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ORIGINAL ARTICLE

Physical activity and pelvic floor muscle training in patients with pelvic organ prolapse: a pilot study

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Abstract
Introduction and hypothesis The details of the physical activity in patients with mild to moderate pelvic organ prolapse (Pmoderate pelvic organ prolapse (POP) remain under-studied. The purpose of the present study was to investigate objective physical activity levels and the changes in pelvic floor muscle(PFM) strength, symptoms and quality of life (QOL) between before and after PFM training (PFMT) in patients with POP.
Methods In a prospective pilot study, 29 patients with stage II or III POP completed approximately 16 weeks of PFMT. A reliable activity monitor was used to measure physical activity parameters including step counts, activity and total calories expended, and duration at each intensity level. Maximum vaginal squeeze pressure, POP symptoms and QOL were assessed. Changes in these outcome measures were compared before and after PFMT.
Results The step counts per day (mean ± SD) of women with POP was 7,272.9 ± 3,091.7 before PFMT and 7,553.4 ± 2,831.0 after PFMT. There was no significant change between before and PFMT. PFM strength was significantly increased after PFMT. POP-related symptoms including stress urinary incontinence, frequency, postmicturition dribble and interference with emptying the bowels were significantly improved. The QOL scores for general health, physical limitations, emotion, and severity measures were significantly improved after PFMT.
Conclusions Although PFMT changed PFM strength symptoms, and QOL, there were no changes for any physical activity parameters before and after PFMT. This is probably because the physical activity levels in patients with mild to moderate POP were almost same as in age-matched healthy women.

Keywords Physical activity · Pelvic floor muscle training · Pelvic organ prolapse

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Introduction

Pelvic organ prolapse (POP) is defined as the descent of one or more of the anterior vaginal wall, posterior vaginal wall, uterus, or apex of the vagina [1]. Patients with POP complain of various symptoms including vaginal bulge, pelvic pressure and incontinence due to the descent of the pelvic organs, which may substantially affect their quality of life (QOL). It has been reported based on vaginal examination that POP occurs in up to 50% of parous women [2].

The physical activity of patients with POP possibly declines due to POP-related symptoms and distress. One third of middle-aged women with urinary incontinence (UI) stop sports activities to avoid leakage of urine [3]. Nygaard et al. [4] found that compared with women with less severe symptoms, more women with greater symptom distress reported that prolapse interfered with daily activities including household/yard work, working outside the home and recreation. POP has been shown to have an adverse effect on QOL and pelvic floor muscle training (PFMT) has a positive effect on symptoms and QOL [5]. There was significant improvement of prolapse symptoms and QOL after 14 weeks of PFMT compared with before PFMT.

PFMT is now widely used women with POP. It is the first-line treatment for POP recommended by International Continence Society (ICS; level of evidence grade B) [6]. In humans, the pelvic floor muscle (PFM) is innervated by branches of the pudendal nerves (somatic nerve) arising from the S2–S4 nerve roots of the sacral plexus, and categorized as skeletal muscle. Thus, PFM can contract and relax voluntarily from a theoretical perspective. The direction of PFM movement is cranial and forward, and squeezes around the urethra, vagina and anus. Hypothetical mechanisms explain how a conscious contraction can prevent the decent of pelvic floor, and muscle strength training can build up structural support over time in patients with POP [7]. Women can learn how to contract their PFM and perform PFM contraction cautiously during daily activities increasing intraabdominal pressure (IAP). When mechanical overload is imposed on skeletal muscle, the cross-sectional area of the muscle increases and neuromuscular function improves as a response to the overload. This principle can be applied to PFMT to treat POP [7]. In a multicenter randomized controlled study women who received individual PFMT showed significantly greater reduction in prolapse symptoms than women in the control group who read lifestyle advice leaflet only [8]. Braekken et al. [9] found that POP improved by one stage in 19% of women who underwent PFMT and in 8% of women who received only lifestyle advice (p=0.035) also found that PFMT for 24 weeks reduced the frequency and bother of prolapse symptoms. They also found that PFMT for 24 weeks increased muscle thickness by 15.6%, levator hiatus area by 6.3% and muscle length by 4.2%, and elevated the bladder position by 4.2 mm and the rectal ampulla position by 3.6 mm [10].

