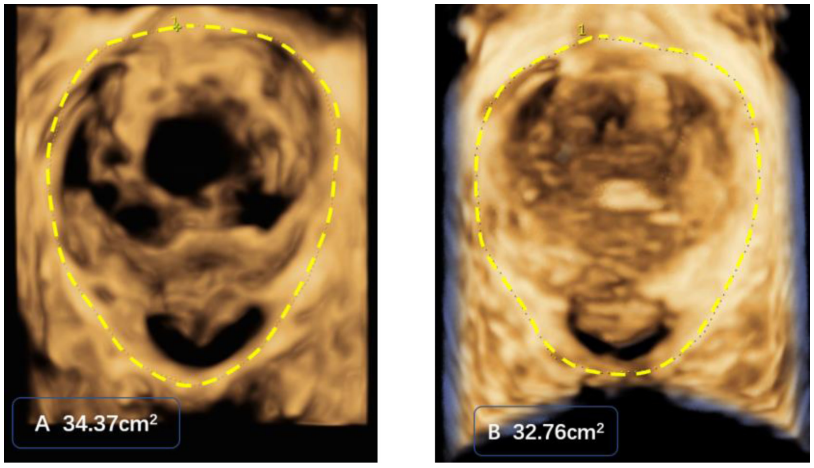

Fig. 3. Sonogram of levator ani hiatus (LAH) in maximum Valsalva state. (A) Image of LAH examined by ultrasound week 6 postpartum. (B) Image of LAH examined by ultrasound 12 week postpartum.

	Yoga asana practice methods	Image
1	Yoga meditation breathing (perineal constriction): vajra sitting position, sitting on the yoga ball, so that the perineal area fully contact the sphere. When inhaling, the abdomen and pelvic floor are relaxed. As exhaling, pull abdomen back slightly and contract pelvic floor muscles	
2	Hip lift: vajra sitting position, with yoga balls between legs. When inhaling, the spine extend. As exhaling, squeeze the ball between legs and lift hips until thighs are perpendicular to the ground, and then reduce it.	
3	Clock type: lie on the back, bend the knees, tighten the feet together, and place the hands on lower abdomen. When inhaling, pelvis slightly forward, abdomen and inner thighs relax. As exhaling, the pelvis slightly backward, abdominal and inner thighs tightened, while lifting the pubis to tighten the pelvic floor muscles, and then reduce it.	
4	Clip ball bridge: lie on the back with the knees bent, yoga balls tucked between the legs. When inhaling, relax the abdomen and thighs. As exhaling, the legs clamp the ball to tighten the pelvic floor muscles while lifting the buttocks upward, and then reduce it.	
5	Cattle face style: mountain sitting position, bend the left knee on the outside of the right hip, bend the right knee on the opposite side, hands folded on the knee. When inhaling, the spine extends. As exhaling, thigh medial and pelvic floor muscles tighten, slightly lift buttocks. It can be alternated left and right, and then reduce it.	
6	Magic chair: mountain pose, arms up, hips flexed to the magic chair position. When inhaling, the spine extends; As exhaling, the legs are adducted and tightened, and the pelvic floor and gluteal muscles are accepted until the body is upright, and then reduce it.	

Fig. 4. Yoga asana practice methods.

	Yoga asana practice methods	Image
7	Bridge: lie on the back with the knees bent, the feet merged and the hands at body sides. When inhaling, relax the abdomen and thighs. As exhaling, tighten the inner side of both legs and pelvic floor muscles, at the same time, lift the buttocks up, to the thigh, hip and abdomen a plane, leg vertical ground, and then reduce it.	
8	Side recumbent leg retraction: lie on body side, bend the lower elbow to support the head, hold the ground with the other hand, bend the upper leg, step on the ground, and form a straight line. When inhaling, lower foot back hook. As exhaling, tighten the lower inner leg and pelvic floor muscles and lift them up off the floor, and then reduce it.	

Fig. 4. Continued

RESULTS

According to the inclusion and exclusion criteria, 128 females with natural birth were included in this study (66 in the control group and 62 in the experimental group). The baseline data of the two groups were subject to normal distribution; the parameter is shown in Table 1.

No significant difference was observed in age, parity, BMI, weight of the first child (kg), and weight of the second child (kg) between the two groups ($p>0.05$).

No significant difference were found in the LAH area on week 6 postpartum between the control and experimental groups at rest, during contraction and Valsalva maneuver ($p=0.45$, 0.40, and 0.83, respectively). Compared with the control group, the LAH area on week 12 postpartum in the experimental group were significantly lower at rest, during contraction and Valsalva maneuver ($p=0.03$, 0.03, and 0.02, respectively); the parameter is shown in Table 2.

Compared with the control group, at rest and during Valsalva maneuver, the differences in the LAH area of experimental group on the week 6 and week 12 postpartum were significantly lower ($p<0.01$, $p<0.001$, respectively). However, no significant difference in the LAH area was observed between the two groups during the contraction state ($p=0.12$); the parameter is shown in Table 3.

DISCUSSION

In this study, the exercise method combined with yoga breathing and asana was adopted to conduct pelvic floor muscle exercise for postpartum women from 1 week to 12 weeks after delivery. The results showed that yoga intervention had a positive effect on the recovery of LAH area in the early postpartum period.

