EXERCISE

Pelvic Organ Prolapse

Pelvic organ prolapse (POP) is a common condition, affecting ~50% of parous women[1]. It is characterized by a variety of pelvic floor symptoms, including dragging in the vagina, feeling of a lump in the vagina, urinary symptoms, bowel symptoms, and discomfort during intercourse[2]. These symptoms can be extremely debilitating and women can be left feeling confused, embarrassed, and as though they cannot do anything – as if every move is going to make it fall out. Unfortunately, patients with POP commonly receive conflicting messages from their providers regarding care and management, and often the primary solution offered to them is surgical intervention. Web-based information regarding treatment for POP is incomplete and largely biased toward surgical treatment[3].

As a physical therapist, I am able to provide an individualized evaluation of the musculoskeletal, visceral and fascial systems, therapeutic exercise, reeducation of movement patterns and motor planning for activities that are most bothersome to you. Patient education includes lifestyle and behavioral interventions. Specifically, physical therapists specializing in women's health will evaluate your structural foundation and posture. We can teach patients appropriate exercises to help strengthen or release the muscles needed for support. We problem solve to find strategies or solutions that decrease downward pressure on the prolapsed area (intra-abdominal pressure). Proper activity and education is key to empowering women with POP to live without fear of movement and exercise.

1. Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2011;(12):CD003882. doi:10.1002/14651858.CD003882.pub4.
2. Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th international consultation on incontinence. *Neurourol Urodyn*. 2014:n/a - n/a. doi:10.1002/nau.22677.
3. Kakos AB, Lovejoy DA, Whiteside JL. Quality of information on pelvic organ prolapse on the Internet. *Int Urogynecology J*. 2015;26(4):551-555. doi:10.1007/s00192-014-2538-z.

Literature Review for Physical Therapy Exercise Interventions for POP

The literature and information regarding surgical intervention for pelvic organ prolapse is extensive; to the contrary, there is an overall lack of information related to physical therapy interventions for pelvic organ prolapse (POP). Surgery is most often recommended to women. Prolapse can reoccur in up to 58% of women after surgery, particularly for younger women and women with more advanced prolapse[1]. Approximately one-third of women who have had surgery undergo at least 1 more surgical repair[2]. Severe complications are possible with prolapse surgery, especially after mesh implants[3,4], and it is not recommended for the frail or those who wish to have more children[5,6]. This emphasizes the need for nonsurgical prevention and treatment of prolapse.

This review is a summary of the literature pertaining to exercise interventions for pelvic organ prolapse. Preliminary evidence for physical therapy efficacy is found in the literature surrounding non-invasive, conservative interventions for POP, such as pelvic floor muscle training, mechanical interventions (pessaries), and lifestyle interventions (behavioral modifications).

What do we know about exercise interventions for pelvic organ prolapse?

A recent systematic review concluded that there is Level 1, Grade A evidence to recommend pelvic floor muscle training (PFMT) in treatment of pelvic organ prolapse[5]. Pelvic floor muscle training is used to improve strength, endurance, and coordination of the pelvic floor muscles. Currently, there are two hypotheses regarding the use of PFMT for prolapse[6]: (1) that strengthening these muscles can improve the structural support for the pelvic organs, and (2) that women develop a "knack" for consciously contracting their pelvic floor before/during increases in intra-abdominal pressure.

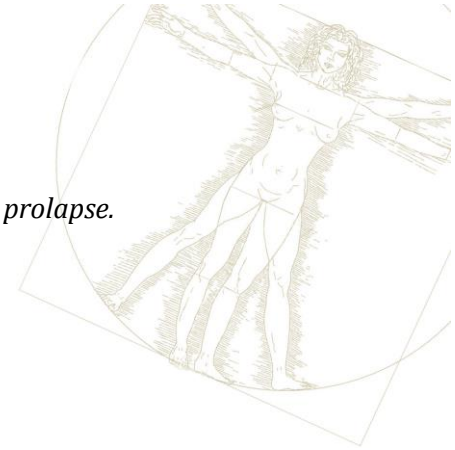
SUMMARY

The number of studies investigating the efficacy of exercise as a non-invasive treatment for pelvic organ prolapse is limited. However, within the available literature, there is general consistency regarding the technique and prescribed dosage comprising of 3 sets of 8-12 max pelvic floor muscle contractions per day. The duration of specific pelvic floor muscle training should be conducted over a 3-6 month period on the basis of muscle physiology, necessary for muscle hypertrophy[7]. Strength is not the only measure of muscle function and unfortunately there is a lack of research regarding sub maximal pelvic floor exercise in conjunction with motor control training.

Adherence to physical therapy instructed PFMT has been found to be quite successful and other alternatives, such as Pilates or hypopressives, may be beneficial. Administration of PFMT is more beneficial for the patient when the supervised training is given individually rather than in a group. This accounts for individual strength and activity differences. Further research is needed to identify the characteristics of patients that predict positive/negative treatment outcomes. The majority of the literature reviewed focused on short duration effects of PFMT; therefore, longer duration follow-up studies of PFMT are warranted.

Additionally, minimizing intra-abdominal pressure has been shown to be effective for managing prolapse symptoms (*see Lifestyle & Behavior Interventions for Prolapse*).

1. Whiteside JL, Weber AM, Meyn LA, Walters MD. Risk factors for prolapse recurrence after vaginal repair. *Am J Obstet Gynecol*. 2004;191(5):1533-1538. doi:10.1016/j.ajog.2004.06.109.
2. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol*. 1997;89(4):501-506. doi:10.1016/S0029-7844(97)00058-6.
3. de Tayrac R, Sentilhes L. Complications of pelvic organ prolapse surgery and methods of prevention. *Int Urogynecology J*. 2013;24(11):1859-1872. doi:10.1007/s00192-013-2177-9.
4. Maher C, Feiner B, Baessler K, Schmid C. Surgical management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2013;4:CD004014. doi:10.1002/14651858.CD004014.pub5.
5. Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th international consultation on incontinence. *Neurourol Urodyn*. 2014:n/a - n/a. doi:10.1002/nau.22677.
6. Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2011;(12):CD003882. doi:10.1002/14651858.CD003882.pub4.
7. Bø APK. Pelvic floor muscle exercise for the treatment of stress urinary incontinence: An exercise physiology perspective. *Int Urogynecology J*. 1995;6(5):282-291. doi:10.1007/BF01901527.



This literature review includes 14 articles addressing exercise and pelvic organ prolapse.

Common abbreviations used within literature review:

ACSM: American College of Sports Medicine
HADS: Hospital Anxiety and Depression Scale
HE: hypopressive exercises
IAP: intra-abdominal pressure
MOS-SF-12: Medical Outcomes Study Short Form Health Survey-12
MVC: maximal voluntary contraction
PFMT: pelvic floor muscle training
PFDI: Pelvic Floor Distress Inventory
PFIQ: Pelvic Floor Impact Questionnaire
PISQ-12: Pelvic Organ Prolapse/ Urinary Incontinence Sexual Questionnaire
POP: pelvic organ prolapse
POP-Q: Pelvic Organ Prolapse Quantification
POP-SS: Pelvic Organ Prolapse Symptom Score
PT: physical therapist
QOL: quality of life
RCT: randomized control trial
(S)UI: (stress) urinary incontinence
VAS: Visual Analog Scale

Citation	Ali-Ross NS, Smith ARB, Hosker G. The effect of physical activity on pelvic organ prolapse. *BJOG Int J Obstet Gynaecol*. 2009;116(6):824-828.
Link	http://www.ncbi.nlm.nih.gov/pubmed/19432572

Summary Of Article	• The objective of this prospective observational study was to determine whether POP increases after physical activity for 54 women undergoing surgery for prolapse
	  ○ Prescribed physical activities consisted of walking for ~45 minutes (including going up and down one flight of stairs), standing up from sitting 5x, bending down to pick up something off the floor 10x, and jogging/stamping briskly on the spot for 1 minute
	• Primary outcome: an increase in POP-Q measurement with activity, assessed after a period of prescribed activity and overnight bed rest
	• Secondary outcomes: associations of symptoms or quality of life scores (PFDI and PFIQ) with an increase in POP-Q measurements
	• Results: significant increase in POP-Q stage following activity (1:4 women)
	  ○ No women increased or decreased by more than one stage
	  ▪ 8/14 increased from stage 2 to 3
	  ○ Maximal increase in POP-Q for the anterior and apical compartment
	  ○ Worsening symptoms of vaginal lump or pelvic heaviness were not associated with POP-Q findings following exertion

Strengths & Limitations	Strengths: • The sample size was statistically calculated • Inclusions and exclusions were demographically matched in all areas except for previous hysterectomy • Both POP-Q examinations were carried out by the same examiner in a

	standard fashion following micturition Limitations: • Lack of asymptomatic group of controls • Examiner was not blinded • Level of activity may have influenced the results • Conducted at a single center (St. Mary's Hospital, Manchester, UK)
Contribution of Evidence for Treatment of Prolapse	This study demonstrates that physical activity can lead to an increase in the degree of prolapse, especially anteriorly, therefore activity modification as well as pelvic floor muscle training may be beneficial in supporting the anterior compartment.

Citation	Bø K, Hilde G, Stær-Jensen J, Siafarikas F, Tennfjord MK, Engh ME. Postpartum pelvic floor muscle training and pelvic organ prolapse—a randomized trial of primiparous women. *Am J Obstet Gynecol*. 2015;212(1):38.e1-38.e7.
Link	http://www.ncbi.nlm.nih.gov/pubmed/24983687
Summary Of Article	• This study was a secondary analysis of a parallel group assessor blind RCT comparing the effectiveness of a 4-month PFMT program on prevention and treatment of signs and symptoms of POP in 175 primiparous women; began 6-8 weeks postpartum ○ Participants were stratified on major levator ani defects, women with 3rd and 4th degree lacerations were excluded from the study as they were automatically referred to physiotherapy ○ PFMT group: followed a supervised, weekly group training program; performed 3 sets of 8-12 close to max PFM contractions per day • Primary outcomes: stage of POP assessed using POP-Q; bladder neck position assessed by 3-/4- dimensional transperineal ultrasonography • Secondary outcomes: symptoms of vaginal bulge using International Consultation on Incontinence Vaginal Symptoms Questionnaire • Results: at post-intervention there was no significant risk difference in POP stage, bladder neck position, or symptoms of vaginal bulge ○ Statistically significant difference in pelvic floor muscle strength from 6 weeks to 6 months in favor of the PFMT group ○ Outcomes did not improve in the subgroup of women with major levator ani defects
Strengths & Limitations	Strengths: • RCT study design • Blinding of assessors (gynecologists and physiotherapists) • Use of supervised training following recommendations for strength training • High adherence ○ 96% of the women in the PFMT group adhered to ≥80% of both group and home training sessions • Use of reliable and valid outcome measures • Explicit inclusion and exclusion criteria

	Limitations: • Loss to follow-up • Small sample size in some of the comparisons • Questionnaire on POP symptoms not validated in a postpartum population • Conducted at a single center (Akershus University Hospital, Norway) • Breastfeeding status not defined in patient population • The exclusion of women with 3rd and 4th degree tears
Contribution of Evidence for Treatment of Prolapse	There is limited knowledge on remission of POP in the postpartum period, however this study found no improvement in POP, bladder neck support, or vaginal bulge symptoms with an intensive group PFMT program for primiparous women beginning 6-8 weeks postpartum. There was a small but statistically significant improvement in the muscle strength in the training group. More cohort studies and randomized controlled trials are needed before strong conclusions can be made regarding the effect of PFMT starting at 6-8 weeks postpartum on POP in primiparous as well as multiparous women

Citation	Bø K, Majida M, Engh ME. Does a ring pessary in situ influence the pelvic floor muscle function of women with pelvic organ prolapse when tested in supine? *Int Urogynecology J*. 2012;23(5):573-577.
Link	http://www.ncbi.nlm.nih.gov/pubmed/22086263

Summary of Article	• The objective of this short-term experimental study was to compare vaginal resting pressure and MVC of the PFM measured with and without a ring pessary in situ
	  ○ 22 women with POP-Q grade II-IV, who were able to correctly contract the PFM and hold contraction for 10s were included
	  ○ Size of the pessary was loose-fitting but large enough to retain prolapse
	• Outcome measures: resting pressure and MVC were measured with a manometer in supine
	• Results: statistically significant difference in vaginal resting pressure but not of MVC with the ring pessary in situ

Strengths & Limitations	Strengths: • Method of measurement has been shown to be reproducible and valid • Performed an a-priori power calculation based on measurements with the same methodology • All women had thorough instruction and confirmation of ability to perform a correct PFM contraction before entering the study • Single examiner assessed ability to perform a correct contraction; two experienced gynecologists inserted the pessaries Limitations: • Order of procedures was not randomized, potential for a learning effect • Measurements only done in the supine position • Only one type of a pessary (ring) was used

	• Conduced at a single center in Lørenskog, Norway • Exclusion criteria included breastfeeding, pregnancy, prolapse too advanced to allow for introduction of the measurement catheter into the vagina • Short-term study, only assessed the immediate effect of repositioning
Contribution of Evidence for Treatment of Prolapse	PFM strength can be accurately measured with and without a ring pessary repositioning the prolapse in supine; thus, PFM training would be effective regardless of the presence of a ring pessary in supine, but has yet to be confirmed in other positions. Future study is needed to determine long-term effect of a more permanent use of a ring pessary on different aspects of PFM morphology and function. Furthermore, additional investigation is needed to interpret the statistically significant increase in vaginal resting pressure with the ring pessary in situ.

Citation	Brækken IH, Majida M, Engh ME, 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(2):170.e1-170.e7.
Link	http://www.ajog.org/article/S0002-9378(10)00250-4/pdf

Summary Of Article	• This study was a RCT comparing the effectiveness of PFMT (n = 59) to a control (n = 50) for prolapse
	  ○ Both groups received lifestyle advice and learned how to contract their PFM before and during increase in abdominal pressure ("the Knack")
	  ○ PFMT group: 3 sets of 8-12 max PFM contractions per day, recorded training adherence in an exercise diary; supervised by a PT once a week during the first 3 months, every second week during the last 3 months
	• Primary outcomes: stage of POP classified using the POP-Q system, position of bladder and rectum (determined using ultrasound), and frequency and bother of prolapse symptoms (from a validated questionnaire)
	• Secondary outcomes: frequency and bother of bladder and bowel symptoms (from a validated questionnaire)
	• Results: significantly more women in the PFMT group than the control group improved 1 POP-Q stage
	  ○ Within the PFMT group, the number of women improving 1 stage on the POP-Q increased with increasing degree of POP
	  ▪ 0% for stage 1 POP, 16.7% for stage II POP, 35.7% for stage III POP
	  ○ Women in the PFMT group had significantly greater improvement than the control group in PFM strength
	  ○ Of the symptomatic women in the PFMT group, 74% reported reduced frequency of vaginal bulging and/or heaviness at the 6-month posttest
	  ○ Women in the PFMT group adhered with 89% of the prescribed home exercises and 86% of the PT training sessions

Strengths & Limitations	Strengths: • Assessor-blinded, randomized, controlled, parallel group trial • PFM function evaluated using a reliable and valid method

	• Inclusion of women with all types of POP (stages I-III) • Standardized training protocol • Low dropout rate & high adherence to the training protocol Limitations: • Differences between groups in prolapse symptoms at baseline • Different amount of time spent by the PT between groups • Relatively small sample size • Extensive exclusion criteria ○ Included POP stage 0 or IV, inability to contract PFM, breastfeeding, previous POP surgery, radiating back pain, pelvic cancer, neurologic disorders, psychiatric disorders, untreated urinary tract infection, planning to become pregnant in next 6 months or to be away for more than 4 weeks of the intervention period
Contribution of Evidence for Treatment of Prolapse	This study demonstrated that PFMT can result in elevation of the pelvic organs, and it would be plausible to infer that PFMT could be used in prevention of POP. Additionally, this study supported the use of PFMT for reduction of prolapse symptoms, which the authors argue may be considered the most important treatment effect, as the subjective symptoms are the main indication for surgery. Future studies are needed to determine long-term effects of PFMT

Citation	Braekken IH, Majida M, Ellström Engh M, Bø K. Can Pelvic Floor Muscle Training Improve Sexual Function in Women with Pelvic Organ Prolapse? A Randomized Controlled Trial. *J Sex Med*. 2014.
Link	http://www.ncbi.nlm.nih.gov/pubmed/25401779

Summary Of Article	• This study was a partially blind secondary analysis of a RCT *(see 2010 Braekken study)* comparing the effectiveness of PFMT (n = 59) to a control (n = 50) in improving sexual function in women with POP
	  ○ Both groups received lifestyle advice and learned how to contract their PFM before and during increase in abdominal pressure ("the Knack")
	  ○ PFMT group: 3 sets of 8-12 max PFM contractions per day and recorded training adherence in an exercise diary; supervised by a PT once a week during the first 3 months, every second week during the last 3 months
	• Primary outcomes: validated POP-specific questionnaire used to describe frequency and bother of prolapse, bladder, bowel, and sexual symptoms; answers from a semi-structured interview
	• Secondary outcomes: PFM function (strength, endurance, and vaginal resting pressure) measured by a manometry in supine
	• Results: significantly more women in the PFMT group (39% vs. 5%) reported an improvement in sexual function
	  ○ Women reporting improved sexual function had the greatest increase in PFM strength and endurance
	  ○ No significant change in number of sexual active women
	  ○ No significant differences between groups regarding change in

	satisfaction with frequency of intercourse ○ No differences in change to vaginal resting pressure between groups
Strengths & Limitations	Strengths: • Subjects were stratified according to stage of POP and then randomized • Interviewer was blinded to questionnaire data • PFMT protocol was designed in accordance with guidelines from the ACSM Limitations: • Exclusion criteria was extensive and included inability to contract the PFM • Interviewer was not blinded to group allocation • 60% of subjects at baseline reported they had no sexual complaints • Higher frequency of prolapse symptoms and sexual difficulties were reported in the PFMT than the control group at baseline • 19 women declined to be interviewed • Lack of a specific and comprehensive questionnaire to assess sexual function
Contribution of Evidence for Treatment of Prolapse	This study found that the majority of women in the PFMT group reported unchanged sexual function after 6 months; however, those that did report improved sexual function had the greatest increase in PFM strength. Therefore it would be reasonable to conclude that PFMT has the potential to improve sexual function in some women. Although sexuality is multi-factorial, the authors noted that women with POP may have a negative self-image of their vagina, which may cause them to be insecure about their sexuality, thus by improving their muscle awareness and control it could improve their self-confidence and sexual function. Future studies should be conducted using the PISQ-12 as it is a valid, reliable, and responsive measure of sexual function in women with POP