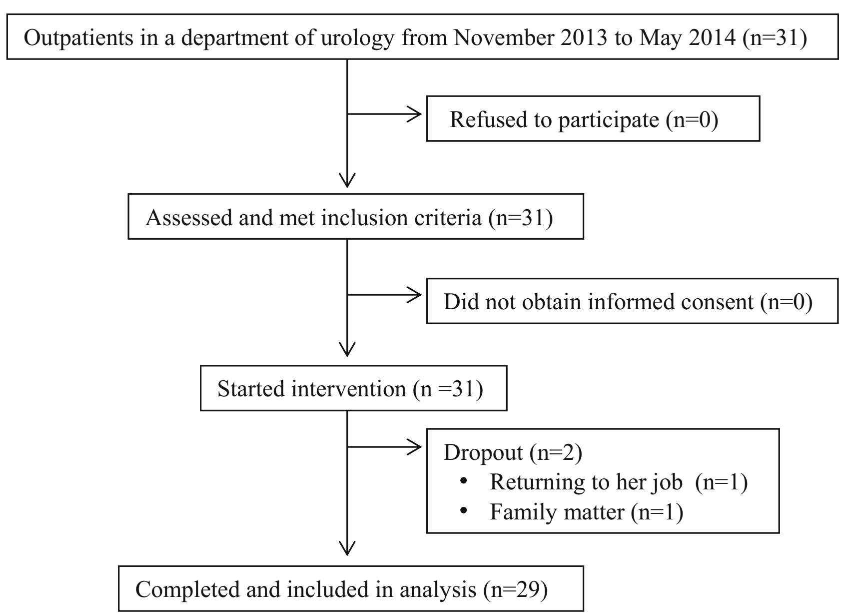
However, the details of daily physical activity including step counts, activity and total calories expeded and duration at each intensity level remain under-studied. The purpose of this study was to investigate physical activity and the changes in PFM strength, symptoms, and QOL between before and after PFMT in women with mild or moderate POP.

Materials and methods

Subjects

The study participants comprised 31 patients with POP (Fig. 1). The sample size to detect a significant change in PFM strength after PFMT was calculated as follows. The required sample size was estimated based on the previous before-and after trial with an effect size of 0.69, a power of 0.8 and a significance level of 0.05 [11]. A sample size of 22 was found to be needed. A final sample size of 27 was set to allow for possible dropout. Inclusion criteria were POP (stage II or III) diagnosed according to pelvic organ prolapse quantification (POP-Q) system [1] by the urologist. Exclusion criteria were pregnancy, less than 1 year after giving birth, serious psychiatric or neurological disease, history of gynecology or obstetric surgery, lower urinary tract infection, concurrent treatment of incontinence or POP, taking hormonal medicine, judged as not being suitable for the study by doctor (for example, because of inability to attend for physical therapy due to long distance or loss of mobility). The Research Ethics Committee of Nagoya University School of Medicine

Fig. 1



approved this study (13-502). All participants were given written information regarding the research.

Intervention

One week before starting the PFMT period, a physical therapist provided information on the study procedure and obtained informed consent from all participants who were also given an accelerometer to measure their physical activity level.

All participants attended six times routinely (at 0, 2, 4, 8, 12 and 16 weeks). They were instructed in the intensive PFMT program. First, the anatomy and function of PFM were individually explained with a pelvis model and pictures to demonstrate how to contract the PFM correctly. Second, the physical therapist assessed the PFM by inspecting the prineum and palpating with inward movement with the instruction “contract around the urethra as if you are trying to stop passing urine”. If the women could not contract the PFM properly, she was taught how to correctly contract the PFM with normal breathing without using the abdominal muscles or muscles surrounding the hip joints. The women were encouraged to check their PFM contraction at home using their fingers. Lifestyle advice was also provided including the advice not to strain and to avoid heavy lifting and patients were also instructed in the "knack" of the technique as described by Miller et al. [12]. The technique is considered effective if the patient can contract the PFM intentionally to anticipate urine leakage and descent pelvic organs when IAP increases so that further downward displacement of the pelvic organs in prevented. Physiotherapists give advice on when and how to contract the PFM during physical exertion such as heavy lifting, coughing and jumping.

Home exercise

Daily home exercise was introduced for all participants. They performed three sets per day, and reported their home exercise adherence using an exercise diary. The adherence rate was defined as the days when at least one set of PFMT was performed during 16 weeks.