Pelvic floor muscle tissue stretching and elasticity reduction are easy during pregnancy and childbirth, leading to pelvic floor functional defects[22, 23]. If these defects do not recover in time in the early postpartum, they can cause decompensation, resulting in irreversible damage[24]. Studies confirmed[25] that it was difficult for parturients to achieve the pre-pregnancy state of pelvic floor tissue through self-recovery within 6 weeks postpartum. However, immediate postpartum rehabilitation treatment can effectively reduce the occurrence of pelvic floor dysfunction and promote the recovery of pelvic floor function[26]. Considering the importance of postpartum rehabilitation, yoga intervention has been accepted by most postpartum women. Some studies have shown that[27–29] yoga combined with pelvic floor function training can improve the pelvic floor fiber systolic pressure, which is conducive to the recovery of postpartum body shape and the improvement in pelvic floor muscle strength. Studies have shown that starting yoga early in the postpartum period helps to restore the structure and function of the pelvic floor after delivery[30, 31]. Other studies have also confirmed that[2] the yoga treatment helped position pelvic organs in a higher position to avoid prolapse in the contraction state of the levator ani muscle. In addition, yoga is an aerobic exercise; long-term adherence can effectively prevent and treat pelvic floor-related diseases[32]. This study used yoga breathing combined with postures to perform pelvic floor functional rehabilitation exercises for postpartum women from 1 week to

Table 1. Baseline data of the control and experimental groups

Variable	Control group	Experiment group
Number of cases	66	62
Age (years)	31	31
Parity	1	1
BMI (kg/m^2)	22.47 ± 4.08	21.41 ± 1.93
Weight of first child (kg)	3.17 ± 0.39	3.25 ± 0.60
Weight of second child (kg)	3.22 ± 0.37	3.22 ± 0.44

Mean ± SD.

Table 2. Baseline data on the week 6 and week 12 postpartum between the control and experimental groups at rest, during contraction and Valsalva maneuver

Groups	State	Control group	Experiment group
Week 6 postpartum	Rest	15.12 ± 3.55	15.63 ± 3.91
	contraction	11.98 ± 2.56	11.59 ± 2.71
	Valsalva	23.5 ± 6.35	23.75 ± 6.94
Week 12 postpartum	Rest	15.00 ± 3.54	13.67 ± 3.06*
	contraction	11.18 ± 2.54	10.2 ± 2.30*
	Valsalva	22.7 ± 6.87	19.94 ± 6.22*

Mean ± SD.
*p<0.05 vs. control group.

Table 3. Difference in the LAH area between the control and experimental groups at the week 6 and week 12 postpartum at rest, during contraction and Valsalva maneuver

State	Control group	Experiment group
Rest	0.12 ± 3.12	1.95 ± 3.41**
Contraction	0.80 ± 2.29	1.39 ± 1.91
Valsalva	1.91 (−2, 3.64)	2.29 (0.58, 6.08)***

Mean ± SD.
**p<0.01, ***p<0.001 vs. control group.

12 weeks after delivery. It also explored the effect of yoga intervention on early postpartum anal levator hiatus recovery, so as to improve the pelvic floor function.

Previous studies[33, 34] have shown that the LAH area increases after vaginal delivery, which is closely related to the occurrence of pelvic floor dysfunction. The risk of adverse events can be predicted based on the abnormal morphological changes in the levator ani muscle in postpartum females[35]. The shape of the LAH area during Valsalva maneuver can help evaluate the elasticity of the levator ani muscle[36]. This study found that the difference in the LAH area between the week 6 and week 12 postpartum in the resting and Valsalva states was significantly smaller in the yoga group than in the control group. The method of perineal constriction in yoga involves pelvic floor muscle exercise through muscle contraction in the perineal area. Yoga intervention significantly reduces the LAH area, especially in the case of increased abdominal pressure, and hence plays a supporting role in pelvic organs. The results showed that the elasticity of levator ani muscle increased after yoga intervention, and the support ability of the muscle was enhanced in the rest and Valsalva states. However, in the contraction state, no significant difference was observed between the experimental and control groups. It was possible that the muscle could contract due to the relative tension of the examinee during the examination. Previous studies reported that the size of the LAH area reflected the contractility of levator ani muscle[4], and the increase in the LAH area was an important pathogenic factor for pelvic floor dysfunction[37]. Early postpartum yoga intervention can effectively reduce the LAH area, which further reduces the risk of pelvic floor dysfunction.

This study was novel in using pelvic floor four-dimensional ultrasound to evaluate the therapeutic effect of yoga intervention on levator ani muscle recovery. Pelvic floor ultrasound can dynamically check, intuitively and accurately evaluate the shape and structure of LAH in early postpartum women, and provide effective data support for clinical diagnosis, prevention, and treatment[38]. It is widely used in diagnosing pelvic floor dysfunction and evaluating the effect before and after treatment[39, 40]. In this study, pelvic floor ultrasound was used to evaluate the morphological changes in the LAH area in the

resting, contraction, and Valsalva states. The results showed that the four-dimensional ultrasound examination of the pelvic floor comprehensively and dynamically presented the situation of the pelvic floor and provided parameters and time reference for the prediction and diagnosis of early postpartum pelvic floor dysfunction.

This study also had certain limitations. It only analyzed the effects of yoga intervention within 12 weeks postpartum and did not evaluate the long-term effects of the postpartum intervention, which will be explored in the follow-up study.

This was the first prospective study on the quantitative intervention of pelvic floor recovery in early postpartum women by yoga rehabilitation exercise and accurate measurement of the LAH area by pelvic floor ultrasound, which provided reference data for the conservative treatment of pelvic floor dysfunction in early postpartum women. The results of this study showed that early postpartum yoga intervention significantly reduced the LAH area, which was expected to decrease the incidence of pelvic floor dysfunction.

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Conflict of interest

The authors have no conflict of interest to declare.

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