Citation	Culligan PJ, Scherer J, Dyer K, et al. A randomized clinical trial comparing pelvic floor muscle training to a Pilates exercise program for improving pelvic muscle strength. *Int Urogynecology J*. 2010;21(4):401-408.
Link	http://www.ncbi.nlm.nih.gov/pubmed/20094704

Summary Of Article	• This study compared the effect of a PFMT program to a Pilates exercise program (neutral spine technique) in improving pelvic muscle strength
	  ○ 62 adult non-pregnant women with little or no pelvic floor dysfunction were randomized to Pilates (n = 30) or PFMT (n = 32), all were able to "find" their pelvic floor muscles
	  ○ Each group had 12 weeks of bi-weekly 1 hour one-on-one sessions with either a physical therapist (n = 2) or a certified Pilates instructor (n = 4)
	• Primary outcomes: strength was measured using perineometry
	• Secondary outcomes: PFDI-20 short form, PFIQ-7 short form
	• Results: both the groups got stronger with no difference between groups; PFDI and PFIQ scores improved from baseline but not between groups

Strengths & Limitations	Strengths: • RCT study design • Strength measurements were obtained by a single clinical research nurse

	• Very detailed protocols for both programs were included Limitations: • Actual complaints of pelvic floor dysfunction was not required – no women with greater than stage 1 POP were enrolled • High drop out rates, especially for PFMT group (Pilates: n = 2, PFMT: n = 8) • Findings are only relevant for those that can "find" their pelvic floor muscles • Relatively small sample size
Contribution of Evidence for Treatment of Prolapse	As both groups improved from baseline, Pilates may be feasible for improving pelvic floor strength in women who can perform a pelvic muscle contraction correctly, and thus could potentially be used for women with POP. Most Pilates exercises are performed in conjunction with a pelvic floor muscle contraction and thus if adherence to Pilates is better that a PFMT program, then it could be used as an alternative program. However, further studies are needed before concluding whether or not Pilates can actually treat pelvic floor dysfunction.

Citation	Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th international consultation on incontinence. *Neurourol Urodyn*. 2014[Epub ahead of print].
Link	http://www.ncbi.nlm.nih.gov/pubmed/25400065

Summary Of Article	• Highlights and new evidence on conservative management of UI and POP are presented and reviewed in this paper from the 5th International Consultation on Incontinence (ICI)
	  ○ The previous review published in 2008 was used as a baseline
	  ○ An update literature search of randomized controlled trials on female conservative management was conducted from Jan. 2008 to Aug. 2012
	  ○ A brief description is followed by the state of the science, level of evidence, and grade of recommendation
	• Primary outcome of interest: individual's subjective report of UI
	• Secondary outcomes: UI-specific QOL questionnaires, symptom severity, and objective measurements
	• Results/Recommendations for Conservative Management of POP:
	  ○ Lifestyle Interventions
	  ▪ Include weight loss, reducing activities that strain the pelvic floor, and treating constipation; goal is to avoid further exacerbation by decreasing intra-abdominal pressure
	  ▪ Being overweight or engaging in occupations involving heavy lifting may play a role in POP (Level 3)
	  ▪ No studies identified that evaluate the effectiveness of lifestyle interventions in the treatment of women with POP
	  ○ Physical Therapy
	  ▪ No evidence from intervention studies in preventing POP (1 trial underway)

	▪ Based on observational studies, better PFM function may be associated with lower risk of POP (Level 3) ▪ PFMT may improve symptoms of POP and the anatomical defects (Level 1) ▪ Recommendation: PFMT can improve POP symptoms and reduce the severity (Grade A) ○ Pessaries ▪ Large number of observational studies, 2 RCTs ▪ Clinically significant improvements in the majority of symptoms as well as QOL scales for both types of pessaries; no significant differences between Gellhorn and the ring with support (Level 2) ▪ Recommendation: either pessary may improve POP symptoms and reduce the impact (Grade B)
Strengths & Limitations	Strengths: • Summary of the literature up to August 2012 • Extensive suggestions for areas for future research Limitations: • None noted
Contribution of Evidence for Treatment of Prolapse	New evidence supports the effectiveness of implementing PFMT and physical therapy in the treatment of POP. An association between a women's employment in heavy occupational lifting and POP were found as well as an association between POP and bodyweight. More research is needed in the prevention of female POP.

Citation	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. *The Lancet*. 2014;383(9919):796-806.
Link	http://www.ncbi.nlm.nih.gov/pubmed/24290404
Summary Of Article	• This parallel-group, multicenter RCT aimed to determine the effectiveness of one-to-one individualized PFMT for reducing POP symptoms ○ Female outpatients with newly-diagnosed symptomatic stage I, II, or III prolapse were randomly assigned to receive either an individualized PFMT program (n = 225) or a prolapse lifestyle advice leaflet with no muscle training control group (n = 222) ○ PFMT intervention consisted of 5 one-to-one sessions for PFMT over 16 weeks (at weeks 0, 2, 6, 11, and 16), duration chosen on the basis of muscle physiology (15 weeks needed to gain muscle hypertrophy) • Primary endpoint: POP-SS at 1 year • Secondary outcomes: perceived change in POP since start of the study, QOL measured as interference of POP symptoms with everyday life, number of days with POP symptoms in the previous 4 weeks, uptake of further POP treatment, severity of incontinence, bowel symptoms, sexual symptoms, general health, use of health services in primary and secondary care, and the

	frequency of practice of PFM exercises in the past 4 weeks; intervention adherence
	• Results: women in the intervention group reported fewer prolapse symptoms (i.e. a significantly greater reduction in POP-SS score) than those in the control group at both 6 and 12 months, which also exceeded the minimally important change for POP-SS
	  ○ 84% completed follow-up POP-SS at 6 months, 66% at 12 months
	  ○ The most commonly reported symptom at baseline was "a feeling of something coming down", which persisted at 6 and 12 months
	  ○ At 12 months "discomfort worse while standing" and "lower abdominal heaviness" were significantly less common
	  ○ A greater proportion of women in the PFMT group had an improvement in their POP stage, although this was not a significant difference

Strengths & Limitations	Strengths: • Outcome assessors were masked to group allocation • Statistician was masked until after data analysis • Analysis was by intention-to-treat analysis • Relatively large trial, conducted at 25 centers (23- UK, 1- NZ, 1- Australia) • Sponsor of the study had no role in study design, data collection/analysis/interpretation, or writing of report • Compliance with trial processes and intervention was generally high ○ 80% of women attended 4-5 physiotherapy sessions • Motivation for prolapse surgery was identified as a potentially important factor affecting how adherent women will be to PFMT Limitations: • Low rate of questionnaire response at 12 months • Not all women had a prolapse assessment at 6 months, therefore there was attrition in the POP-Q responses • Short follow-up period of 12 months
Contribution of Evidence for Treatment of Prolapse	One-to-one PFMT is effective for improving symptoms of prolapse for at least 1 year and can be used by a physical therapist to help treat patients with POP stage I, II, or III. Further studies are needed to look at longer duration results as well as PFMT effectiveness in specific subgroups.

Citation	Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2011;(12):CD003882.
Link	http://www.ncbi.nlm.nih.gov/pubmed/22161382
Summary Of Article	• Update of a Cochrane review first published in 2004, previously updated in 2006, to determine the effectiveness of conservative management for preventing and treating POP in comparison with no treatment or other treatment options • Selection criteria: only randomized and quasi-randomized trials in women with POP that included a physical or lifestyle intervention in at least one arm

	of the trial
	• Main results: 6 trials included, 3 new to update
	  ○ Greater improvement in the PFMT group compared to the control group (4 trials, significant risk for bias in 2/4 trials)
	  ○ PFMT supplementing surgery versus surgery alone findings differed between trials (2 small trials, neither measured prolapse-specific symptoms)
	  ○ Insufficient evidence regarding other lifestyle changes (for example, avoiding lifting or losing weight)

Strengths & Limitations	Strengths: • Two reviewers assessed all trials for in-/exclusion and methodological quality • Data was cross checked Limitations: • 4 small trials (<25 women per arm), 2 had moderate to high risk of bias
Contribution of Evidence for Treatment of Prolapse	There is now some evidence that supports the effectiveness of PFMT for improving prolapse symptoms and severity. Further studies are needed to analyze long-term effects of PFMT as well as determining cost-effectiveness; large RCTs looking at PFMT supplementing surgery is needed to determine usefulness of combining these treatments. Future areas of research include assessing lifestyle change interventions and prolapse prevention.

Citation	Hagen S, Thakar R. Conservative management of pelvic organ prolapse. *Obstet Gynaecol Reprod Med.* 2012;22(5):118-122.
Link	http://www.sciencedirect.com/science/article/pii/S1751721412000346

Summary Of Article	• This article describes conservative approaches to the treatment of POP
	• Lifestyle interventions: "seek to avoid exacerbation of POP by decreasing intra-abdominal pressure", effectiveness unknown without any RCTs
	  ○ Observational studies have found associations between POP and heavy lifting, being overweight, and constipation
	  ○ Notably, the studies have found an association of lifestyle factors and symptoms of prolapse, but not an association with anatomical severity
	• PFMT: may improve the structural support for the pelvic organs by improving functional strength, co-ordination, and endurance of the pelvic floor muscles; growing evidence in support of the effectiveness of PFMT including two full-sized trials (Braekken et al. 2011, Hagen et al. 2011)
	  ○ There are no studies looking at the effectiveness of the Knack for POP
	• Pessaries: most commonly used to support and reposition prolapsed pelvic organs; shown to be largely successful, a RCT found no difference between types in symptom relief
	  ○ Two types: Support (e.g. ring, Gehrung) & Space-filling (e.g. Gellhorn, Cube, Donut, Inflatoball)

Strengths & Limitations	Strengths: • Very clear layout

	Limitations: • No in-text citations are given • Risk of author bias
Contribution of Evidence for Treatment of Prolapse	Recommendations • *Lifestyle Changes* to reduce IAP to ease the downward pressure on the prolapsed area: avoiding constipation via diet and fluid adjustments or use of medication, altering lifting habits (e.g. lift multiple small weights rather than single large weights), altering exercise from high impact to low or no impact, losing weight, smoking cessation, and avoiding bladder irritants such as caffeine • *PFMT*: a first option to treat prolapse symptoms • *Pessaries*: safe, simple, inexpensive non-surgical option for managing POP

Citation	Kashyap R, Jain V, Singh A. Comparative effect of 2 packages of pelvic floor muscle training on the clinical course of stage I-III pelvic organ prolapse. *Int J Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet*. 2013;121(1):69-73.
Link	http://www.ncbi.nlm.nih.gov/pubmed/23332657

Summary of Article	• This RCT compared the effect of two packages of PFMT on POP
	  ○ 140 women with stage I-III prolapse were randomly assigned to receive one-to-one PFMT and a self-instruction manual (SIM) (n = 70) or to just receive the SIM (n = 70)
	  ○ PFMT intervention consisted of one-to-one sessions for PFMT over 24 weeks (follow up visits at 1, 3, 6, 12, 18, and 24 weeks)
	  ○ For both groups, the home exercise program consisted of a 3 sets per day of 10 voluntary contractions, each held for 10 seconds with a 10 second rest in between
	• Primary outcomes: symptoms - assessed via the POP-SS, VAS, and PFIQ-7
	• Results: marked improvements in both groups from baseline to 24 weeks
	  ○ Significant between-group changes in mean VAS and PFIQ-7 scores at 18 and 24 weeks
	  ○ One-to-one PFMT along with the SIM effectively reduced symptoms and severity of POP and improved quality of life

Strengths & Limitations	Strengths: • Very detailed recruitment process Limitations: • Short duration of follow-up (24 weeks) • Lack of stratified randomization method • Conducted at a single gynecology outpatient department in India
Contribution of Evidence for Treatment of Prolapse	This study showed that using one-to-one PFMT and self-instruction manual (SIM) provided greater improvements in POP symptoms than SIM alone. That being said, women in both groups showed a clear shift from moderate and severe grades of POP to a mild grade, thus education and improved awareness even without PFMT can make a difference. It should be noted that this study was

	conducted in India where women experience certain limitations with regard to treatment seeking (e.g. feeling embarrassed, fear of surgery and pain, lack of money and time, dependence on husbands for seeking care, and lack of female doctors in peripheral hospitals), and therefore may not seek treatment until symptoms are unbearable, which may or may not be similar to other countries. It was emphasized that one-to-one intervention is important due to the intimate nature of discussing reproductive health problems.

Citation	Khan ZA, Whittal C, Mansol S, Osborne LA, Reed P, Emery S. Effect of depression and anxiety on the success of pelvic floor muscle training for pelvic floor dysfunction. *J Obstet Gynaecol*. 2013;33(7):710-714.
Link	http://www.ncbi.nlm.nih.gov/pubmed/24127961

Summary of Article	• This prospective observational study aimed to determine the impact of anxiety and depression on PFMT
	  ○ 108 women (age 20-83, mean 47.85 years) with pelvic floor dysfunction (10.5% with POP symptoms) referred to physiotherapy underwent subjective and objective assessments of their pelvic floor and psychological health at the beginning and end of a 6 month program
	  ▪ Divided into 3 groups based upon Hospital Anxiety and Depression Scale (HADS) score
	  ○ Structured physiotherapy program consisted of six group sessions and two individuals sessions spaced over 6 months with further individual sessions as needed
	  ▪ Exercise: 10 long squeezes, up to 10 seconds each, followed by 10 short squeezes, at least three times each day
	• Outcome measures: Modified Oxford Grading for pelvic floor strength, Queensland Pelvic Floor Questionnaire, and HADS score
	• Results: strong correlation between the severity of anxiety/depression symptoms and the severity of their pelvic floor dysfunction
	  ○ Improvement was seen in all domains of pelvic floor dysfunction, with the exception of sexual function
	  ○ Patients with no or mild anxiety/depression benefited most from PFMT

Strengths & Limitations	Strengths: • Heterogeneous group of patients Limitations: • High dropout rate (n = 52, 51% had moderate to severe anxiety/depression) • Population in Swansea, UK may not be typical of all patient populations
Contribution of Evidence for Treatment of Prolapse	This study suggests that the level of psychiatric symptoms of anxiety and depression may be an important predictor for PFMT outcomes. Perhaps a targeted approach, avoiding group physiotherapy, should be undertaken for managing patients with higher levels of anxiety/depression as well as the consideration for adjunct therapies.

Citation	Resende APM, Stüpp L, Bernardes BT, et al. Can hypopressive exercises provide additional benefits to pelvic floor muscle training in women with pelvic organ prolapse? *Neurourol Urodyn*. 2012;31(1):121-125.
Link	http://www.ncbi.nlm.nih.gov/pubmed/22038880

Summary of Article	• The objective of this single-blind study was to compare the effect of hypopressive exercises (HE) including pelvic floor muscle contraction to PFMT alone and a control on pelvic floor muscle function
	  ○ 63 women with stage II POP were randomly assigned to PFMT group, HE + PFMT group, or the control group; each group received lifestyle advice regarding weight loss, constipation, coughing, and avoidance of heavy lifting
	  ○ Each intervention group received 3 initial treatment sessions, performed daily exercises at home over 3 months, with phone calls made every 2 weeks by the physiotherapist with monthly follow-up appointments; each participant filled out an exercise diary
	  ▪ HE performed in three steps: (1) slow, diaphragmatic inspiration, (2) total expiration, (3) diaphragmatic aspiration + PFM contraction; 2 sets per day of 8-10 repetitions holding each contraction for 6-8s, one set in lying and other in standing position
	  ▪ PFMT protocol: 3 sets per day of 8-12 MVC held for 6s with 12s rest between each contraction followed by 3 fast contractions in a row
	• Outcome measures: MVC determined using the Modified Oxford grading system, muscle activation measured by SEMG
	• Results: both intervention groups were superior to the control group regarding MVC, endurance, and muscle activation
	  ○ PFMT group was superior regarding endurance

Strengths & Limitations	Strengths: • RCT study design • Single blinded assessor • Defined protocol Limitations: • Did not assess POP symptoms, focused solely on pelvic floor muscle function (women who did take part in the present study also participated in a RCT on PFTM to reduce POP; results not yet available) • Control group dropout rate of 27% (n =5, due to motivational problems) • Small sample size • Lack of priori power calculation
Contribution of Evidence for Treatment of Prolapse	It was concluded that adding hypopressive exercises to PFMT does not improve pelvic floor muscle function; however, the sample size was relatively small and this study did not assess POP symptoms. This study further supports the use of PFMT for improving PFM function.