One set of home exercise program comprised:

- Position: supine, sitting, standing
- Rapid maximal contractions: 1–2 s, four times
- Sustained maximal contractions: 6–8 s, eight times
- Rest after each contraction: 6 s

Primary outcomes

Physical activity was measured using a validated triaxial accelerometer (Lifecoder GS or PLUS: Suzken Co.,Ltd., Nagoya, Aichi, Japan) [13, 14]. The accelerometer objectively recorded the parameters including step counts, activity and total calories expended, and the duration of light, moderate and vigorous intensity exercise during daily life. All participants wore it at waist level except when sleeping, taking a bath or swimming during their study period. Data were collected for 1 week before their visits. In their study, Tudor-Locke and Bassett classified step count-determined physical activity as: (1) sedentary (<5,000 steps/day), (2) low active (5,000-7,499 steps/day), (3) somewhat active (7,500–9,999), and (4) active (≥10,000 steps/day). We stratified participants into these groups in order to identify their physical activity level [15]. Patients were divided into an incresed physical activity group, no change group, and decreased physical activity group to detect differences in physical activity levels between before and after PFMT. All patients reported adherence to wearing the accelerometer by keeping a diary. If adherence was less than 3 days per week, the data were excluded [16, 17].

Secondary outcomes

Regarding adherence to home-based exercise, the PFMT program was prescribed with both rapid and sustained PFM contractions, three sets per day. Adherence was defined as the mean percentage of days of the prescribed exercise period when at least one set of exercises was performed with respect to the entire PFMT period. PFM strength was measured using a perineometer (Peritron 9300V; Cardio Design Pty, Oakleigh, VIC, Australia). An air-filled silicone sensor was connected to the perineometer with a pressure transducer. The sensor was inflated to 100 cm H_2O and reset to zero on insertion into the vagina. PFM strength was assessed with the woman in the supine position and with the instruction to contract the PFM as much as possible. The maximum vaginal squeeze pressure was measured three times, and the maximum value was recorded. The urologist measured POP-Q stage before and after 16 weeks of PFMT. POP-Q stage was assessed in a different institution from where the supervised PFMT was conducted. The urologist was also blinded to the outcomes including physical activity, symptoms and QOL during the study period. The prolapse quality-of-life (P-QOL) questionnaire is a condition-specific questionnaire that evaluates urogenital prolapse symptoms and QOL in patients with POP [18, 19]. The P-QOL questionnaire includes 20 items in the following nine domains: general health, prolapse impact, role limitations, physical limitations, social limitations, personal relationships, emotions, sleep/energy and severity measures. The scores of each P-QOL domain range between 0 and 100, with higher scores indicating greater impairment of QOL. In addition, the P-QOL questionnaire was administered to assess 18 urogenital symptoms, including incontinence, bulge/lump, heaviness, urinary stream, straining to open the bowels, and low back pain, among others. Each symptom was scored on a five-point scale ("not applicable", "none/not at all", "slightly/a little", "moderately", "a lot"). Bothersome symptoms were defined as those scored "slightly/a little", "moderately" and "a lot". Regarding frequency of opening the bowels, constipation was defined as fewer than three defecations per week [20]. These outcome measures were assessed before and after 16 weeks of PFMT.

Data analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 16.0J for Windows. Of 31 participants, 29 completed PFMT and their data were included in the analysis. Data distribution was assessed with the Shapiro-Wilk test for continuous data. The step count data were normally distributed, and therefore the paired Student's *t* test was used to compare within a group. Since other outcomes were not normally distributed, the Wilcoxon signed-ranks test was used for within-group comparisons. As 18 urogenital symptom items of the P-QOL questionnaire were nominal scales, the chi-squared test for categorical data was used. The urogenital symptoms scores were compared between before and after PFMT. The significance level was set at $p<0.05$.

Results

Recruitment and baseline characteristics

Initially, 31 women were recruited. Two women dropped out due to returning to work and family matter (dropout rate 6.45%, 2/31). Thus, 29 women completed the study. Table 1 shows the demographic characteristics of the remaining women contributing data to the analysis. The anterior vaginal wall was primarily involved in most women. The details of the anterior vaginal wall prolapses are as follows; anterior compartment prolapse only (90.0%, 27/30) followed by a combination anterior compartment and apical prolapse (0.03%, 1/30), a combination anterior and posterior compartment (0.03%, 1/30), and a combination of anterior and posterior compartment and apical prolapse (0.03%, 1/30). Regular exercise was defined as any physical exercise for at least 30 minutes per day at least three times a week.

Table 1 Demographic characteristics of the 29 women who completed the study

Variable	Value
Age (years), mean ± SD	65.8 ± 7.3
Body mass index (kg/m^2), mean ± SD	23.1 ± 3.2
Parity, median (range)	2 (2–3)
POP-Q stage, *n* (%)	
II	17 (58.6)
III	12 (41.4)
Type of POP, *n* (%)	
Anterior vaginal wall	28 (96.6)
Posterior vaginal wall	0 (0.0)
Apical	1 (3.4)
Women with an occupation, *n* (%)	11 (37.9)
Women who had regular exercise, *n* (%)	9 (31.0)
Women who were sexually active, *n* (%)	7 (24.1)

Physical activity

Physical activity levels are shown in Table 2. Data from five women were missing due to low adherence to wearing the accelerometer during the study period. There were no significant changes in any of the physical activity items measured for seven consecutive days between before and after PFMT. The numbers of women in each physical activity group before and after PFMT, respectively, were as follows; <5,000 steps/day, 5 and 3 women; 5,000-7,499 steps/day, 6 and 8 women; 7,500-9,999 steps/day, 9 and 11 women; and ≥10,000 steps/day, 4 and 2 women. Patients who had storage problems with lower physical activity before PFMT were more likely to show an increase in activity after PFMT. The step counts in each group before PFMT were as follows, increased activity group (5 patients), 6,128.8 ± 2,110.0; no change group (11 patients), 7,421.0 ± 2,253.0; decreased activity group (3 patients), 10,840.2 ± 649.5.

Compliance

All participants visited the physical therapist six times (preliminary instruction, and at 0, 2, 4, 8, 12 and 16 weeks). The median PFMT period was 16.4 weeks (range 14.1–21.9 weeks). Adherence to the home exercise program was 94.1 ± 11.0%.

PFM strength

Data were missing for one participant due to fear of inserting the perineometer. The maximum vaginal squeeze pressures measured using the perineometer were 24.0 ± 13.9 cm H_2O before and 31.2 ± 14.5 cm H_2O after PFMT. There was a significant increase after PFMT ($p < 0.01$). PFM strength increased by approximately 30% after PFMT. There were no significant correlations between the increase in PFM strength and improvement in POP-Q data, urogenital symptoms, QOL scores or physical activity.

Table 2 Physical activity levels before and after PFMT in 24 women with complete data

	Before PFMT	After PFMT	*p* value
Steps/day	7272.9 ± 3091.7	7553.4 ± 2831.0	ns[b]
Energy expenditure (kcal/day)			
Activity	161.4 ± 81.8	169.2 ± 74.6	ns[c]
Total	1593.9 ± 193.3	1623.5 ± 182.1	
Duration of activity (min/day)[a]			
Light intensity	59.6 ± 46.2	60.1 ± 24.4	ns[c]
Moderate intensity	17.1 ± 14.2	17.6 ± 12.4	
Vigorous intensity	1.4 ± 3.3	1.6 ± 4.3	

The data are presented as means ± SD

ns not significant

[a] Estimated metabolic equivalents: 1.8 to 2.9 for light intensity, 3.6 to 5.2 for moderate intensity, 6.1 to >8.3 for vigorous intensity

[b] Paired Student's *t* test

[c] Wilcoxon signed-ranks test

POP-Q measurements

POP-Q Aa and Ba were significantly elevated after PFMT compared with before PFMT ($p < 0.01$; Table 3). The differences in POP-Q values between before and after PFMT are shown in Table 4. Two women (6.9%) showed a deterioration in POP-Q values, 18 women (62.1%) showed no change, and 9 women (31.0%) showed improvement. No significant changes in POP-Q stage were seen.

POP-related symptoms and QOL

Regarding changes in urogenital symptoms between before and after PFMT, going to the toilet to pass urine very often ($p < 0.01$), stress urinary incontinence (SUI, $p < 0.05$), postmicturition dribble ($p < 0.05$) and vaginal bulge interfering with emptying the bowels ($p < 0.01$) were significantly improved after PFMT, but other symptoms did not change significantly, as shown in Table 5.

Changes in P-QOL domain scores between before and after PFMT are shown in Table 6. The four domain scores including general health, physical limitations, emotions and severity measures significantly improved after 16 weeks of PFMT ($p < 0.01$). The impact of prolapse tended to be alleviated after PFMT ($p = 0.059$).

Table 3 Complete POP-Q data before and after PFMT in the 29 patients who completed the study

POP-Q point	Before PFMT	After PFMT	*p* value[a]
Aa	1.0 (−2.0–2.5)	0.5 (−2.5 to 2.5)	<0.01
Ba	1.0 (−1.5–4.0)	0.5 (−2.5 to 3.5)	<0.01
C	−4.0 (−6.0–2.5)	−5.0 (−6.5 to 2.0)	ns
Ap	−2.5 (−3.0–1.5)	−3.0 (−3.0 to 1.0)	ns
Bp	−2.5 (−3.0–1.5)	−3.0 (−3.0 to 1.0)	ns
D	−6.0 (−7.0 – −2.0)	−6.5 (−8.0 to −3.0)	ns

The data are presented as medians (minimum – maximum)

ns not significant

[a] Wilcoxon signed-ranks test

Discussion

The present prospective study investigated objective physical activity levels and changes in PFM strength, symptoms, and QOL between before and after PFMT in Japanese women with mild to moderate POP. We hypothesized that physical activity levels in women with POP would be low before PFMT and would increase after PFMT because of relief of prolapse symptoms and distress.