Citation	Wiegersma M, Panman CMCR, Kollen BJ, et al. Pelvic floor muscle training versus

	watchful waiting or pessary treatment for pelvic organ prolapse (POPPS): Design and participant baseline characteristics of two parallel pragmatic randomized controlled trials in primary care. *Maturitas*. 2014;77(2):168-173
Link	http://www.maturitas.org/article/S0378-5122(13)00325-3/pdf

Summary Of Article	• This study consists of two parallel open label RCTs
	  ○ POPPS trial 1: women with mild POP (stage 1 or mild stage 2) receive either PFMT (n=145) or watchful waiting (n=142)
	  ○ POPPS trial 2: women with advanced POP (advanced stage 2 or stage 3) receive either PFMT (n=79) or pessary treatment (n=81)
	  ○ PFMT treatment: does not follow a standard protocol, physiotherapists will adjust their treatment to the need of each patient
	  ○ All outcomes will be measured at 3, 12, and 24 months
	• Primary outcome: POP-related symptoms measured by the PFDI-20
	• Secondary outcomes: condition-specific and general quality of life measured by the PFIQ-7 and MOS-SF-12, sexual function measured by the PISQ-12, POP-Q stage, pelvic floor muscle function, post-void residual volume, patient's perception of improvement, and cost-effectiveness (utility via EQ-5D)
	• Results: not yet available

Strengths & Limitations	Strengths: • Target number of patients in each treatment group are achieved, giving sufficient power • Physiotherapists had to be registered with the Dutch Pelvic Physiotherapists' Organization (NVFB), which requires an extra 3 year training program Limitations: • Research physicians not blinded • Patients not blinded
Contribution of Evidence for Treatment of Prolapse	Results not available; may in the future provide evidence for choosing between watchful waiting, PFMT, or pessary treatment for improving symptoms of POP.

Literature Review: Intra-abdominal pressure with Lifting and Functional Activities

Lifestyle interventions and behavioral modifications, such as avoiding of heavy lifting, seek to avoid exacerbation of pelvic organ prolapse by decreasing intra-abdominal pressure (IAP), thereby lessening the downward pressure on the pelvic organs. Strenuous physical activity and lifting heavy weights has been linked to pelvic floor disorders and have been shown to increase IAP. A limited number of studies have looked at IAP during activity for women with pelvic floor dysfunction, specifically prolapse. Therefore, understanding what happens in healthy adults is a first step to patient education. This literature review includes 5 articles addressing IAP.

Physical therapy education should focus on modifying patient-specific activities to minimize IAP as a means for managing prolapse symptoms. Activity modifications could include, altering a patient's lifting strategy, by assessing their posture and breathing, or changing the quantity of weight being lifted in order to successfully maintain good form. This strategy focuses on how to do activities correctly rather than simply avoiding lifting altogether. Learning strategies to maintain proper technique, breathing correctly and striving for a biomechanically advantageous posture is important to learn during symptom-provoking activities.

Lifestyle interventions have been shown to be increasingly important in the treatment for Pelvic Organ Prolapse (POP). In a review of the International Consultation on Incontinence and POP the authors suggest that future research take into account the effects of lifestyle factors with the exact nature and timing of physical therapies. In a recent research article by Due lifestyle advice demonstrates significant improvement in the quality of life of patient s with POP.

Common abbreviations used within literature review:

BMI: Body Mass Index

IAP: intra-abdominal pressure

Mm Hg: millimeters of mercury; unit of pressure measurement

POP: pelvic organ prolapse

RCT: randomized control trial

Citation	Cobb W, Burns J, Kercher K, Matthews B, James Norton H, Todd Heniford B. Normal Intraabdominal Pressure in Healthy Adults. *Journal of Surgical Research*. 2005;129(2):231-235. doi:10.1016/j.jss.2005.06.015.
Link	http://www.ncbi.nlm.nih.gov/pubmed/16140336

Summary of Article	• This article reviewed mean intraabdominal pressure (IAP) for non-obese healthy adults doing 13 different functional tasks.
	• The purpose of the study was to link IAP for healthy individuals to precautions for critically ill patients.
	• The participants wore a transurethral bladder (Foley) catheter and performed a variety of tasks.
	• In 5 of the 13 tasks, participants with higher BMIs had higher mean IAP.
	• In the abdominal crunch, participants with higher BMIs had lower IAP readings. This could be explained if they had less abdominal muscle strength than participants with lower BMIs.
	• The highest IAP was during coughing and jumping.
	• Initial mean IAP from lowest to highest
	  ○ Supine 1.8 mmHg
	  ○ Sitting: 6.7mmHg
	  ○ Bench press 25lbs: 7.4 mmHg
	  ○ Bend at Waist: 14.4 mmHg
	  ○ Standing from a chair: 20.0 mmHg
	  ○ Bend at Knees: 20.6 mmHg
	  ○ Arm curl 10lb weight: 25.5 mmHg
	  ○ Abdominal Crunch: 26.7 mmHg
	  ○ Sitting Valsalva (straining with a closed epiglottis): 39.7 mmHg
	  ○ Standing Valsalva: 64.9 mmHg
	  ○ Stairs: 68.9 mmHg
	  ○ Sitting cough: 81.4 mmHg
	  ○ Standing cough: 107.6 mmHg
	  ○ Jumping: 171 mmHg

Strengths & Limitations	Strengths: • The study included both males and females. • The study looked for correlations between BMI and mean IAP. Limitations: • There were only 20 participants and they were age 30 or younger so the results of this study cannot be generalized to the whole population. • They did not have obese participants so findings suggesting that individuals with high BMIs have a greater increase in mean IAP doing functional activities cannot be applied to obese patients. • The measurements were taken in the urinary bladder so they may not reflect increases in pressure on the whole pelvic floor. • Patients with a POP should bend at the waist instead of bending at the knees

	to pick things up to reduce IAP.
Contribution of Evidence for Treatment of Prolapse	Patients with a diagnosis of POP or patients at risk for POP should avoid jumping and coughing to avoid increases in IAP. Treatment for POP may include connecting patients to resources to quit smoking, allergy medication, or an inhaler for asthma to reduce coughing. Sitting is a better option than standing for challenging physical activities that may increase IAP such as a cough.

Citation	Coleman T, Hamad N, Shaw J et al. Effects of walking speeds and carrying techniques on intra-abdominal pressure in women. *International Urogynecology Journal.* 2014;26(7):967-974. doi:10.1007/s00192-014-2593-5.
Link	http://www.ncbi.nlm.nih.gov/pubmed/25527480
Summary of Article	This article looked at the effect of walking speeds and increasing loads on mean intra-abdominal pressure (IAP) and area under the IAP curve (pressure as it relates to time). It measured healthy women with a wireless intravaginal pressure transducer. • **Walking speed**: The women self-regulated their walking speeds with instruction to walk slowly, normally, or quickly for 400 meters. Although intraabdominal pressures varied between participants, intra-abdominal pressures stayed relatively constant throughout the duration of the walk at a given speed. The mean maximum intraabdominal pressure for the participants increased with increased walking speeds. • **IAP During Different Carrying Techniques**

Carrying Technique	Description of body positon	Mean Max IAP in cmH2O
1. Double arm carry	Weight split between two grocery bags hanging from straight arms	54.0
2. Backpack	Weight carried in backpack	55.0
3. Combination Carry	Two bags, one on the hip in the dominant hand and one hanging in the non-dominant hand	55.9
4 A weight carried in a car seat (total weight 30lbs)	Weight held in the manner they normally would normally carry it	65.8
5 Side carry	All the weight held in the dominant hand resting on the hip	67.7
6 Front Carry	Carrying at waist level in front of the body	77.3

The double arm carry (1) had the lowest mean max IAP and lowest range of max IAP followed closely by carrying in a backpack (2) and combination carry (3). The side carry (5), front carry (6), and awkward carry (4), all had significantly higher max IAP. The uneven weight distribution in 4 and 5 were likely to require more trunk stability to support the spine resulting in an increase in IAP

Strengths & Limitations	Strengths: • The study randomized which participants started on a given trial to eliminate carryover if increased IAP after one task affected another task. Limitations: • All of the participants were healthy without pelvic floor dysfunction. • Participants who reported a vaginal bulge, were pregnant or were less than 6 months postpartum were excluded. • All the participants had a BMI between 19 and 30 kg/m2. Women with stress incontinence or pelvic organ prolapse are likely to have a risk factor such at a high BMI, pregnancy, and vaginal delivery. The results of this study may not reflect the population at risk for developing pelvic organ prolapse. • Only 49 women were enrolled and only 46 completed the exercise session. • The study did not look at test-retest reliability for IAP. • Seventy-eight percent of the participants were nulliparous so carrying a car seat was likely to be a novel task. • The change in IAP may not indicate the IAP for women who regularly carry car seats and have found efficient techniques.
Contribution of Evidence for Treatment of Prolapse	Although all the IAP for all of the activities were lower than coughing they were sustained for a long duration of time. Additionally, walking and carrying are functional activities women are likely to do often. The 30lb weight was chosen because it is comparable to the weight of a toddler and a car seat. Women diagnosed with POP or at risk for POP should be advised to walk slowly and carry their children, groceries, or other objects split evenly between two bags or in a backpack.

Citation	De Keulenaer B, De Waele J, Powell B, Malbrain M. What is normal Intra-abdominal pressure and how is it affected by positioning, body mass and positive end-expiratory pressure? *Intensive Care Med*. 2009;35(6):969-976. doi:10.1007/s00134-009-1445-0
Link	http://www.ncbi.nlm.nih.gov/pubmed/19242675
Summary of Article	This literature review considered articles establishing normal IAP in different body positions from January 1966–June 2007. The purpose was to help avoid abdominal hypertension and abdominal compartment syndrome. • **Elevated Head of Bed**: In the hospital the head of the hospital bed is usually elevated 30-45 degrees to avoid ventilator associated pneumonia and pressure ulcers. Studies found that intraabdominal pressure increases proportionally as the head of the bed is raised to increasing elevations. At the normal 30-45 degree head of bed elevation normal IAP is between 4-9 mmHg. The effect of the incline of the head of the bed was more significant for patients with higher BMIs. If patient's IAP is measured in supine and then they spend their time with the head of the bed elevated their risks

	associated with elevated IAP may be underestimated. • **Prone**: Some studies showed that patients in prone have more pressure on their abdomen and subsequently an increased IAP. Other studies found no correlation between the prone position and IAP. The type of mattress seemed to be important because compression on the abdomen should be reduced to decrease IAP. • **Lateral semi-recumbent**: There is not research on the lateral semi-recumbent position and IAP so the authors did a small study with 10 patients. The IAP was higher in the lateral semi-recumbent position. • **IAP and high MBI**: Several studies have found a direct increase in mean IAP with larger BMIs. Mean IAP for obese patients is normally from 7-14 mmHg. IAP for the general population is usually from 5 to 7 mmHg.
Strengths & Limitations	Strengths: • This is a literature review with lots of evidence from many different studies. • All the studies reviewed used bladder pressure to measure IAP so the measurements from the different studies can be compared. Limitations: • This review assumes that the abdomen works as a hydraulic system without accounting for the shear deformation of the viscera. • The article is from 2009 and the most recent articles they examined were from 2007. There may be more comprehensive current research available now.
Contribution of Evidence for Treatment of Prolapse	Based on this literature review sitting with the head elevated and increased BMI can increase IAP. This review did not have enough conclusive evidence to make a recommendation about side-lying, prone positions or elevating the lower body higher than the head. More research is needed to understand the best positions for exercise.

Citation	Park H, Han D. The effect of the correlation between the contraction of the pelvic floor muscles and diaphragmatic motion during breathing. *J Phys Ther Sci*. 2015;27(7):2113-2115. doi:10.1589/jpts.27.2113.
Link	http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4540829/
Summary of Article	This article focuses on the way pelvic floor contraction works in conjunction with the diaphragm and abdominals during breathing in healthy adult women. A radiograph was used to look at the movement of diaphragm during breathing while participants contracted their pelvic floor muscles. During pelvic floor contraction, their diaphragm motion was reduced by 5.6cm. The reduced diaphragm motion observed can be accounted for because the pelvic floor muscles and abdominals have to relax to allow the diaphragm to lower during inspiration. As the abdominals and pelvic floor muscles contract during exhalation, they increase IAP and force the diaphragm up.

	The participants' forced vital capacity decreased slightly and their forced expiratory volume decreased significantly with a pelvic floor contraction because their lungs were unable to expand fully due to decreased diaphragm movement. Maximum voluntary ventilation is a measure of how long participants can sustain an exhalation; it is an important indicator of participants' abilities to maintain breathing during exercise. Maximum voluntary ventilation increased significantly with a PFM contraction. The increased pelvic floor contraction helped the participants push air out more efficiently.
Strengths & Limitations	Strengths: • They conducted three tests for each participant and found the average diaphragm movement. Limitations: • There were only 20 participants and all of them were college age females. • The researchers were unable to link their findings to clinical guidelines about when to instruct patients to relax or engage their pelvic floor during breathing.
Contribution of Evidence for Treatment of Prolapse	The pelvic floor muscles should be trained in coordination with the diaphragm and abdominals. The pelvic floor muscles are not used functionally in isolation. During exercise patients should engage their pelvic floors moderately during inhalation to improve their maximum voluntary ventilation. When patients have difficulty fully expanding their lungs during inspiration, they should be evaluated to see if they are contracting their pelvic floor excessively and limiting diaphragm movement.

Citation	Talasz H, Kremser C, Kofler M, Kalchschmid E, Lechleitner M, Rudisch A. Proof of concept: differential effects of Valsalva and straining maneuvers on the pelvic floor. *Eur J Obstet Gynecol Reprod Biol*. 2012;164(2):227-33.
Link	http://www.ncbi.nlm.nih.gov/pubmed/22771226
Summary of Article	This study design purpose was to show differentiation between the two maneuvers in healthy women, the Valsalva Maneuver (VM)and Strain Maneuver (SM) described in urogynecologic research. Four healthy women underwent MRI to assess cranio-caudal movements of the diaphragm and pelvic floor and of concomitant changes in abdominal muscle thickness and diameter during a VM and SM. During dynamic MRI the participants were cued without references to the abdominal wall or pelvic floor with these cues: (1) to "breathe forcefully three to four times within 10 s without accentuating inspiration or expiration" (2) to perform the VM described as follows: "take a breath, then close the

	mouth, pinch the nostrils with the thumb and the index finger, than blow air forcefully toward the blocked mouth and nostrils and direct the increasing pressure into the ears" (3) to perform the SM, described as follows: "take a breath, then contract the abdominal muscles and strain downwards with the intention to evacuate stool or urine". The VM reflects an expiratory pattern with diaphragm and pelvic floor elevation, whereas during SM the pelvic floor descends. In both positions increase in anterolateral abdominal muscle thickness was considered to reflect muscle contraction.
Strengths & Limitations	**Strengths:** Displacement of the PF was clearly visible with dynamic MRI. **Limitations:** MRI measurements were obtained from a small sample of four healthy women; all of whom were familiar with the breathing-dependent role of the PF. Further special MRI investigations in combination with electromyography and pressure recordings are therefore necessary to sufficiently delineate the complex role of the abdominal muscles, particularly in the SM.
Contribution of Evidence for Treatment of Prolapse	Teaching patients the difference between a Valsalva Maneuver and strain maneuver with activities that cause IAP is very applicable to patient with POP. Learning to use breathing with an exhale on effort and pelvic floor muscles in a coordinated manner protects the contracted and elevated PF against high IAP. All activities that provoke symptoms with POP should be evaluated for the patients breathing maneuver strategy.

Movement, Exercise and Breathing with Pelvic Floor Dysfunction (PFD)
A Literature Review

SUMMARY

This series of articles reviews the factors important in clinical application of breathing, Activities of Daily Living (ADL) and exercise prescription in women with Pelvic Floor Dysfunction (PFD). It reviews the often-quoted 1998 study regarding the "knack"—a motor planning task of precontracting the pelvic floor prior to symptom-provoking activities—as well as presenting newer terminology clarification of Valsalva versus Strain. We also look at studies that address pelvic floor activation or Intra-Abdominal Pressure (IAP) with functional activities and hypopressive exercise.

Undoubtedly, clinicians need to consider activities that significantly increase IAP when they prescribe exercises and return women with PFD and prolapse to active lifestyles. There is a lack of standardization of IAP measurement techniques, and the studies reviewed used different devices and pressure measurements, both of which make comparison difficult. Currently, the research acknowledges the high variability between individuals' mean maximal IAP during activity. Therefore, specific activity restrictions should not apply to all women. Women who are symptomatic with activities need individual assessment. Physical therapists are in a unique position to assess prolapse stages, evaluate pelvic floor and global muscle/joint function and movement patterns, and provide training in dynamic activities to improve functional performance.