To our knowledge, accelerometers have not been used to evaluate physical activity levels in patients with POP. We found that there were no significant changes in any parameters of physical activity measured using an activity monitor after PFMT, whereas there were increases in PFM strength, elevation of the anterior vaginal wall, and improvements to some degree in POP-related symptoms and QOL. These contradictory outcomes may be explained by the fact that the physical

Table 4 Changes in POP-Q stage between before and after PFMT in the 29 patients who completed the study

Change in stage	Number (%) of women
+2	0 (0.0)
+1	2 (6.9)
No change	18 (62.1)
−1	7 (24.1)
−2	2 (6.9)

A positive value indicates aggravation. A negative value indicates improvement

Table 5 Self-reported prolapse symptoms before and after PFMT in the 29 patients who completed the study

Symptom	Before PFMT	After PFMT	*p* value[a]
Going to the toilet to pass urine very often	18 (62.1)	2 (6.9)	<0.01
Urgency	13 (44.8)	7 (24.1)	ns
Urge incontinence	9 (31.0)	3 (10.3)	ns
Stress incontinence	11 (37.9)	2 (6.9)	<0.05
Feeling a bulge/lump from or in the vagina	21 (72.4)	20 (69.0)	ns
Heaviness or dragging feeling as the day goes on from the vagina or the lower abdomen	9 (31.0)	10 (34.5)	ns
Vaginal bulge interfering with emptying your bowels	11 (37.9)	1 (3.4)	<0.01
Discomfort in the vagina which is worse when standing and relieved by lying down	16 (55.2)	10 (34.5)	ns
Poor urinary stream	24 (82.8)	19 (65.5)	ns
Straining to empty your bladder	6 (20.7)	6 (20.7)	
Urine dribbles after emptying your bladder	15 (51.7)	6 (20.7)	<0.05
Bowels do not feel completely empty after opening	10 (34.5)	6 (20.7)	ns
Constipation	9 (31.0)	8 (27.6)	ns
Straining to open your bowels	17 (58.6)	16 (55.2)	ns
Vaginal bulge which gets in the way of sex	1 (3.4)	1 (3.4)	ns
Lower backache worsens with vaginal discomfort	2 (6.9)	4 (13.8)	ns
Do you help empty your bowels with your fingers?	1 (3.4)	1 (3.4)	ns
How often do you open your bowels?	7 (24.1)	7 (24.1)	ns

The data are presented as number (%) of women with bothersome symptom for each item.

ns not significant

[a] Chi-squared test

activity levels in women with stage II and III POP before PFMT were almost equal to those in age-matched healthy Japanese women. Before PFMT, the average number of steps per day was 7,272.9 ± 3,091.7. A National Health and Nutrition Survey for a community-dwelling population [21] demonstrated that the average numbers of steps per day in 3,670 subjects aged 50–59 years and 4,533 subjects aged 60–69 years were 7,318 and 6,662, respectively. In nine women who engaged in regular physical activity, the numbers of steps per day were 8,601.2 ± 2,110.0 and 8,073.0 ± 1,593.2 before and after PFMT, respectively, in contrast to 6,619.3 ± 1,998.7 and 7,188.7 ± 1,774.1 in women who did not engage in regular activity. The activities in which the nine women originally participated were long-distance walking (six women), aerobic exercise (one), golf (one), and swimming (one). We did not statistically analyze the statistical differences in physical activity levels and in other parameters between the two groups because of distributions of the patients. A previous study investigating physical activity in patients with POP in whom surgery was planned showed that severe POP was more likely to interfere with houseyashold/yard work, working outside the home and recreation than less severe POP [4]. In this study, women with mild to moderate POP were still physically active in spite of prolapse symptoms and dissatisfaction with QOL. This result may imply that women sought to maintain their routine daily activities such as working, household chores and exercises by using pads, lying down during the day and changing their exercise routine.

Table 6 Total scores for each P-QOL questionnaire domain before and after PFMT in the 29 patients who completed the study

Domain	Before PFMT	After PFMT	*p* value[a]
General health	25 (0–75.0)	25 (0–75.0)	<0.01
Prolapse impact	33.3 (0–66.7)	0 (0–66.7)	ns
Role limitations	16.7 (0–50.0)	0 (0–66.7)	ns
Physical limitations	16.7 (0–66.7)	0 (0–66.7)	<0.01
Social limitations	0 (0–22.2)	0 (0–44.4)	ns
Personal limitations	0 (0–66.7)	0 (0–100.0)	ns
Emotions	33.3 (0–44.4)	11.1 (0–44.4)	<0.01
Sleep/energy	0 (0–33.3)	0 (0–33.3)	ns
Severity measures	16.7 (0–50.0)	8.3 (0–33.3)	<0.01

The data are presented as medians (minimum – maximum)

ns Not significant

[a] Wilcoxon signed-ranks test

Although the number of participants in this study was limited, of those who had storage problems, less active women tended to show an increase in their activity level after training. UI may be one of the factors that can influence physical activity among patients. Psychological barriers, such as fear, bothersomeness and distress, possibly lead to avoiding daily activities in middle-aged and older patients with UI [3, 22].

Women with more severe UI tend to be more likely to be insufficiently active [23].

Nygaard et al. [24] studied 301 women with POP stages II, III and IV and found that 36% of the women showed an increase, 18% a decrease and 47% no change activity level between before and after surgery. Stach-Lempinen et al. [25] found that in women with UI physical activity measured objectively for 1 week did not change even after successful surgical treatment, and the women maintained an active lifestyle similar to that in the general population. The According to previous studies focusing on physical activity levels under normal living conditions women with POP seem to show that physical activity levels do not change except in those with severe symptoms that substantially interfere with activities before as well as after surgery.

It remains unknown if instructions and supervised exercise affected the results. We did not give instructions and supervised exercises to the participants since the physical activity level was the main study outcome. To our knowledge, there is no evidence from randomized controlled trials or quasirandomized trials regarding the effects of physical activity interventions in women with UI and there are no studies that have investigated the effects of education or supervised exercises on physical activity in patients with POP.

There were four limitations in this study. First, this was a pretest-posttest quasiexperimental study without a control group. Because of the limitations of the study design, it is hard to evaluate the extent of any cause and effect relationship. Although there are epidemiological studies [27] investigating physical activity in patients with pelvic floor dysfunction, information about changes in physical activity levels before and after an intervention is still limited. Two experimental studies on physical activity in this field have been published [24, 25]. Both studies included patients in whom pelvic floor surgery was planned, and measured the change in physical activity between before and after surgery. To our knowledge, there are no studies that have investigated the changes in physical activity levels in patients with mild to moderate POP. It would be worthwhile to focus on changes in physical activity levels in patients with less severe POP undergoing conservative treatment because these patients also complain of unsatisfactory QOL due to their urogenital symptoms. We believe that our findings provide basic data for understanding physical activity in these patients' daily life. It increases risk that potential confounding factors influence the results of this study. We should give careful consideration on the results of this study. Second, there may have been selection bias in our method. Self-selection bias may have resulted from different degrees of interest in PFMT among POP patients. To avoid this bias, we strictly included patients who have had been previously diagnosed with POP, and visited the urologist from November 2013 to May 2014, and all these patients were asked if they would be prepared to participate in this study. In addition, this study was a single-center trial. Further research is required in the form of a multicenter trial to confirm or refute the results. Third, the sample size was small. Only a small number of patients with pelvic floor dysfunction seek treatment in Japan [26]. We are faced with difficulty of finding a large population of POP patients. In particular, it is difficult to identify patients with mild and moderate POP under such circumstances. As physiotherapy in the field of women's health is yet been covered by public medical insurance, very few physiotherapists see POP patients in clinical setting. The findings require cautious interpretation because a small sample size can be the cause of generalization error. Large-scale research is certainly needed to solve this problem in future. Forth, the sample size could not be calculated to determine the necessary number of participants for the evaluation of the primary outcomes. This was because very little previous data were available on physical activity measured using an accelerometer not only in patients with POP but also in those with pelvic floor dysfunction eligible for conservative treatment. Our study, therefore, is a first step toward developing clinical research to conduct a randomized controlled trial of physical activity levels in this field. Further studies with greater numbers of patients are required to estimate sample size by power analysis.

In the present study the patients showed a significant increase in the strength of the PFM between before and after PFMT. The PFMT regimen in this study was considered to be effective for the treatment of POP in increasing PFM strength as has been shown in previous studies using different measurements including digital assessment [5, 28], surface electromyography [5], perineometry [10].