Common abbreviations used within literature review:

BN: Bladder Neck
BMI: Body Mass Index
EMG: Electromyography
IAP: Intra-Abdominal Pressure
PFD: Pelvic Floor Dysfunction
PFM: Pelvic Floor Muscle
PFMT: pelvic floor muscle training
PFDI: Pelvic Floor Distress Inventory
PFIQ: Pelvic Floor Impact Questionnaire
POP: pelvic organ prolapse
POP-Q: Pelvic Organ Prolapse Quantification
PT: physical therapist
HRs-QOL: health related quality of life
RCT: randomized control trial
(S)UI: (stress) urinary incontinence

Citation	Miller, J. M., Ashton-Miller, J. A., & DeLancey, J. O. (1998). A pelvic muscle precontraction can reduce cough-related urine loss in selected women with mild SUI. *Journal of the American Geriatrics Society*, *46*(7), 870-874.
Link	https://www.ncbi.nlm.nih.gov/pubmed/9670874
Summary of Article	A prospective randomized single-blind intervention study of post-menopausal women with a mean age of 68. Measures gathered at baseline included a bladder diary, digital muscle test and a standing stress test (Paper Towel Test). The 27 women with SUI (not with prolapse below the hymeneal ring) were randomized into immediate skill intervention instruction or a wait-listed control group. The immediate intervention group received skill training they termed the Knack. The knack is described as "intentionally contracting the pelvic floor muscles just before (1 second in advance of the cough) and throughout the IAP rise associated with a cough." Urine leakage was measured with and without the use of the Knack during a deep and medium cough after one week of PFM instruction. Individual results showed that at 1-week follow-up, the Knack reduced urine loss resulting from a medium cough by an average of 98.2%, compared with that of a similar cough performed 1 minute before without the Knack (P =.009); likewise, urine loss was reduced by an average of 73.3% (P =.003) in a deep cough. No strength changes in the PFM were measured in the one week interim despite statistically significant reduction in urine loss which occurred with both types of cough.
Strengths & Limitations	**Strengths:** Study demonstrates the immediate effect on SUI of behavioral training/ lifestyle intervention utilizing a precontraction of the pelvic floor. **Limitations:** No direct measure of IAP during different types of cough was utilized. The volume of the urine in bladder was at least 100, but not controlled. Small sample size. No mention of posture or standing position variables. Study limited to postmenopausal women and those with prolapse above the hymenal ring.
Contribution of Evidence for Treatment of Prolapse	This is a classic, frequently referenced article describes pelvic floor motor control skill training "the Knack" benefit in reducing urine loss. The application of this first stage self-help behavioral/lifestyle intervention deserves application to all patients with PFD that demonstrate symptoms with activities that cause increases in IAP.

Citation	Hsu, Y., Hitchcock, R., Niederauer, S., Nygaard, I., Shaw, J., & Sheng, X. (2018). Variables Affecting Intra-abdominal Pressure During Lifting in the Early Postpartum Period. Female Pelvic Medicine & Reconstructive Surgery, 24(4)287-291
Link	https://www.ncbi.nlm.nih.gov/pubmed/28727649
Summary of Article	An observation ancillary study with 206 postpartum women, mean age 27.38 years, drawn from an ongoing prospective study that is following nulliparous women from third trimester to 1 year postpartum. The subjects were 6-10 weeks post vaginal delivery. The aim of the study is to determine different factors that may affect maximal IAP during lifting. Height, weight, BMI, weight gain during pregnancy, waist circumference, pelvic floor muscle strength, abdominal muscle endurance, time to complete lifting task, breath holding, and lifting technique (bent vs straight knee) measurements were taken during study visit. IAP was measured with a wireless transducer (developed and validated by the authors) placed in the upper 1/3 of the vagina while lifting 12.5 kg (based on average car seat weight of 6.8 kg and infant weight at 10 weeks of 5.7 kg) three times. Mean maximal IAP (cmH_2O) was defined as the average of 5 highest "peaks" recorded during lifting task of at least 1 second apart. No instructions were given on how to lift or how to breathe (goal was to observe patient own technique), though women reported whether breath holding occurred during lifts. Results show that: • Max IAP was positively associated with weight, waist circumference, BMI, and duration of lifting task • Height was negatively associated with maximal IAP • Weight gain during pregnancy, leg position with lifting, breath holding, pelvic floor strength and abdominal muscle endurance was not associated with mean maximal IAP. Though the authors found positive IAP association between body habitus (weight, BMI, waist circumference) and duration of lifting, but the results show weak correlations between these variables. No other modifiable factors were found to affect maximal IAP during this early postpartum period. Lifting technique and breath holding did not affect IAP.
Strengths & Limitations	**Strengths**: Large number of cohorts in their early postpartum period. **Limitations:** There may be confounding variables that the authors fail to account such as fatigue with task. IAP increase measurements during the study were limited to a short duration, which may not be generalizable to daily activities. The technique of breath holding was not identified as a Valsalva or Strain maneuver. See Baessler, et al article below.

Contribution of Evidence for Treatment of Prolapse	The authors acknowledged the high variability between individuals' mean maximal IAP and were not able to find modifiable factors that could affect the IAP during this early postpartum period. Clinically, women with higher body habitus may benefit from training in IAP management. The fact that and the lack of instruction of how to lift did not affect the IAP negatively may reflect the subject's ability to accommodations to an activity style that minimizes symptoms. Results from the parent research study (projected completion in 2019-2020) may provide information about IAP factors as predictive of pelvic floor health at 1 year postpartum.
Citation	Baessler, K., Metz, M., & Junginger, B. (2017). Valsalva versus straining: There is a distinct difference in resulting bladder neck and puborectalis muscle position. Neurourology and Urodynamics, 36(7), 1860-1866.
Link	https://www.ncbi.nlm.nih.gov/pubmed/28139845
Summary of Article	An RCT of 85 incontinent women (mean age 48) and 17 continent women (mean age 33) designed to assess the difference between Valsalva maneuver and straining on bladder neck stiffness and PFM activation in these two types of population. Measurements were done in standing. A dual tip Microtip transducer (10 Char) was inserted urethrally and orientated laterally measuring urethral and vesical (abdominal) pressures. To record PF muscle EMG activity, a surface electrode attached to a sponge (Disposable Vaginal Surface Electrode, Mediwatch UK). PFM position and movement was assessed with perineal ultrasound. Abdominal pressure, BN, and PFM position and PFM EMG activity were measured in upright position with legs slightly apart for placement of ultrasound probe. Tasks were performed in a specific order without repetition and stopped once a plateau of increased abdominal pressure was reached and visible on the screen. Valsalva was instructed to be performed against a closed mouth and glottis and digitally obstructed nose as if equalizing pressure in an aircraft. No instructions were given on length/effort of Valsalva. For straining, women were instructed to relax the PF and strain or push as if defecating. Straining was instructed to keep tasks as spontaneous as possible and avoid fainting. Assessors were blinded of continent status and performed analyses of measurements offline. Results are as follows: • During the start of Valsalva, increase in PFM EMG was observed in 71% of healthy and 76% of incontinent women (P = 0.607 between groups) • During Valsalva, PFM relaxation was visible 0% of healthy and 2.4% of incontinent women ((P = 0.523 between groups) • PFM activation (ventrocranial movement of the PR muscle) 53% in healthy and 38% incontinent women (P = 0.38)

<table>
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During straining, PFM relaxation on perineal ultrasound found in 59% healthy and 61% in incontinent women (P = 0.856 between groups)
During straining, PFM activation on EMG was 29% in healthy and 32% in incontinent women (P = 0.849 between groups)
PR muscle was significantly stiffer with Valsalva (distance of PR muscle to pubic symphysis was significantly shorter compared to straining)
BN and PR muscle descend was observed more with straining.

Results show that Valsalva maneuver is more associated with better BN support and stiffer PF whereas straining leads to descent of PF and BN.
</td></tr>
<tr><td>Strengths & Limitations</td><td>Strengths: This study contains validated concurrent measurements in a functional standing position.
Limitations: Straining and Valsalva efforts were not completely standardized, measuring process was not blinded, only one set of testing was performed, and the vaginal sponge EMG electrode placed may have moved during investigations. Smaller sample size without patients with pelvic organ prolapse.</td></tr>
<tr><td>Contribution of Evidence for Treatment of Prolapse</td><td>This research demonstrates that there is a difference between Valsalva maneuver and straining, so these terms should not be used interchangeably. These are two different PF activation patterns. Clinicians need to be accurate when providing education and instructions to patients during pelvic floor examination, documentation and with functional tasks.</td></tr>
<tr><td>Citation</td><td>Tian, T., Kruger, J., Budgett, S., Smalldridge, J., Hayward, L., & Stinear, J. (2017). Assessing exercises recommended for women at risk of pelvic floor disorders using multivariate statistical techniques. International Urogynecology Journal, 1-8.</td></tr>
<tr><td>Link</td><td>https://www.ncbi.nlm.nih.gov/pubmed/28905083</td></tr>
<tr><td>Summary of Article</td><td>A cross-sectional cohort study of 53 postpartum participants with median age of 39 years, mean BMI of 25.8 kg/m^2. This study measured IAPs with a self-inserted wireless intravaginal sensor and compared IAP during two versions of the same exercise (recommended vs discouraged). Classification of exercises were taken from the recommendations of the International Urogynecological Association and Australia's Pelvic Floor First Initiative. Exercises performed were as follows:

<table>
<tr><th>Exercise Type</th><th colspan="2">Exercise Version</th></tr>
<tr><td></td><td>Discouraged</td><td>Recommended</td></tr>
<tr><td>Ball rotations</td><td>With feet off the floor</td><td>With feet on the floor</td></tr>
<tr><td>Lunges</td><td>With weights</td><td>Narrow lunges</td></tr>
<tr><td>Core Training</td><td>Curl-ups, on mat with knees bent</td><td>On all fours, lifting arm and opposite leg</td></tr>
<tr><td>Push-ups</td><td>Full push-ups</td><td>Wall push-ups</td></tr>
</table>
</td></tr>
</table>

	Squats	Wide squats	Narrow squats
	Plank	Full plank	Modified plank
	Cycling	Standing	Seated
	Step-ups	High (41 cm)	Low (21 cm)
	Shoulder-presses with dumbbells	With squats	Seated on Swiss ball
	Cardiovascular	Running (7 km/h)	Walking (4 km/h)
	IAP was analyzed with several components of the pressure trace in kPa (mean pressure, maximum peak pressure, maximum pressure amplitude, and mean rate of pressure increase). Results show no IAP difference detected between the recommended and discouraged versions for ball rotations, lunges, core, push-ups, and squats *(p>0.05).* However, there was a statistically significant difference with plank, cycling, step-ups, shoulder-presses, and cardiovascular exercises *(p=0.01).* The authors concluded these differences related to the degree of core stability required to perform the discouraged versions of the exercise.		
Strengths & Limitations	**Strengths:** The specifically designed wireless intravaginal pressure sensor that enabled measurements of IAP during exercise without restrictions. Multivariate statistical analysis was also used that included analysis of components of the pressure trace. The inclusion criteria were broad, making results to be more generalizable. **Limitations:** The level of fitness of each participant varies and could affect the way exercises were performed, their breathing pattern, and generation of IAP. No specific instructions to breathe or how to perform exercises were given to participants. In the conclusion, the authors emphasized the exercises that did not cause changes but did not elaborate on the positive findings.		
Contribution of Evidence for Treatment of Prolapse	Performing recommended instead of conventional exercise may not necessarily protect the pelvic floor as believed and vice versa. Using the terms recommended or safe may limit women from activities that they can do without increase in symptoms or stage of POP. Instructions of how to breathe and biomechanically perform exercises should be individually addressed, otherwise we may be unnecessarily limiting woman's ability to be active. The study also gives insights on activities that may need closer monitoring and patient specific training including plank, cycling, step-ups, shoulder-presses performed with squats, and cardiovascular exercises.		
Citation	Yamasato, K. S., Oyama, I. A., & Kaneshiro, B. (2014). Intraabdominal pressure with pelvic floor dysfunction: do postoperative restrictions make sense?. The Journal of reproductive medicine, 59(7-8), 409-413.		
Link	http://europepmc.org/abstract/med/25098032		
Summary Of Article	The aim of this prospective study of 147 patients with mean age of 57 years is to compare IAP during various physical activities including (1) standing up from a chair, (2) coughing once, (3) lifting 10 lb (4.54 kg), (4) lifting 20 lb		

	(9.07 kg), and (5) pushing 20 lb (9.07 kg) in women with pelvic floor dysfunction. Measurements were taken after urodynamic testing using the vaginal pressure catheter (cm H_2O) to measure IAP during the above tasks. Age, height, weight, indication for urodynamic testing, and degree of POP were also taken for each subject. Results show significantly less IAP with lifting 10 lb than standing up and coughing ($P<0.001$ for both), and no significant difference when compared to pushing 20 lb ($p=0.611$). Even when compared to lifting 20 lb, standing up and coughing consistently generated significantly higher IAP ($p<0.001$). Subjects with higher BMI was also associated with higher IAP generated. Older age (70-89 years) generated significantly less IAP than those <70 years old ($p=0.01$). IAP did not differ with presence of POP for any of the activities.
Strengths & Limitations	**Strengths:** Small exclusion criteria, enabling good variety in the sample. Measurements were taken preoperatively which can be applicable postoperatively, but may not represent patient task performance after surgery. **Limitations:** Contributing/conflicting factors such as degree of POP, history of pelvic surgery, menopausal status, and parity were not taken into account that may have affected the outcomes of the study. Activities were also done in the same order, which may have affected subsequent IAP generation. Study sample was small and outcomes were primarily descriptive.
Contribution of Evidence for Treatment of Prolapse	Findings that coughing and standing generated greater IAP than the usually restricted lifting of 20 pounds has implications for post-surgical activities. Cough and sit to stand training may be valuable education to control IAPs in patients with PFM disorders. The authors also suggest the potential association of chronic coughing with poorer surgical outcomes, though this has yet to be studied. Cough and sit to stand training may be valuable education to control IAPs in patients with PFM disorders, thus decreasing PF tension and POP symptoms.
Citation	Ithamar, De Moura Filho, Benedetti Rodrigues, Duque Cortez, Machado, De Paiva Lima, Lemos. (2018). Abdominal and pelvic floor electromyographic analysis during abdominal hypopressive gymnastics. Journal of Bodywork & Movement Therapies, 22(1), 159-165.
Link	https://www.sciencedirect.com/science/article/pii/S1360859217301353
Summary of Article	An observational study of 30 nulliparous women with mean age of 25.77 years and BMI of 21.11kg/m^2. The aim of the study is to determine whether abdominal hypopressive gymnastics (AHG) can promote abdominal and PFM activation. All participants received AHG training a week before data collection. Instructions to AHG were as follows: 1. Start with costal breathing, raising the lower ribs, then total expiration 2. Expiratory apnea and, with the glottis closed, contract accessory inspiratory muscles (serratus anterior, intercostals, scalenes and sternocleidomastoid) to expand and raise rib cage These were analyzed in orthostatic (upright standing), quadruped, and supine position. Surface EMG with analog/digital (A/D) converter to

	measure muscle activation: rectus abdominis (RA), external oblique (EO), and grouped transverse abdominal and internal oblique (TrA/IO) muscles. Self-inserted intravaginal probe was used to assess PFM. Maximum voluntary contraction (MVC) for each muscle was recorded prior to registering EMG signal during AHG. Each muscle's normalized MVC were performed in supine position and determined as follows: 1. RA: trunk flexion 2. EO: contralateral trunk rotation 3. TrA: abdominal retraction maneuver, bringing navel towards spine 4. PFM: contract PFM with instruction, "Pull up and in, and squeeze around the probe" MVC for AHG was then measured in supine, quadruped, and orthostatic position with the order randomized. Results show that TrA/IO and PFM showed higher activation percentages in all position assessed followed by EO and RA muscles during AHG. Abdominal and PFM recruitment showed small variations between the positions analyzed, with no statistically difference between muscle activation amplitude in supine, sitting, and orthostatic positions therefore indicating that gravity did not affect capacity of PFM to activate with hypopressive technique.
Strengths & Limitations	**Strengths:** Looked at muscle activation for AHG in different positions. AHG training was given to each participant prior to measurements. **Limitations:** This study only used healthy, nulliparous women, who may not be generalizable to those with PF dysfunction. Although participants received training a week before data collection, there is no mention of length and duration of the training. The type of EMG recordings obtained precluded an assessment of response time between the muscles evaluated making it impossible to confirm or determine the temporal sequence of recruitment of these muscles during AHG. Although not the aim of the study there was IAP measurement to verify the low-pressure status.
Contribution of Evidence for Treatment of Prolapse	AHG is also called low pressure fitness is capable of activating TrA/IO and PFM muscles. Baessler et al 2017 showed PF activation with closed glottis maneuvers that are similar to the breathing taught in this technique. The multiple steps required in this technique may limit functional use while helping the patient with breath strategies and neuromuscular reeducation. The use of this technique is still limited because of the advanced training needed for practitioners to teach correct performance.

Pelvic Organ Prolapse

Pelvic organ prolapse (POP) is a common condition, affecting ~50% of parous women[1]. It is characterized by a variety of pelvic floor symptoms, including, feeling of a lump, bulge or dragging sensation in the vagina. The condition of POP also can cause changes in urinary function, bowel function, and discomfort during intercourse[2]. These symptoms can be debilitating and women can be left feeling confused, embarrassed, or isolated - feeling as though they cannot do anything, as if every move is going to make her organs fall out. Unfortunately, patients with POP commonly receive conflicting messages from their providers regarding care and management, and often the primary solution offered to them is surgical intervention. Web-based information regarding treatment for POP is incomplete and largely biased toward surgical treatment[3].

Specifically, physical therapists specializing in women's health and pelvic floor dysfunction will evaluate your structural foundation (muscles, fascia and ligament integrity) and posture. As a physical therapist, I am able to provide an individualized evaluation and educational information. The evaluation includes an exam of the musculoskeletal, visceral systems and the pelvic floor musculature. The exam leads to the selection of the most appropriate therapeutic exercise, reeducation of movement patterns and motor planning for activities that are most bothersome to you. Patient education includes lifestyle and behavioral interventions. We can teach patients appropriate exercises to help strengthen or release the muscles needed for organ support. We problem solve to find strategies or solutions that decrease downward pressure (intra-abdominal pressure, abbreviated IAP) on the prolapsed area. Proper education and activity training is key to empowering women with POP to live without fear of movement and to return to exercise.

1. Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2011;(12):CD003882. doi:10.1002/14651858.CD003882.pub4.
2. Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th international consultation on incontinence. *Neurourol Urodyn*. 2014:n/a - n/a. doi:10.1002/nau.22677.
3. Kakos AB, Lovejoy DA, Whiteside JL. Quality of information on pelvic organ prolapse on the Internet. *Int Urogynecology J*. 2015;26(4):551-555. doi:10.1007/s00192-014-2538-z.

Literature Review for Lifestyle & Behavior Interventions for Pelvic Organ Prolapse

This review is a summary of the published articles pertaining to lifestyle interventions and behavioral modifications for pelvic organ prolapse. Preliminary evidence for physical therapy efficacy is found in the literature surrounding non-surgical, conservative interventions for POP, such as pelvic floor muscle training, mechanical interventions (pessaries), and lifestyle interventions and behavioral modifications.

The literature and information regarding surgical intervention for pelvic organ prolapse is extensive; to the contrary, there is an overall lack of information related to physical therapy interventions for pelvic organ prolapse (POP). Surgery is frequently recommended to women. After surgery, prolapse can reoccur in up to 58% of women, particularly for younger women and women with more advanced prolapse[1]. Approximately one-third of women who have had surgery undergo at least 1 more surgical repair[2]. Complications are possible with prolapse surgery, especially after mesh implants[3,4], and it is not recommended for the frail or those who wish to have more children[5,6]. This emphasizes the need for nonsurgical prevention and treatment of prolapse.

KEY POINTS

The main risk factors for developing pelvic organ prolapse are age and parity as well as a family history of prolapse. Additional factors that can play a role in worsening POP symptoms include obesity, heavy lifting, smoking (chronic coughing), constipation, and occupations requiring increased physical activity. However there is no research that pertains to motor planning during heavy lifting and monitoring associated intra-abdominal pressure changes. Further research is also needed to determine the relationship and influence between hormonal status of the breasting feeding and post-menopausal woman on POP.

Lifestyle interventions and behavioral modifications, such as weight loss and avoidance of heavy lifting, seek to avoid exacerbation of pelvic organ prolapse by decreasing intra-abdominal pressure (IAP), thereby lessening the downward pressure on the prolapsed area. Strenuous physical activity and lifting heavy weights has been linked to pelvic floor disorders and have been shown to increase IAP. A limited number of studies have looked at IAP during activity for women with pelvic floor dysfunction, specifically prolapse.

Physical therapy education should focus on modifying patient-specific activities to minimize IAP as a means for managing prolapse symptoms. Activity modifications could include, altering a patient's lifting strategy, by assessing their posture and breathing, or changing the quantity of weight being lifted in order to successfully maintain good form. This focuses on how to do activities correctly rather than simply avoiding lifting altogether. Maintaining proper technique, breathing correctly and striving for a biomechanically advantageous posture during symptom-provoking activities and behaviors can be done with or without additional support from a pessary. Even if surgical management is selected, this lifestyle advice should be adhered to post-operatively to enhance long-term success[8].

Additionally, pelvic floor muscle training has been shown to be effective in conjunction with lifestyle modifications for treating pelvic organ prolapse. The next literature review will address *PT Exercise Interventions for Prolapse.*

1. Whiteside JL, Weber AM, Meyn LA, Walters MD. Risk factors for prolapse recurrence after vaginal repair. *Am J Obstet Gynecol*. 2004;191(5):1533-1538. doi:10.1016/j.ajog.2004.06.109.
2. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol*. 1997;89(4):501-506. doi:10.1016/S0029-7844(97)00058-6.
3. de Tayrac R, Sentilhes L. Complications of pelvic organ prolapse surgery and methods of prevention. *Int Urogynecology J*. 2013;24(11):1859-1872. doi:10.1007/s00192-013-2177-9.
4. Maher C, Feiner B, Baessler K, Schmid C. Surgical management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2013;4:CD004014. doi:10.1002/14651858.CD004014.pub5.
5. Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th international consultation on incontinence. *Neurourol Urodyn*. 2014:n/a - n/a. doi:10.1002/nau.22677.
6. Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2011;(12):CD003882. doi:10.1002/14651858.CD003882.pub4.
7. Ali-Ross NS, Smith ARB, Hosker G. The effect of physical activity on pelvic organ prolapse. *BJOG Int J Obstet Gynaecol*. 2009;116(6):824-828. doi:10.1111/j.1471-0528.2009.02112.x.
8. Hagen S, Thakar R. Conservative management of pelvic organ prolapse. *Obstet Gynaecol Reprod Med*. 2012;22(5):118-122. doi:10.1016/j.ogrm.2012.02.003.

This literature review includes 13 articles addressing lifestyle interventions and behavioral modifications in relation to pelvic organ prolapse.

Common abbreviations used within literature review:

ACSM: American College of Sports Medicine

HADS: Hospital Anxiety and Depression Scale

HE: hypopressive exercises

IAP: intra-abdominal pressure

MOS-SF-12: Medical Outcomes Study Short Form Health Survey-12

MVC: maximal voluntary contraction

PFMT: pelvic floor muscle training

PFDI: Pelvic Floor Distress Inventory

PFIQ: Pelvic Floor Impact Questionnaire

PISQ-12: Pelvic Organ Prolapse/ Urinary Incontinence Sexual Questionnaire

POP: pelvic organ prolapse

POP-Q: Pelvic Organ Prolapse Quantification

POP-SS: Pelvic Organ Prolapse Symptom Score

PT: physical therapist

QOL: quality of life

RCT: randomized control trial

(S)UI: (stress) urinary incontinence

VAS: Visual Analog Scale

Citation	Christensen ST, Hartvigsen J. Spinal curves and health: a systematic critical review of the epidemiological literature dealing with associations between sagittal spinal curves and health. *J Manipulative Physiol Ther*. 2008;31(9):690-714.
Link	http://www.ncbi.nlm.nih.gov/pubmed/19028253

Summary of Article	• The objective of this systematic critical literature review of epidemiological studies published before 2008 was to determine whether sagittal spinal curves are associated with health, estimate the strength of such associations, and consider whether these relations are likely to be causal
	  ○ 54 original studies were included, 36 identified through electronic searches and 18 after screening of reference lists
	• Results: no strong evidence for an association between sagittal spinal curves and any health outcomes
	  ○ Moderate evidence for an association between sagittal spinal curves and 4 health outcomes: temporomandibular disorders, pelvic organ prolapse, daily function, and death
	  ○ Studies were generally of low methodological quality

Strengths & Limitations	Strengths: • Included cross-sectional, case-control, and cohort studies • Clear search strategies described • Checklist was used for abstraction of core information from each article, which the 2 authors completed independently and discrepancies were resolved by discussion Limitations: • Only included reports that were written in English
Contribution of Evidence for Treatment of Prolapse	Moderate evidence for an association between sagittal spinal curves and pelvic organ prolapse was found, however this association was likely to be causal according to the authors. Further research of better methodological quality is needed to truly determine this effect.

Citation	Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th international consultation on incontinence. *Neurourol Urodyn*. 2014[Epub ahead of print].
Link	http://www.ncbi.nlm.nih.gov/pubmed/25400065

Summary Of Article	• Highlights and new evidence on conservative management of UI and POP are presented and reviewed in this paper from the 5th International Consultation on Incontinence (ICI)
	  ○ The previous review published in 2008 was used as a baseline
	  ○ An update literature search of randomized controlled trials on female conservative management was conducted from Jan. 2008 to Aug. 2012
	  ○ A brief description is followed by the state of the science, level of evidence, and grade of recommendation
	• Primary outcome of interest: individual's subjective report of UI

	• Secondary outcomes: UI-specific QOL questionnaires, symptom severity, and objective measurements
	• Results/Recommendations for Conservative Management of POP:
	  ○ Lifestyle Interventions
	  ▪ Include weight loss, reducing activities that strain the pelvic floor, and treating constipation; goal is to avoid further exacerbation by decreasing intra-abdominal pressure
	  ▪ Being overweight or engaging in occupations involving heavy lifting may play a role in POP (Level 3)
	  ▪ No studies identified that evaluate the effectiveness of lifestyle interventions in the treatment of women with POP
	  ○ Physical Therapy
	  ▪ No evidence from intervention studies in preventing POP (1 trial underway)
	  ▪ Based on observational studies, better PFM function may be associated with lower risk of POP (Level 3)
	  ▪ PFMT may improve symptoms of POP and the anatomical defects (Level 1)
	  ▪ Recommendation: PFMT can improve POP symptoms and reduce the severity (Grade A)
	  ○ Pessaries
	  ▪ Large number of observational studies, 2 RCTs
	  ▪ Clinically significant improvements in the majority of symptoms as well as QOL scales for both types of pessaries; no significant differences between Gellhorn and the ring with support (Level 2)
	  ▪ Recommendation: either pessary may improve POP symptoms and reduce the impact (Grade B)

Strengths & Limitations	Strengths: • Summary of the literature up to August 2012 • Extensive suggestions for areas for future research Limitations: • None noted
Contribution of Evidence for Treatment of Prolapse	New evidence supports the effectiveness of implementing PFMT and physical therapy in the treatment of POP. An association between a women's employment in heavy occupational lifting and POP were found as well as an association between POP and bodyweight. More research is needed in the prevention of female POP.

Citation	Gerten KA, Richter HE, Wheeler TL, et al. Intraabdominal pressure changes associated with lifting: implications for postoperative activity restrictions. *Am J Obstet Gynecol*. 2008;198(3):306.e1-306.e5.
Link	http://www.ajog.org/article/S0002-9378(07)01103-9/abstract

Summary Of Article	• This study sought to understand potential causes and prevent recurrence after surgical intervention POP
	  ○ 41 women (19-65 years of age) who were being seen for urodynamic studies as part of their evaluation of UI and/or POP performed 4 separate lifting maneuvers with 0, 2.5, 5, 10, and 15kg; each combination was repeated twice
	  ▪ Maneuver A (Squat): rising from a squatting position, flexing at the knees with a straight back while bringing the weight up to the level of the xiphoid bone
	  ▪ Maneuver B (Squat Assist): same as maneuver A with the addition of the subject's placing 1 hand on a hip-high counter to assist
	  ▪ Maneuver C (Counter): lifted weight off a hip-high countertop
	  ▪ Maneuver D (Receive): received the weight into slightly bent outstretched arms while standing
	• Outcome measures: validated pelvic floor symptoms questionnaire, POP stage measured using the POP-Q, pelvic floor muscle strength assessed with digital palpation, IAP recorded with a transrectal microtip catheter
	• Results: a significant interaction between weight quantity and lift maneuver was found such that the relationship between weight lifted and IAP depended on the specific maneuver that was performed
	  ○ Regardless of maneuver, increasing weight lifted produced higher IAPs
	  ○ Receiving the weight generated the smallest increases in IAP
	  ○ Squat lifting produced the highest increases in IAP
	  ○ BMI, height, and weight were not significant determinants of IAP
	  ○ Larger waist-to-hip ratios were associated with higher IAP

Strengths & Limitations	Strengths: • Controlled manner in which the weights were lifted • Maneuvers designed in accordance with functional application • Appropriate statistical correction method was used • Studying women with pelvic floor disorders is advantageous as the results should then be generalizable to this population of women Limitations: • Subjects were being seen for care of existing pelvic floor disorders, which could have affected IAP measurement
Contribution of Evidence for Treatment of Prolapse	This study found that regardless of lifting technique, IAP significantly increased with increasing weight lifted. Receiving the weight generated the smallest increases in IAP, whereas squat lifting produced the highest increases – squatting without any weight generated more IAP than lifting 10kg off a counter or

	receiving 15kg into outstretched arms. When treating a patient with POP, this study suggests that the patient should be educated on both lifting techniques and quantity of weight to minimize increases in IAP. Furthermore, this study highlights the need for consistent postoperative active restrictions among surgeons.

Citation	Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2011;(12):CD003882.
Link	http://www.ncbi.nlm.nih.gov/pubmed/22161382

Summary Of Article	• Update of a Cochrane review first published in 2004, previously updated in 2006, to determine the effectiveness of conservative management for preventing and treating POP in comparison with no treatment or other treatment options
	• Selection criteria: only randomized and quasi-randomized trials in women with POP that included a physical or lifestyle intervention in at least one arm of the trial
	• Main results: 6 trials included, 3 new to update
	  ○ Greater improvement in the PFMT group compared to the control group (4 trials, significant risk for bias in 2/4 trials)
	  ○ PFMT supplementing surgery versus surgery alone findings differed between trials (2 small trials, neither measured prolapse-specific symptoms)
	  ○ Insufficient evidence regarding other lifestyle changes (for example, avoiding lifting or losing weight)

Strengths & Limitations	Strengths: • Two reviewers assessed all trials for in-/exclusion and methodological quality • Data was cross checked Limitations: • 4 small trials (<25 women per arm), 2 had moderate to high risk of bias
Contribution of Evidence for Treatment of Prolapse	There is now some evidence that supports the effectiveness of PFMT for improving prolapse symptoms and severity. Further studies are needed to analyze long-term effects of PFMT as well as determining cost-effectiveness; large RCTs looking at PFMT supplementing surgery is needed to determine usefulness of combining these treatments. Future areas of research include assessing lifestyle change interventions and prolapse prevention.

Citation	Hagen S, Thakar R. Conservative management of pelvic organ prolapse. *Obstet Gynaecol Reprod Med*. 2012;22(5):118-122.
Link	http://www.sciencedirect.com/science/article/pii/S1751721412000346
Summary Of Article	• This article describes conservative approaches to the treatment of POP • Lifestyle interventions: "seek to avoid exacerbation of POP by decreasing intra-abdominal pressure", effectiveness unknown without any RCTs ○ Observational studies have found associations between POP and heavy

	lifting, being overweight, and constipation ○ Notably, the studies have found an association of lifestyle factors and symptoms of prolapse, but not an association with anatomical severity • PFMT: may improve the structural support for the pelvic organs by improving functional strength, co-ordination, and endurance of the pelvic floor muscles; growing evidence in support of the effectiveness of PFMT including two full-sized trials (Braekken et al. 2011, Hagen et al. 2011) ○ There are no studies looking at the effectiveness of the Knack for POP • Pessaries: most commonly used to support and reposition prolapsed pelvic organs; shown to be largely successful, a RCT found no difference between types in symptom relief ○ Two types: Support (e.g. ring, Gehrung) & Space-filling (e.g. Gellhorn, Cube, Donut, Inflatoball)
Strengths & Limitations	Strengths: • Very clear layout Limitations: • No in-text citations are given • Risk of author bias
Contribution of Evidence for Treatment of Prolapse	Recommendations • *Lifestyle Changes* to reduce IAP to ease the downward pressure on the prolapsed area: avoiding constipation via diet and fluid adjustments or use of medication, altering lifting habits (e.g. lift multiple small weights rather than single large weights), altering exercise from high impact to low or no impact, losing weight, smoking cessation, and avoiding bladder irritants such as caffeine • *PFMT*: a first option to treat prolapse symptoms • *Pessaries*: safe, simple, inexpensive non-surgical option for managing POP

Citation	Hendrix SL, Clark A, Nygaard I, Aragaki A, Barnabei V, McTiernan A. Pelvic organ prolapse in the women's health initiative: Gravity and gravidity. *Am J Obstet Gynecol*. 2002;186(6):1160-1166.
Link	http://www.ncbi.nlm.nih.gov/pubmed/12066091
Summary of Article	• The objective of this cross-sectional analysis of women who enrolled in the Women's Health Initiative (WHI) Hormone Replacement Therapy Clinical Trial (n = 27,342) was to describe the prevalence of and correlates for pelvic organ prolapse ○ Eligibility criteria included: postmenopausal, unlikely to move or die within 3 years, not currently using hormone replacement, not participating in any other clinical trials • Outcome measures: baseline questionnaires ascertained demographics and personal habits; visual pelvic examination to assess uterine prolapse, cystocele, and rectocele

	○ Descriptive statistics and logistic regression models were used to investigate factors that were associated with POP • Results: African American women had the lowest risk for any form of POP; Hispanic women had the highest risk for uterine prolapse, increased risk for cystocele, but not rectocele; Asian women had the highest risk of cystocele and rectocele, but not uterine prolapse ○ Prevalence in women with a uterus (n = 16,616): 41.1% ▪ 14.2% uterine prolapse, 34.3% cystocele, 18.6% rectocele ○ Prevalence in women who had hysterectomy (n = 10,727): ~38% ▪ 32.9% cystocele, 18.3% rectocele ○ Parity and obesity were strongly associated with increased risk ○ Current smoking and increasing alcohol intake were associated with lower risk ○ Minimal or no association of POP was found with education, occupation, overall QOL, chronic illnesses, time since menopause, breast-feeding, duration of hormone use, hysterectomy status, past smoking, coffee consumption, and physical activity (episodes per week)
Strengths & Limitations	Strengths: • Large population • WHI clinic gynecologist certified the persons performing the pelvic examinations to ensure proper performance Limitations: • With the exception of hysterectomy, previous therapy for POP, which included surgery, was not ascertained • Grade of prolapse was not differentiated • Physical activity determined by episodes per week, no other details included • This study was not designed to determine risk factors for POP, but to evaluate the effects of hormone replacement therapy on the prevalence of and correlates for pelvic organ prolapse • Different examiners performed the examinations • Interexaminer reliability was not assessed and may bias the results • Neither a split speculum examination nor POP-Q grading system was used • Data are cross-sectional and thus cause and effect cannot be determined, only associations can be identified
Contribution of Evidence for Treatment of Prolapse	This study adds a dimension about the prevalence and ethnic variation for pelvic organ prolapse in its various forms, which could have implications in screening patients with different ethnic backgrounds. Pelvic organ prolapse was found to affect more than one third of the women in this trial; however previous therapy for POP was not examined and thus there is potential for improvement with intervention.