A meta-analysis of studies investigating the efficacy of PFMT in the treatment of POP showed that there is greater improvement in prolapse symptoms and POP-Q stage in women receiving PFMT compared to controls [29]. In the present study, women with POP stage II or III showed statistically significant improvement in SUI, voiding frequency, postmicturition dribble and discomfort with emptying the bowel. However, the symptoms "Feeling a bulge/lump from or in the vagina" and "Heaviness or dragging feeling as the day goes on from the vagina or the lower abdomen" did not improve significantly after PFMT in this study, and this could explain and/or physical activity did not change. Patients with discomfort around abdomen and/or a pelvic floor reported that they had bulge symptoms, heaviness and/or dragging feeling during standing and long-distance walking. Regarding minimal clinically important difference for the different prolapse locations, it was difficult to identify which prolapse location was associated with the greatest improvement in symptoms and QOL because of the small numbers of patients with apical prolapse and posterior vaginal wall. Of the 29 women, 28 had anterior vaginal wall prolapse and only one had apical prolapse. Subjectively, 18 patients with anterior wall prolapse reported improvement in symptoms, 10 reported no change in symptoms, and none reported aggravation of symptoms. The patient with apical prolapse reported no change in symptoms. The number of studies investigating the use of PFMT in the treatment of POP is still limited, and more research is needed focusing on different factors including age, race and lifestyle.

Patients with POP have urogenital symptoms which can adversely affect their QOL. In the present study, we recruited women who had reported some degree of symptoms in their daily life. Digesu et al. [18] found that QOL scores in patients symptomatic POP were lower than that in asymptomatic patients. A previous study investigating the effectiveness of PFMT in the treatment of POP using the validated POP questionnaire P-QOL compared POP symptoms between before and after treatment [5]. The P-QOL questionnaire results for the QOL domains in this study mostly coincided with those in the previous study, except for the results for the role limitations and emotions domains which were different between two studies. Stupp et al. [5] found significant improvements in the role limitations domains in contrast to this study. The median score for the role limitations domain was higher (score 50, range: 0–100) than in this study (score 16.7, range: 0–50) at baseline. The previous study included considerably younger patients (mean age 52.95 ± 6.4 years), and this may have been a possible factor contributing to the difference. Japanese women showed an adverse impact of POP before PFMT in the emotions domain. In a stage-matched comparison of patients with POP, the median scores for the emotion domain before PFMT in Japanese and Brazilian patients were 33.3 and 0, respectively. This score difference might be because of a difference in national character. Similarly, studies of middle-aged elderly Japanese women with lower urinary tract symptoms [26, 30]. This pilot study indicated that although QOL scores improvement were shown, objective have shown impairment in the emotion domain as assessed using a QOL improved, physical activity levels did not increase, as discussed above. Further studies are needed to identify the factors that contribute to physical activity in patients with POP.

In conclusion, the objective physical activity levels in patients with mild to moderate POP might not be able to be changed while they are still affected by POP symptoms and impaired QOL. PFMT cannot affect physical activity levels even after symptoms and QOL improve, which is probably because activity levels are almost the same as in aged-matched healthy women.

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Compliance with ethical standards

Conflict of interest None.