Citation	Lind LR, Lucente V, Kohn N. Thoracic kyphosis and the prevalence of advanced

	uterine prolapse. *Obstet Gynecol*. 1996;87(4):605-609.
Link	http://www.ncbi.nlm.nih.gov/pubmed/8602316

Summary of Article	• The objective of this retrospective case-control study was to determine if there is an association between the degree of thoracic kyphosis and prevalence of advanced uterine prolapse in women
	  ○ Medical records were reviewed for 412 consecutive women who underwent either abdominal or vaginal hysterectomy; 48 cases of women with uterine prolapse to or beyond the level of the introitus were matched to 48 controls for age, weight, menopausal status, and hormonal status
	• Outcome Measure: spinal curvature was measured preoperatively using a lateral chest x-ray and the Ferguson method
	• Results: the degree of thoracic kyphosis was significantly higher in patients with uterine prolapse than in controls; a higher degree of thoracic kyphosis was associated with an incremental higher occurrence of uterine prolapse
	  ○ A higher number of vaginal deliveries were associated with a higher likelihood of uterine prolapse

Strengths & Limitations	Strengths: • Well-defined criteria for matching case-control subjects • Model was used to develop an odds ratio associated with the degree of spinal curvature, controlling for the effect of the number of vaginal deliveries Limitations: • Assumed to be a study of white women only (97% population at the private institution is white), a population in which osteoporosis is more common • Did not compare uterine weight (all subjects <700g) • Although the mean difference in thoracic kyphosis of 5° is statistically significant, it is small from a clinical viewpoint and may suggest more dramatic changes elsewhere in the spine
Contribution of Evidence for Treatment of Prolapse	This study demonstrates the importance of limiting thoracic kyphosis while maintaining proper lumbar lordosis to help mitigate the risk for uterine prolapse, particularly in those who have had multiple vaginal deliveries. It is hypothesized that with increased kyphosis the position of the rib cage over the abdomen changes such that it increases IAP and would therefore increase POP symptoms. Reviewed literature by the authors suggest the most practical method for preventing kyphosis is to reduce the risk of osteoporosis with adequate calcium and vitamin D intake, regular exercise, abstinence from smoking, and moderation in alcohol intake.

Citation	Mattox TF, Lucente V, McIntyre P, Miklos JR, Tomezsko J. Abnormal spinal curvature and its relationship to pelvic organ prolapse. *Am J Obstet Gynecol*. 2000;183(6):1381-1384.
Link	http://www.ncbi.nlm.nih.gov/pubmed/11120500

Summary of Article	• The objective of this multicenter, prospective, case-control study was to evaluate the relationship of spinal curvature and pelvic organ prolapse, specifically, the loss of lumbar lordosis or pronounced thoracic kyphosis
	  ○ 363 patients referred for complaints of UI or POP underwent a detailed history with examination, POP was measured using the POP-Q
	  ○ Spinal curvature was measured from C7 to lumbosacral joint space with a flexi-curve malleable rod with patients in a fully erect position
	• Primary outcomes: determining whether spinal curvature abnormalities existed between women with and without prolapse, evaluating the effects of lumbar curvature on POP, and noting and correlation between an increasing spinal abnormality and degree of POP
	• Secondary outcomes: examined whether race, history of osteoporosis, and loss of height could predict patients with an abnormal spinal curvature
	• Results: 84/92 patients with abnormal curvature currently or previously had had pelvic organ prolapse (sensitivity 91%); only 11% with stage 0 prolapse had an abnormal spinal curve whereas 30% with stage III did
	  ○ Patients with an abnormal spinal curve were 3.2 times more likely to develop pelvic organ prolapse
	  ○ Most prevalent spinal abnormality was a loss of lumbar lordosis (75%)
	  ○ There was no difference in the number of vaginal deliveries, weight of largest vaginally delivered infant, or body mass index

Strengths & Limitations	Strengths: • Multicenter study • Large sample size Limitations: • 95% of the subjects were white • Not noted that the method for spinal measurement was reliable or validated • Potential for selection bias, thus affecting the external validity of findings
Contribution of Evidence for Treatment of Prolapse	This study suggests that the loss of lumbar lordosis may be a significant factor in the development of pelvic organ prolapse. It was also noted that older patients were more likely to have both pelvic organ prolapse and an abnormal spinal curvature. This study measured spinal curvature with the subjects in a fully erect position; however, it would be important to analyze curvature in dynamic and alternative positions, especially those that are symptomatic for a patient.

Citation	Nguyen JK, Lind LR, Choe JY, McKindsey F, Sinow R, Bhatia NN. Lumbosacral spine and pelvic inlet changes associated with pelvic organ prolapse. *Obstet Gynecol*. 2000;95(3):332-336.
Link	http://www.ncbi.nlm.nih.gov/pubmed/10711538
Summary of Article	• The objective of this study was to determine the association between advanced pelvic organ prolapse and changes in lumbar lordosis and/or pelvic inlet orientation

	○ 20 women with uterovaginal prolapse (grade 2 or greater) were matched with 20 women without significant prolapse (grade 1 or less), all were vaginally parous ○ Lateral lumbosacral spine/pelvic x-rays were taken with the participants standing in their usual upright posture, with their shoes taken on and hands at chest level • Outcome measures: angles of lumbar lordosis and the pelvic inlet were measured by a radiologist • Results: mean lumbar lordotic curve angle in women with POP was significantly lower than that of controls (32.0° vs. 42.4°) & mean angle of pelvic inlet in women with POP was significantly larger than that of controls (37.5° vs. 29.5°)
Strengths & Limitations	Strengths: • No significant differences in the mean age, BMI, race, menopausal status, gravidity, and vaginal parity between the prolapse and nonprolapse groups • Radiologist was blinded to pelvic exam findings Limitations: • Small sample size • Factors including chronic constipation, child birth weights, and occupation were not taken into consideration • X-rays were taken with shoes on, although it was noted all wore flat-heeled • Conclusions are limited mainly to the Hispanic population
Contribution of Evidence for Treatment of Prolapse	This study found that women with pelvic organ prolapse to or beyond the hymen had significantly less lumbar lordosis than women without prolapse. The authors hypothesize that lumbar lordosis deflects and/or absorbs a fraction of the downward intra-abdominal forces, thereby helping to prevent POP. They also found that the pelvic inlet was oriented more vertically, theoretically such that most of the downward intra-abdominal force is directed towards the pubic bone and rectus abdominus muscles, in women with normal pelvic organ support than in women with prolapse.

Citation	O'Dell KK, Morse AN, Crawford SL, Howard A. Vaginal pressure during lifting, floor exercises, jogging, and use of hydraulic exercise machines. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007;18(12):1481-1489.
Link	http://www.ncbi.nlm.nih.gov/pubmed/17982711

Summary of Article	• The objective of this exploratory, descriptive study was to describe the median and maximum IAP in reproductive age (mean 31.1 years, 20-51), non-obese (mean BMI 22.7, 18.5-29.3) women (n = 12) without risk factors for prolapse during 2 activity and exercise sessions for a total 34 activities
	  ○ Session 1: standing and sitting at rest, jogging in place, lifting (15, 30, 45lbs) from varied positions (seated lifting from the floor, standing lifting from the floor to 34" counter, standing lifting from counter to 72" shelf from the floor), rising from the floor, selected floor exercises (e.g. yoga position Down Dog), and supine abdominal exercises including sit-ups, crunch style sit-ups, low bicycling movements, and V-sit
	  ▪ Activities were repeated first with breath holding without initial inspiration and then exhaling with effort
	  ○ Session 2: circuit of 10 hydraulic exercise machines with 10 jogging platforms at a women-only exercise facility
	• Outcome measures: vaginal pressure measured with an air-charged single-use vaginal pressure catheter attached to a portable urodynamic machine
	  ○ Participants' 3 maximum pressure peaks for each activity were measured, and the maximum and mean of the 3 peaks were entered into the statistical software
	• Results: Not all individuals demonstrated relative pressure patterns that were consistent with overall group patterns
	  ○ Mean vaginal pressures (cm H_2O): cough 98.0 (48.0-133.7), exercise machines 37.0 (20.3-182.3), supine exercise 34.0 (6.3-91.9), standing 24.0 (15.9-28.5)
	  ○ Common instruction to exhale with exertion was found to be ineffective in consistently decreasing vaginal pressure

Strengths & Limitations	Strengths: • Reproducibility was supported by test-retest pressure assessment • High correlations between resting pressures and BMI were consistent with previous reports and support construct validity • Statistical conclusion validity supported by priori power analysis Limitations: • Small sample size (n = 12) • Subjects had normal pelvic structure and no known risk factors for POP • Several external validity limitations No mention or reference to the use of PF muscles with exhale with exertion
Contribution of	This study found that cough, bearing down in a seated position, and spontaneous

Evidence for Treatment of Prolapse	laugher resulted in statistically similar vaginal pressure, which was significantly more than all other tested activities. The highest median pressure for studied activities resulted from lifting 45lbs from the floor. Exercise machines that targeted the torso muscles in the seated position resulted in higher pressures than other hydraulic machines, while supine abdominal exercises exerted relatively low pressure. Furthermore, this study suggests that expiration with exertion is unlikely to consistently decrease IAP. However, they also did not report that they instructed or coached the participants to use the pelvic floor when exhale with exertion. It should be noted that wide individual variance was observed within this small study; thus, further research is needed before establishing clinical activity recommendations. Regardless, this study highlights instances for which IAP increases most and thus patients with POP can be educated to avoid or monitor their activities accordingly.

Citation	Schimpf M, Tulikangas P. Evolution of the female pelvis and relationships to pelvic organ prolapse. *Int Urogynecol J Pelvic Floor Dysfunct*. 2005;16(4):315-320.
Link	http://www.ncbi.nlm.nih.gov/pubmed/15654501

Summary of Article	• This article examines the evolution of the pelvic structure by reviewing the changing roles and functions of nonhuman primate and human female anatomy and speculate how it might put some women more at risk for pelvic organ prolapse
	  ○ Humans require pelvic floor support for abdominal and pelvic viscera rather than the abdominal wall as in quadrupeds
	  ○ Humans gain some visceral support via the pubic symphysis, which is inclined ~45°, compared to a vertically oriented symphysis in apes
	  ○ Women have a lumbosacral angle, measuring between 60-80°, that changes dramatically throughout life (starting at ~20°), whereas mammals that do not ambulate upright have a lumbosacral angle of ~0°
	  ▪ Lumbosacral angle impacts the direction and path of the birth canal and possibly may increase the risk of prolapse
	  ○ MRI has demonstrated increased muscle loss and decreased levator ani muscle thickness in women with pelvic organ prolapse
	• Conclusions: Prolapse is a multifactorial dilemma
	  ○ Attribute the ~90° lumbosacral angle to sparing the pelvic floor some of the forces of intra-abdominal pressure
	  ○ Maintaining/rehabbing levator muscle bulk and strength may prevent many cases of pelvic organ prolapse
	  ○ Avoiding injury/reconstructing the perineum could help preserve its role in support

Strengths & Limitations	Strengths: • Clear layout of information • Present many areas for future study

	Limitations: • Understanding of adaptations is speculative
Contribution of Evidence for Treatment of Prolapse	This article exemplifies the role of posture on bony structure. It is put forth that pelvic organ prolapse results from an inadequacy of pelvic bones, muscles, and ligaments that were previously used for other purposes being used in a more supportive way. The authors suggest that strengthening the pelvic floor may be key to preventing many cases of pelvic organ prolapse. Additionally, the combination of a woman having less lumbar lordosis and a more horizontally oriented pelvic inlet, may mean a higher proportion of the weight of the abdominal and pelvic viscera is supported by the pelvic floor, thus leading to pelvic organ prolapse.

Citation	Shaw JM, Hamad NM, Coleman TJ, et al. Intra-abdominal pressures during activity in women using an intra-vaginal pressure transducer. *J Sports Sci*. 2014;32(12):1176-1185.
Link	http://www.ncbi.nlm.nih.gov/pubmed/24575741

Summary of Article	• This study measured IAP with a novel wireless intra-vaginal pressure transducer during diverse activities (31) of 57 women aged 18-54
	  ○ Activities included clinical assessments (coughing, Valsalva), light, moderate, and vigorous intensity exercise tasks and routine household activities (dusting, scrubbing floor, lifting); most activities required 20-40 seconds to complete
	• Calculations: maximal, area under the curve, and first moment of the area intra-abdominal pressure for each activity
	• Results: statistically significant difference in maximal pressure between levels of walking, cycling, and high pressure activities
	  ○ Coughing had the highest maximal pressure - more than lifting and carrying 18.2kg, abdominal curl ups, full sit ups, and running
	  ○ Statistically significant differences in median maximal IAP between walking at:
	  ▪ 4.8 km/h on level grade vs. 4.8 km/h on 7% grade
	  ▪ 4.8 km/h on level grade vs. 4.3 km/h while carrying 11.4kg
	  ○ Intra-abdominal pressure while seated cycling at 450 kg·m/min was lower than seated cycling at 600kg·m/min which was lower than standing cycling at 900kg·m/min

Strengths & Limitations	Strengths: • Used a novel, wireless intra-vaginal pressure transducer with known validity • Low attrition rate • Well described standardized methods • Variety of activities • Multiple calculations (not just maximal pressure) were included Limitations:

	• Variability of responses/wide range of pressure values • Element of uncertainty with measuring pressures in the upper vagina vs. actual intra-abdominal cavity • Sample population consisted of young, healthy, active women
Contribution of Evidence for Treatment of Prolapse	These findings may have relevance when educating patients with pelvic floor dysfunction on different postures and activities to minimize their symptoms, however individuals with POP were not explicitly studied and the findings may not be generalizable. Further studies are needed to better understand the variability of IAP with activity to prescribe evidence-based activity restrictions.

Citation	Yamasato KS, Oyama IA, Kaneshiro B. Intraabdominal pressure with pelvic floor dysfunction: do postoperative restrictions make sense? *J Reprod Med*. 2014;59(7-8):409-413.
Link	http://www.ncbi.nlm.nih.gov/pubmed/25098032

Summary Of Article	• This prospective, descriptive study aimed to quantify and compare IAPs in women with pelvic floor dysfunction using a vaginal catheter
	  ○ 147 women (18.4% with POP, 6.8% with POP and SUI)
	  ○ IAPs measured for: (1) standing up from a chair, (2) coughing, (3) lifting 10lb (4.54kg), (4) lifting 20lb (9.07kg), and (5) pushing 20lb
	• Outcomes: primarily descriptive
	• Results: coughing and standing up generated significantly more pressure than lifting 10 or 20lb (bending from the standing position to grasp bag off of floor)
	  ○ Obese subjects (BMI ≥30.0) generated significantly more pressure than did normal weight subjects (BMI 18.5-24.9)
	  ○ IAPs were significantly lower for standing up in patients ≥70 years old, but otherwise no variance observed based on age

Strengths & Limitations	Strengths: • Vaginal catheter has been shown to be comparable to the rectal catheter in estimating IAPs • Detailed protocol Limitations: • Relatively small number of obese patients (n=15, 10%) • Heterogenous population – factors such as degree of POP, history of pelvic surgery, menopausal status, and parity may have impacted IAPs • Primarily descriptive outcomes
Contribution of Evidence for Treatment of Prolapse	The study found that lifting up to 20lb generated less IAP than activities such as coughing and standing up from a chair, which may have implications for post-operative restrictions. Furthermore, although women with POP were not explicitly studied, women with pelvic floor dysfunction were studied and this study supports the potential efficacy of postural education and technique in decreasing IAP and thereby pelvic floor tension and POP symptoms.

Pelvic Organ Prolapse and Lifestyle Advice Literature Review

SUMMARY

The current published studies investigating the effectiveness of lifestyle modifications on pelvic organ prolapse (POP) are quite limited. The scarcity of research may be attributed to a variety of factors. First, there is inherent difficulty in studying the effectiveness of lifestyle intervention, due to the impossibility of blinded subjects in a double or single blinded research study. Secondly, effectively standardizing treatment in lifestyle education is difficult,[1] as there is a need to tailor lifestyle advice to individual patients' needs.

In reviewing the existent POP lifestyle research, the studies reviewed did not include the functional needs and goals of individual patients as an outcome measure. Current research is also limited by the convention of treating POP patients as a homogenous group and instead of individually considering differences in POP etiology, severity, and patients' level of function, in designing treatment protocols for POP studies. We recommend future research use functional outcome measures and individual goals to assess POP treatment effectiveness, including health related quality of life measures. We also suggest research should consider a more comprehensive picture of function and symptoms of POP beyond incontinence related symptoms and anatomical grading.

1. Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th International Consultation on Incontinence. *Neurourology and Urodynamics*. 2014;35(1):15-20. doi:10.1002/nau.22677.

2. Te West N.C.A.I., Moore KH. Recent Developments in the Non-surgical Management of Pelvic Organ Prolapse. *Current Obstetrics and Gynecology Reports*. 2014;3(3):172-179. doi:10.1007/s13669-014-0087-6

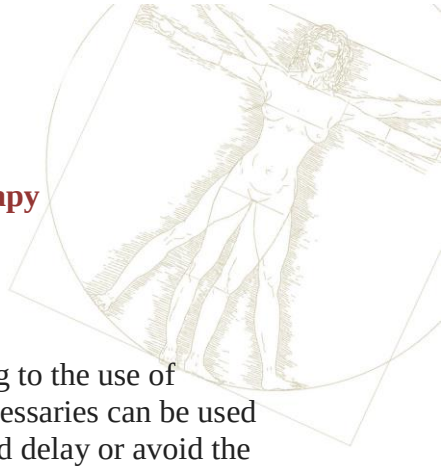
Common abbreviations used within literature review:
PFMT: pelvic floor muscle training
PFDI: Pelvic Floor Distress Inventory
PFIQ: Pelvic Floor Impact Questionnaire
PISQ-12: Pelvic Organ Prolapse/ Urinary Incontinence Sexual Questionnaire
POP: pelvic organ prolapse
POP-Q: Pelvic Organ Prolapse Quantification
POP-SS: Pelvic Organ Prolapse Symptom Score
PT: physical therapist
HRs-QOL: health related quality of life
RCT: randomized control trial
(S)UI: (stress) urinary incontinence

	Te West N.C.A.I., Moore KH. Recent Developments in the Non-surgical Management of Pelvic Organ Prolapse. *Current Obstetrics and Gynecology Reports*. 2014;3(3):172-179. doi:10.1007/s13669-014-0087-6
	http://onlinelibrary.wiley.com/doi/10.1002/nau.22677/full
Summary Of Article	The authors discuss a variety of non-surgical interventions for POP including observation, vaginal oestrogen, lifestyle modifications, physiotherapy, and vaginal pessaries. TeWest and Moore suggest all of these options should be discussed with patients as alternatives to surgery, although the authors found randomized controlled trials on the effectiveness of these interventions were limited.
Strengths & Limitations	Strengths: Thoroughly researched article with 53 references for 4 pages of text. Good overview of non-surgical POP treatment options. Limitations: The authors do address some of the risks and complications of pessary rings, but fail to address the advantages of lifestyle treatment and physiotherapy or any risks of these treatments.
Contribution of Evidence for Treatment of Prolapse	Lifestyle modifications have been used to address known risk factors for POP such as obesity, chronic cough, heavy lifting and constipation. The authors cite a Meyers et al study where weight loss and an education program on POP showed no difference in POP symptoms. Although the authors found the evidence lacking in the literature for improving chronic cough, heavy lifting techniques and constipation, they concluded treating all of these condition to help improve POP symptoms was reasonable.
	Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: Summary of the 5th International Consultation on Incontinence. *Neurourology and Urodynamics*. 2014;35(1):15-20. doi:10.1002/nau.22677.
	http://onlinelibrary.wiley.com/doi/10.1002/nau.22677/full
Summary Of Article	Dumoulin and colleagues review conservative management of UI and POP with graded recommendations and levels of evidence, using a 2008 review as a starting point. The paper includes brief descriptions of each treatment option and areas where further research is needed. Treatment options reviewed include lifestyle interventions, physical therapies, scheduled voiding regiments, alternative medications, anti-incontinence devices and pessaries.
Strengths & Limitations	Strengths: • Review of current literature with graded recommendations and evidence levels are helpful for overview of treatment options. Limitations: • Review of literature from 2008- 2012, may not include most current research. • This review lumped UI and POP together, many of the studies in the review looked only at UI symptoms.

	• Treatment protocols from studies not detailed in review, need to refer to original studies for more details on treatment protocols.
Contribution of Evidence for Treatment of Prolapse	• Recommendation for supervised PFMT with UI, with clinicians providing the most intensive PFMT possible (Grade A recommendation). • Increased BMI and POP may be linked. • Heavy lifting in occupations and POP may be linked. • Significant association between POP symptoms and irritable bowel as well as defecatory dysfunction problems and POP. • PFMT recommended to improve POP symptoms (Grade A recommendation).

	Hagen S, Stark D, Dougall I. A survey of prolapse practice in UK women's health physiotherapists: What has changed in the last decade? *International Urogynecology Journal*. 2015;27(4):579–585. doi:10.1007/s00192-015-2864-9.
	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4819739/
Summary Of Article	An online survey was sent to members in the Association of Chartered Physiotherapists in Women's Health and the Chartered Physiotherapists Promoting Continence (UK). The survey results showed the most common prolapse treatments were PFMT (93 %), lifestyle advice (92 %) and biofeedback-assisted PFMT (83 %), according to 289 respondents. Most respondents were experienced or senior physiotherapists and treated 26 women or more with POP in the last year, a significant increase since 2002.
Strengths & Limitations	Strengths: survey of experienced practitioners, helping to understand the clinical expertise on treating POP. Limitations: Due to survey format and blanket categories of treatment, results are not particularly helpful in crafting a treatment plan.
Contribution of Evidence for Treatment of Prolapse	This research provides a snapshot of the current state and direction over the past 10 years of POP treatment by physiotherapists in the UK. The vast majority of physiotherapists treating POP in the UK are using both PMFT and lifestyle interventions. The data also shows an increase in patient population with POP receiving physiotherapy"over the last decade in the UK.

	Due U, Brostrom S, Lose G. (2016) The 12-month effects of structured lifestyle advice and pelvic floor muscle training for pelvic organ prolapse. *Acta Obstetricia et Gynecologica Scandinavica is*. 2016;95:811–819.
	https://www.ncbi.nlm.nih.gov/pubmed/26910261
Summary Of Article	This study presented the 12 month follow up of Due and colleagues study of lifestyle advice vs. a structured lifestyle advice program and pelvic floor muscle training (PFMT). At the 12 month mark the benefits of pelvic floor muscle training in addition to the lifestyle advice showed limited improved results- both groups had improvements in bladder symptoms, bowel symptoms and prolapse symptoms. Lifestyle education topics for the six group sessions were based on known POP-promoting factors, such as straining, constipation, being overweight, and heavy lifting. The following topics were presented: (information from personal communication with the author). Introduction to POP and how to reduce pressure on the pelvic floor; bladder function and POP; bowel function and POP and how to improve micturition and defecation technique; diet, weight loss, and POP; QoL and POP and impact of POP on body image and sexuality; sports and POP and how to increase level of activity without increasing pressure on the pelvic floor.Both groups improved symptoms of stress urinary incontinence. The group with PFMT saw improved "bulge" symptoms and improved bowel-related HRQoL. Neither group had improvements in the majority of the symptom and HRQoL scores after 12 months, and there was no significant between group difference in symptom and HRQoL scores.
Strengths & Limitations	Strengths: Longer term evidence for lifestyle advice to treat POP is limited and this 12 month long study is a good first step. Limitations: Small sample size. N= 83. Lifestyle advice program curriculum was not outlined in detail but was obtained to help clinicians understand the scope of the advice. The curriculum was delivered in a group class setting and not tailored to individual patients.
Contribution of Evidence for Treatment of Prolapse	Patients treated with structured lifestyle advice programs alone show comparable results to patients treated with both lifestyle advice and strength training when evaluated after 12 months. Bulge symptoms and bowel QoL respond better to PFMT. This study highlights the importance of patient education in POP management and reviews the topics covered.



Pessaries, Pelvic Organ Prolapse and Physical Therapy

A Literature Review

SUMMARY

This literature review is a summary of recently published articles pertaining to the use of pessaries to treat Pelvic Organ Prolapse (POP). With a diagnosis of POP, pessaries can be used to prevent prolapse from worsening, relieve prolapse related symptoms, and delay or avoid the need for surgical intervention. In clinical practice, pessaries are often recommended to help patients return to activity or sport with decreased symptoms. Further research is needed to determine how this practice can be most efficient and effective for patients and clinicians.

Current physical therapy management of POP includes pelvic floor muscle training (PFMT) as well as lifestyle modifications targeting toileting techniques and habits, posture, movement strategies and breathing patterns that manage intra-abdominal pressure. This approach is successful in some, but not all women, identifying the need for further treatment interventions such as pessary usage.

The goal of this review is to better understand the role pessary can play in physical therapy for POP. The topics addressed in this review include the effect of pessary use on quality of life (QOL) compared to other forms of treatment such as PFMT and surgery. Articles reviewing candidate selection criteria for success and failure and common practice regarding pessary fitting and practitioner training are presented. Our review found that pessaries are an effective form of treatment for POP symptoms and can in some cases prevent the need for surgery. Based on the literature in this review, pessaries should be offered and/or considered as a first form of treatment in women with POP.

Further research is needed to determine how this practice can be most efficient and effective for patients and clinicians. Most existing research has been done on pessary use in post-menopausal women. There is little to no literature looking at the effectiveness of pessary use for POP in postpartum women or those under the age of 55. We included literature regarding PF strength assessments and early postpartum POP intervention in younger patients to try and gain an understanding of how a pessary could be used in the postpartum population.

Additionally, commonly used outcome measures for POP treatment and pessary use such as the Pelvic Floor Distress Inventory (PFDI-20) measure severity of symptoms. These measures do not look at the impact pessary use has on functional activities such as walking, running or lifting, all important activities in the postpartum period and beyond. To date, symptoms rather than functional activity restrictions have been identified as the prime purpose of pessary use.

Common abbreviations used within this literature review:
BMI: Body Mass Index
CRADI: Colorectal and Anal Distress Inventory
DRA: Diastasis Rectus Abdominis
EMG: Electromyography
IAP: Intra-Abdominal Pressure
MVC: Maximum Voluntary Contraction

PCS: Physical Component Summary
PFD: Pelvic Floor Dysfunction
PFM: Pelvic Floor Muscle
PFMT: Pelvic Floor Muscle Training
PFDI: Pelvic Floor Distress Inventory
PFIQ: Pelvic Floor Impact Questionnaire
PISQ: Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire
POP: Pelvic Organ Prolapse
POPDI: Pelvic Organ Prolapse Distress Inventory
POPPS: Pelvic Organ prolapse in primary care: effects of Pelvic floor muscle training and Pessary treatment Study
POP-Q: Pelvic Organ Prolapse Quantification
PT: physical therapist
HRs-QOL: health related quality of life
RCT: randomized control trial
(S)UI: (stress) urinary incontinence
UDI: Urogenital Distress Inventory
TVL: Total Vaginal Length

Articles

Citation	**Cheung et al. Vaginal pessary in women with symptomatic pelvic organ prolapse. Obstet Gynecol. 2016;128(1):73-80.**
Link	**https://www.ingentaconnect.com/content/wk/aog/2016/00000128/00000001/art00014**
Summary of Article	This article is a two-armed, single-blind, randomized controlled trial from China that compares quality of life and complications in 276 women with symptomatic POP. Patients were treated with or without vaginal pessaries in addition to being taught pelvic floor muscle strengthening exercises. The mean age of the women was 62.5 and 62.7 in the pessary and control groups, respectively Inclusion criteria: women with symptomatic POP stages I-III as measured by POP-Q who had had no previous treatment for POP. Women were randomly assigned to either the pessary group or control group. Women in the pessary group were fitted with a ring pessary and taught a pelvic floor strengthening program and women in the control group were only taught the pelvic floor strengthening program. The exercise program including a teaching session 2 weeks after the first consultation followed by 3 more sessions at 4, 8 and 16 weeks. The women were advised to do 8-10 exercises daily with 2 sets of 8-12 repetitions each. The reported compliance with the exercise program was 43.1% in the pessary group and 53.3% in the control group. The mean age of the women was 62.5 and 62.7 in the pessary and control groups, respectively. Women in the pessary group had significantly lower scores on both the POPDI and POPIQ at 6 months and 12 months after initial pessary fitting.

	Women in the control group had no significant change in scores. Furthermore, more women in the pessary group achieved a minimally important change in both outcome measure scores and reported a perceived improvement in symptoms. Both groups reported similar adherence to the exercise program, indicating that the use of a vaginal pessary had significant impact on quality of life and symptoms of POP. Other factors including age, parity, BMI, stage of prolapse, compartment of prolapse, menopausal status and sexual activity were found to have no correlation with increased outcome measure scores. There were complications in both the pessary and control groups. De novo stress urinary incontinence was the only complication found to be significantly more likely in the pessary group than in the control group. Other complications including vaginal bleeding and discharge, urge urinary incontinence and voiding difficulty also occurred in the control group. This suggest that POP itself may increase risk for developing these complications even in the absence of a pessary.
Strengths & Limitations	**Strengths**: Large participant group that were available for randomization due to surgery wait length at medical facility. **Limitations:** This study was done on an older population (mean age of 62.6) making it hard to generalize to younger women. A long-term follow-up looking at surgical rates between the 2 groups following treatment could have been another outcome reported. Anatomical changes in POP using POP-Q were not reported, only quality of life was used to measure improvement in POP.
Contribution	The vaginal pessary was effective and beneficial in stage I, II and III POP, suggesting pessary use should be considered regardless of stage on not only in patients who are considered poor surgical candidates. It is difficult to achieve high compliance rates with exercise programs. Pessary treatment can be done in addition to exercises in order to improve overall outcomes in patients with POP.

Citation	**Robert M, Schulz JA, Harvey MA. Technical update on pessary use. *Journal of Obstetrics and Gynaecology Canada*. 2013; 35(7):664-674.**
Link	**https://www.sciencedirect.com/science/article/abs/pii/S1701216315308884**
Summary of Article	This is a Canadian technical update on pessary use. It contains information regarding pessary use for POP, urinary incontinence and pregnancy, this review presents only the details relevant to treating POP. Most women with POP can be successfully fitted with a pessary. Success rates of pessary fitting range between 71-90%. Ring pessaries are the most

	common type used and can be effective in all stages of POP. If a ring pessary cannot be successfully fitted, other types including a Shaatz or Gellhorn can still be successful. Successful pessary use is dependent on proper fit. When a pessary is successfully fitted in the first 4-weeks of use, there is more likely to be long term use. Furthermore, adequate patient education and follow-up care is necessary in order to achieve success. Although there are no standards for pessary care, this review recommends a follow-up visit 2 to 4 weeks following initial fitting. If able, the pessary user should remove the pessary once a week and wash with soapy water. In some cases where self-care is not possible, the health care professional should follow-up with the patient every 3 months. Space occupying pessaries such as a Gellhorn or cube can be more difficulty to manage with self-care. Predictors of unsuccessful fitting include a vaginal length < 6 cm, an introitus > 4 fingers in breadth, the presence of rectocele, previous vaginal surgery and coexisting stress urinary incontinence. Complications of pessary use are rare and usually minor. The most common complications are erosion (8.9%) and vaginal infection (2.5%). These complications can be treated with removal of the pessary for 2-4 weeks and use of local estrogen in the form of cream or a tablet. The use of estrogen cream was not found to be effective in preventing complications. Vaginal discharge is another common complaint of a pessary user but can usually be alleviated by pessary removal. Other major complications such as vesicovaginal fistulae, bowel fistulae and incarcerated pessaries are extremely rare and associated with neglected pessaries. Satisfaction rates among pessary users are very high. Women who choose to treat POP with pessary use are likely to be just as satisfied as those who choose to have surgical intervention.
Strengths & Limitations	**Strengths:** Although there is still no established standard of care, this review provides instructions on fitting and managing pessaries that can be translated into clinical practice. **Limitations:** There is limited information on how pessary treatment differs in different patient populations, specifically pre vs. post-menopausal women. There were also no outcome measures reported related to pessary use for treatment of POP.
Contribution	The recommendation from this review is that pessaries should be considered as a first-line treatment in all patients presenting with POP. Successful pessary use is dependent on ongoing management which is often the patient's responsibility. Patients need to be sufficiently educated and followed-up with to achieve best outcomes.

Citation	**Coolen et al. Primary treatment of pelvic organ prolapse: pessary use versus prolapse surgery. *Int Urogynecol J*. 2018 29:99-107.**
Link	**https://www.ncbi.nlm.nih.gov/pmc/article/PMC5754400/**
Summary of Article	This is a prospective cohort study from the Netherlands of 113 people with symptomatic pelvic organ prolapse to compare functional outcomes following either pessary treatment or surgical intervention. Inclusion criteria were the presence of symptomatic POP (POP-Q of stage II or higher) with urogenital symptoms and a desire to undergo treatment. The study was intended to be a randomized control trial, however, only 6 of the 113 women agreed to randomization so all results were reported as a prospective cohort. The subjects were all counseled by their gynecologist and given a choice between pessary and surgery. The mean ages or participants were 63.2 and 57.6 for the pessary and surgery groups, respectively. Patients with symptomatic POP had a strong preference whether they received surgical or pessary intervention. Because the patients had a choice of which treatment they would like to receive, the study was able to look at personal factors regarding treatment choice. Surgery and pessary use are very different interventions in terms of invasiveness, risk and impact. Subjects who elected to undergo pessary treatment were older and had higher POP-Q stages of the anterior and posterior compartments than those in the surgery group. At baseline, those who chose pessary treatment reported significantly lower scores in the pain/discomfort section of the Urogenital Distress Inventory (UDI) as well as the social section of the Incontinence Impact Questionnaire. Both prolapse surgery and pessary use are effective interventions and can improve functional outcomes in women with POP. Patients who underwent surgery had less POP related symptoms and were less likely to need addition interventions compared to those using pessaries. There was a 60% continuation rate of pessary use in the pessary group at 12 months. Surgery was prevented in 72% of the pessary users after 12 months. Although the pessary group had more symptoms reported, scores were very low overall. At 12 months, both groups reported incontinence via the UDI. The pessary group had a mean score of 16.7 and the surgical group of 33.3 on the incontinence section. Scores in both groups were improved compared to baseline. All other sections of the UDI were 0 for both groups at 12 months except for overactive bladder which was 5.6 in the surgical group. Because pessary use did lead to reduced need for surgery, the article suggests pessary treatment should be used as a primary treatment for POP followed by surgery as needed.
Strengths & Limitations	**Strengths**: This study followed-up with subjects 12 months after receiving treatment which can give some insight into long term impact of pessary versus surgical treatments. Although the study failed to be a randomized

	control trial, the lack of randomization was able to provide information on what patient characteristics may lead to a preference of one treatment over the other. **Limitations:** Multiple physicians provided counseling to patients regarding intervention choice. A lack of consistency of counseling between physicians and potential physician bias towards patient age may have led to selection bias. Multiple different types of surgeries were performed, and the study did not differentiate outcomes based on type of surgery.
Contribution	Continued use of a pessary can lead to reduced symptoms and reduced indication for surgery. Although improvements in symptoms were seen after 6 months of pessary use, patients continued to improve through the 12-month follow-up when the study was concluded. This suggests that for pessary intervention to be most effective in managing symptoms of POP, the pessary should be used for 12 months or potentially longer.