References

1. Bump RC, Mattiasson A, Bø K, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol. 1996;175:10–7.
2. Barber MD, Maher C. Epidemiology and outcome assessment of pelvic organ prolapse. Int Urogynecol J. 2013;24:1783–90. doi:10.1007/s00192-013-2169-9.
3. Brown WJ, Miller YD. Too wet to exercise? Leaking urine as a barrier to physical activity in women. J Sci Med Sport. 2001;4:373–8.
4. Nygaard I, Handa V, Brubaker L, et al. Physical activity in women planning sacrocolpopexy. Int Urogynecol J Pelvic Floor Dysfunct. 2007;18:33–7. doi:10.1007/ s00192-006-0116-8.
5. Stüpp L, Resende AP, Oliveira E, et al. Pelvic floor muscle training for treatment of pelvic organ prolapse: an assessor-blinded randomized controlled trial. Int Urogynecol J. 2011;22:1233–9. doi:10.1007/s00192-011-1428-x.
6. Abrams P, Andersson KE, Birder L, et al. Fourth International Consultation on Incontinence Recommendations of the International Scientific Committee: evaluation and treatment of urinary incontinence, pelvic organ prolapse, and fecal incontinence. Neurourol Urodyn. 2010;29:213–40.
7. Bø K. Can pelvic floor muscle training prevent and treat pelvic organ prolapse? Acta Obstet Gynecol Scand. 2006;85:263–8.
8. Hagen S, Stark D, Glazener C, et al. Individualised pelvic floor muscle training in women with pelvic organ prolapse (POPPY): a multicentre randomised controlled trial. Lancet. 2014;383:796–806. doi:10.1016/S0140-6736(13)61977-7.
9. Braekken IH, Majida M, Engh M, Bø K. Can pelvic floor muscle training reverse pelvic organ prolapse and reduce prolapse symptoms? An assessor-blinded, randomized, controlled trial. Am J Obstet Gynecol. 2010;203:170. e1-7
10. Braekken IH, Hoff Braekken I, Majida M, et al. Morphological changes after pelvic floor muscle training measured by 3-dimensional ultrasonography: a randomized controlled trial. Obstet Gynecol. 2010;115:317–24.
11. Hung H-C, Hsiao S-M, Chih S-Y, et al. Effect of pelvic-floor muscle strengthening on bladder neck mobility: a clinical trial. Phys Ther. 2011;91:1030–8. doi:10.2522/ptj.20100186.
12. Miller JM, Ashton-Miller JA, DeLancey JO. A pelvic muscle precontraction can reduce cough-related urine loss in selected women with mild SUI. J Am Geriatr Soc. 1998;46:870–4.
13. Kumahara H, Schutz Y, Ayabe M, et al. The use of uniaxial accelerometry for the assessment of physical-activity-related energy expenditure: a validation study against whole-body indirect calorimetry. Br J Nutr. 2004;91:235–43.
14. Crouter SE, Schneider PL, Karabulut M, et al. Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. Med Sci Sports Exerc. 2003;35:1455–60.
15. Tudor-Locke C, Bassett DR. How many steps/day are enough? Preliminary pedometer indices for public health. Sport Med. 2004;34:1–8. doi:10.2165/00007256-200434010-00001.
16. Kubota A, Nagata J, Sugiyama M, et al. How many days of pedometer monitoring predict weekly physical activity in Japanese adults? [in Japanese]. Nihon Koshu Eisei Zasshi. 2009;56:805–10.
17. Tudor-Locke C, Burkett L, Reis JP, et al. How many days of pedometer monitoring predict weekly physical activity in adults? Prev Med. 2005;40:293–8. doi:10.1016/j.ypmed.2004.06.003.
18. Digesu GA, Khullar V, Cardozo L, et al. P-QOL: a validated questionnaire to assess the symptoms and quality of life of women with urogenital prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2005;16:176–81. doi:10.1007/s00192-004-1225-x.
19. Takeyama M, Ikeda S, Kobayashi M, et al. Validation of the prolapse quality-of life questionnaire (P-QOL) in Japanese version in

Japanese women [in Japanese]. J Japanese Cont Soc. 2014;25:327–36.
20. Longstreth GF, Thompson WG, Chey WD, et al. Functional bowel disorders. Gastroenterology. 2006;130:1480–91. doi:10.1053/j.gastro.2005.11.061.
21. Matsushita M, Sawada S, Nakagata T, et al. Characteristics of the number of steps in the National Health and nutrition survey [in Japanese]. Nihon Koshu Eisei Zasshi. 2014;61:686–92.
22. Bogner HR, Gallo JJ, Sammel MD, et al. Urinary incontinence and psychological distress in community-dwelling older adults. J Am Geriatr Soc. 2002;50:489–95.
23. Nygaard I, Girts T, Fultz NH, et al. Is urinary incontinence a barrier to exercise in women? Obstet Gynecol. 2005;106:307–14. doi:10.1097/01.AOG.0000168455.39156.0f.
24. Nygaard I, Handa VL, Brubaker L, et al. Changes in physical activity after abdominal sacrocolpopexy for advanced pelvic organ prolapse. Am J Obstet Gynecol. 2008;198:570.e1-5.
25. Stach-Lempinen B, Nygård CH, Laippala P, et al. Is physical activity influenced by urinary incontinence? BJOG. 2004;111:475–80.
26. Homma Y, Yamaguchi O, Hayashi K. Epidemiologic survey of lower urinary tract symptoms in Japan. Urology. 2006;68:560–4. doi:10.1016/j.urology.2006.03.035.
27. Farage MA, Miller KW, Berardesca E, et al. Psychosocial and societal burden of incontinence in the aged population: a review. Arch Gynecol Obstet. 2008;277:285–90. doi:10.1007/s00404-007-0505-3.
28. Hagen S, Stark D, Glazener C, et al. A randomized controlled trial of pelvic floor muscle training for stages I and II pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2009;20:45–51. doi:10.1007/s00192-008-0726-4.
29. Li C, Gong Y, Wang B. The efficacy of pelvic floor muscle training for pelvic organ prolapse: a systematic review and meta-analysis. Int Urogynecol J. 2016;27:981-92. doi:10.1007/s00192-015-2846-y.
30. Hirakawa T, Suzuki S, Kato K, et al. Randomized controlled trial of pelvic floor muscle training with or without biofeedback for urinary incontinence. Int Urogynecol J. 2013;24:1347–54.