Citation	**Mao M, Xu T, Kang J, Zhang Y, Ai F, Zhou Y, Zhu L. Factors associated with long-term pessary use in women with symptomatic pelvic organ prolapse. *Climacteric*. 2019; 1369-7137 (print) 1473-0804 (online).**
Link	**https://www.tandfonline.com/doi/full/10.1080/13697137.2019.1582623**
Summary of Article	This is a prospective study that took place in China looking to identify patient characteristics associated with pessary discontinuation after a successful fitting of either a ring or Gellhorn pessary for POP. Inclusion criteria: patients with symptomatic POP who agreed to a pessary as primary treatment after being counseled about options including pelvic muscle exercises and surgery in addition to pessary use. The main findings are outlined below. Out of 277 patients, 71.8% of patients had a successful fit with the ring pessary and for those whom the ring pessary did not fit, a Gellhorn pessary was used. The study found that 84% patients using the ring pessary were comfortable managing them on their own compared to 58% using the Gellhorn. When the study ended, 18 months following the last fittings, 76.5% of patients were still using their pessary. There were various reasons for pessary discontinuation. The most common reasons were a desire for surgery, difficulty with insertion and removal and too much trouble managing the pessary. Other reasons included frequent expulsion, discomfort, failure to relieve symptoms, vaginal ulceration and/or discharge, difficulty with defecation and de novo stress urinary incontinence. Patients in the continuation group also experienced

	complication and side effects including vaginal erosion, vaginal discharge and de novo stress urinary incontinence. The factors associate with pessary discontinuation were a total vaginal length (TVL) of <7.5cm and a lower baseline score on the Pelvic Organ Prolapse Distress Inventory 6 (POPDI-6). A shorter vaginal length may cause increased rate of expulsion and/or discomfort during activity. Age was also correlated with continuation rate, with patients who were younger than 65 years old being more likely to discontinue pessary use. Patients were more likely to continue pessary use if they were of older age (65+) had a longer TVL (>7.5 cm), had higher baseline scores on the POPDI-6 and reported the need to splint to void.
Strengths & Limitations	**Strengths**: This was a prospective study with a large sample size that had moderate success with patient follow-up (93.9%). **Limitations**: Selection bias was present during counseling. 95.4% of patients in the pessary group were postmenopausal which makes the results of this study hard to confidently apply to a younger population. This study was done at a single center making it hard to generalize to larger populations in other locations.
Contribution	This study looked at characteristics such as age, TVL and POPDI-6 scores that are accessible features for a physical therapist to evaluate and consider when recommending or fitting a pessary. Pessary users in the study followed a self-care protocol following pessary fitting suggesting that some protocol or self-management education and adherence could help improve outcomes. Patients with existing medical comorbidities such as diabetes mellitus, hypertension and heart disease were not shown to have increased risk of pessary discontinuation due to comorbidity.

Citation	**Patnam et al. Moving on: how many women opt for surgery after pessary use for prolapse? *Female Pelvic Med Reconstr Surg*. 2019; 00(00): 1-4.**
Link	**https://europepmc.org/abstract/med/31335479**
Summary of Article	This is a retrospective cohort study from the United States reviewing how many women choose surgery for POP following a successful pessary fitting. It also looked at when surgery occurred following pessary fitting and what factors were associated with these three options, choosing surgery, continuing pessary or discontinuing pessary use without having surgery. The study consisted of 444 women who were successfully fitted with a pessary. Successful fitting of a pessary was defined as leaving the urogynecology office with a pessary in place. There were no significant differences in BMI, race, ethnicity, parity, vaginal atrophy or posterior prolapse beyond the hymen between the 3 groups.

	The study revealed that 31% of the women who were successfully fitted with a pessary opted for POP surgery. Of the women who had surgery, 59% had surgery within one year from pessary fitting and 89% within two years. The median time for surgery was 10 months following pessary fitting. 44% of women continued pessary use for a median of 30 months. Significant factors associated with opting for surgery instead of pessary use were younger age and lower Charleston Comorbidity Index (CCI). The average age of women who underwent surgery was 64 years old compared to 68 years old in those who chose to continue pessary use. In those who did not continue pessary use or have surgery the average age was 65. Those who opted initially for a pessary and subsequently for surgery had significantly lower goal attainment. This study emphasizes that the women who choose surgery after pessary may be less satisfied with their treatment, both symptomatically and functionally. Advanced POP (stage III/IV) was more common in the group that chose pessary compared to those who discontinued without having surgery. Those who discontinued pessary use were more likely to have had a prior hysterectomy than those in the other 2 groups. Finally, 25% of women discontinued pessary use without having surgery. Of these women who discontinued treatment, 33% still had bothersome symptoms related to POP.
Strengths & Limitations	**Strengths:** - Large sample size (444 women) - Followed patients' long term, up to 118 months in some pessary users **Limitations:** - Limited information on how pessaries were fit and what was considered to be successful fitting. Non-standardized criteria of pessary fitting could impact patient satisfaction and continued use among women. - Criteria for successful pessary fitting differed from other studies making it difficult to confidently compare results - The ages of women included in the cohort were not reported
Contribution	Knowing general rates of women who have surgery following pessary fitting can be valuable in educating patients on pessary treatment and potential timing and outcomes of the treatment. This presents clinicians with more knowledge in order to understand how patient characteristics correlate with either surgery or pessary use. This can help clinicians predict which patients will be more successful with pessary use and which may be more likely to opt for surgery.

Citation	**Dwyer L, Kearney R, Lavender T. A review of pessary for Prolapse practitioner training. *Br J Nurs*. 2019; 28(9): S18-S24.**
Link	https://www.magonlinelibrary.com/doi/abs/10.12968/bjon.2019.28.9.S18
Summary of Article	This is a literature review from the UK of 13 articles related to pessary practitioner training which contained these three inclusion criteria: relevant to pessary practitioner training, published in English, of original research. Eight themes were identified regarding pessary practitioner training prevalence of pessary training, type of pessary training, confidence in pessary care provision, impact of pessary care, skills and knowledge required to be a pessary practitioner, barriers, specialty of pessary care providers and ongoing support. Some of the key points are outlined here. Practitioners should have knowledge of vaginal examination, female pelvic anatomy, the range of pessaries available as well as and the clinical characteristics and lifestyle factors that make a pessary suitable for a specific patient. Learning through clinical supervision from a dedicated mentor was unanimously agreed to be the best method of pessary training by nurses. Some barriers include logistics lack of recognition and remuneration for undertaking additional training. There is also was a lack of a policy to support pessary care to be delivered by those other than medical doctors in specific healthcare environments. Overall this review found that there is a lack of standardized training on how to fit pessaries. Research is required to explore how pessary practitioners decide the optimum pessary to use with each patient. Practitioners included in the study were dissatisfied with the current training. They reported that clinical experience providing pessary care correlates with practitioner confidence. It also concluded that the most effective training needs to include both didactic and clinical components regarding fitting pessaries. Ongoing support is also necessary to ensure trainees become confident and translate pessary training into clinical practice.
Strengths & Limitations	**Strengths:** This review identifies specific themes that are involved with pessary training which can help guide and structure future research and training. The review included articles from multiple large countries including the United Kingdom, Australia, United States, Canada and South Africa. Finally, it considered multiple types of practitioners that have potential to fit pessaries including nurses and physical therapists in addition to physicians. **Limitations:** Because the review occurred in multiple countries (UK, Austraila, USA, Canada and South Africa), results may be difficult to generalize given differences in education and healthcare delivery. Only 2

	of the 13 articles included information on pessary practitioners other than physicians.
Contribution	A lack of specific pessary training guidelines (UK) means that practitioners depend on professional experience and manufacturer information rather than direct research evidence. A one-off training session may not be enough to equip health professionals with the skills and knowledge required to work autonomously. Information provided on a baseline medical knowledge base would include pelvic health physical therapists as preferred practitioners Further research is required exploring the clinical impact of pessary practitioner training with a particular focus on patient outcome and patient perspectives.

Citation	**Neumann et al. Training of Australian health care providers in pessary management for women with pelvic organ prolapse: outcomes of a novel program. ANZCJ. 2015; 21(1):6-12.**
Link	**https://search.informit.com.au/documentSummary;dn=047779068721756;res=IELHEA**
Summary of Article	This is prospective study looking at the impact of a multidisciplinary pessary training course for women's health practitioners. A total of 98 health professionals including 79 continence and women's health physiotherapists, 15 continence nurses, 2 gynecologists, 1 urologist and 1 geriatrician. The day long courses were based on a 2012 clinical practice guideline addressing pessary management. The topics included an overview of anatomy, etiology of POP, assessment and management of POP and prescription and fitting of pessaries. Participants were also instructed in patient education regarding pessary self-care, potential complications and follow-up. As part of the training they were able to practice fitting pessaries on models. Questionnaires were sent to the course participants at 3, 6 and 12 months following the training which asked how many pessaries they had fit in clinical practice since the training, what their level of confidence was and what complications and barriers they had experienced. There was a 42% response rate from the practitioners, and findings were reported with the assumption that those who did not respond were not fitting pessaries. 29% of all participants who had not fit a pessary prior to the training course reported they had started to prescribe after taking the course. Practitioners reported the following barriers to providing pessary care: time constraints, costs, suitable patients, support from other colleagues, and public sector issues including lack of established protocols and scope

	of practice issues. A small number reported lacking confidence, especially with different types of pessaries such as the Gellhorn pessary.
Strengths & Limitations	**Strengths**: Provides detail about what was included in training course so that it could potentially be replicated. Looked at specific reasons why clinicians were not able to incorporate pessary use into their clinical practice so that further attempts would be able to account for and address those issues. **Limitations**: The response rate of participants was 42% following the training course. It is not reported how many of the 29% who started fitting pessaries were physiotherapist, nurses or physicians.
Contribution	Scope of practice and protocols for pessary fitting and management need to be standardized. With sufficient training physiotherapists and nurses are able to use pessaries to manage POP. This is currently an extension of the scope of Australian practice for both professions but provides more availability of pessary care for women. Sufficient training should include background information on anatomy and POP, practice fitting pessaries on live models and mentorship from more experienced practitioners

Citation	Bø K, Majida M, Engh ME. Does a ring pessary in situ influence the pelvic floor muscle function of women with pelvic organ prolapse when tested in supine? *Int Urogynecology J*. 2012;23(5):573-577.
Link	http://www.ncbi.nlm.nih.gov/pubmed/22086263
Summary of Article	This is a short-term experimental study from Norway comparing vaginal resting pressure and MVC of the PFM in supine measured with and without a ring pessary in situ. 22 women with POP-Q grade II-IV, who were able to correctly contract the PFM and hold contraction for 10s were included and acted as their own controls. A correct PFM contraction was defined as a visible and palpable inward lift and squeeze around the pelvic opening. The size of the pessary was loose-fitting but large enough to retain prolapse. Resting vaginal pressure and MVC were measured using a fiber-optic microtip transducer connected to a balloon catheter with the patient in supine. There was no significant difference in MVC with the ring pessary in situ. However, there was a significant change in vaginal pressure. Mean vaginal resting pressure increased from 18.8 cm H_2O to 24.1 cm H_2O. Previous research has suggested that women with higher vaginal resting pressure were less likely to have POP (Brackken IH, Majida M, Ellstrom ME, Bo K 2009).
Strengths & Limitations	Strengths: • Method of measurement has been shown to be reproducible and valid • Performed an a-priori power calculation based on measurements with the same methodology • All women had thorough instruction and confirmation of ability to perform a correct PFM contraction before entering the study

	• Single examiner assessed ability to perform a correct contraction; two experienced gynecologists inserted the pessaries • Inclusion criteria included advanced POP stages Limitations: • Order of procedures was not randomized, potential for a learning effect • Measurements only done in the supine position • Only one type of a pessary (ring) was used • Exclusion criteria included breastfeeding, pregnancy, prolapse too advanced to allow for introduction of the measurement catheter into the vagina • Short-term study, only assessed the immediate effect of POP with a pessary and only assessed in the supine position.
Contribution	PFM strength can be accurately measured with and without a ring pessary repositioning the prolapse in supine; thus, PFM training would be effective regardless of the presence of a ring pessary in supine, but has yet to be confirmed in other positions. Although a ring pessary did significantly change immediate resting vaginal pressure in supine, other studies are needed to determine long-term effect of a more permanent use of a ring pessary on different aspects of PFM morphology and function. These findings can be used to recommend pessary use during supine activities i.e. sleep and supine rehabilitation exercises. More information is needed regarding how a pessary impacts functional positions such as sitting and standing.

Citation	Bø K, Hilde G, Stær-Jensen J, Siafarikas F, Tennfjord MK, Engh ME. Postpartum pelvic floor muscle training and pelvic organ prolapse—a randomized trial of primiparous women. *Am J Obstet Gynecol*. 2015;212(1):38.e1-38.e7.
Link	http://www.ncbi.nlm.nih.gov/pubmed/24983687
Summary of Article	This study was a secondary analysis of a parallel group assessor blind RCT from Norway comparing the effectiveness of a 4-month PFMT program on prevention and treatment of signs and symptoms of POP in 175 primiparous women with a mean age 29.8 years who had had a vaginal delivery to a singleton infant after at least 32 weeks gestation. The program began 6-8 weeks postpartum. Women were excluded if they had third- or fourth-degree perineal tears as they were automatically referred to physical therapy. The PFMT group followed a supervised, weekly group training program and performed 3 sets of 8-12 close to max PFM contractions per day. Primary outcomes were the stage of POP which was assessed using POP-Q and bladder neck position which was assessed by 3-/4- dimensional transperineal ultrasonography. Secondary outcomes included symptoms of vaginal bulge which were assessed International Consultation on Incontinence Vaginal Symptoms Questionnaire. Following intervention there was no significant risk difference in POP stage, bladder neck position, or symptoms of vaginal bulge. Outcomes also did not improve in the subgroup of women with major levator ani defects. Statistically significant difference in pelvic floor muscle strength from 6 weeks to 6 months

	in favor of the PFMT group. However, the activity level of both groups was reported to be the same at both six weeks and six months postpartum despite pelvic floor muscle strength.
Strengths & Limitations	Strengths: • RCT study design • Blinding of assessors (gynecologists and physiotherapists) • Use of supervised training following recommendations for strength training • High adherence ○ 96% of the women in the PFMT group adhered to ≥80% of both group and home training sessions • Use of reliable and valid outcome measures • Explicit inclusion and exclusion criteria Limitations: • Loss to follow-up • Small sample size in some of the comparisons • Questionnaire on POP symptoms not validated in a postpartum population • Conducted at a single center (Akershus University Hospital, Norway) • Breastfeeding status not defined in patient population • The exclusion of women with 3rd and 4th degree tears
Contribution	There is limited knowledge on remission of POP in the postpartum period, however this study found no significant improvement in POP-Q score, bladder neck support, or vaginal bulge symptoms with an intensive group PFMT program for primiparous women beginning 6-8 weeks postpartum. There was a small but statistically significant improvement in the muscle strength in the training group. More cohort studies and randomized controlled trials are needed before strong conclusions can be made regarding the effect of PFMT starting at 6-8 weeks postpartum on POP in primiparous as well as multiparous women. If included women with known perineal trauma (3rd and 4th degree tears) may have changed the outcomes. Given this result, clinicians should consider other forms of treatment such as pessary and other behavioral interventions including IAP management for POP in addition to PFMT.

Citation	**Panman et al. Effectiveness and cost-effectiveness of pessary treatment compared with pelvic floor muscle training in older women with pelvic organ prolapse: 2-year follow-up of a randomized controlled trial in primary care. *MENOPAUSE*. 2016; 23(12):1307-1318.**
Link	**https://journals.lww.com/menopausejournal/fulltext/2016/12000/Effectiveness_and_cost_effectiveness_of_pessary.9.aspx?casa_token=8uK5POoU7_MAAAAA:FPdkPCsp4UPrYCtyRC9Br1oZXHrJE8a1aMNKXo3dkQs_fInV7Ft6OJJB01Qsyx1yv4gHO4SK-TGkxFimXljNr-E**

Summary of Article	This is a randomized control trial from the Netherlands that looked at effectiveness and cost effectiveness of pessary treatment compare to PFMT to treat POP. To be included, women had to be 55 years or older and have symptomatic POP. Women with stage 4 POP as measured by the POP-Q were not included in the study. The primary outcome measure was the PFDI-20. Secondary outcome measures included the POPDI-6, CRADI-8, UDI-6. (PISQ-12) and (PCS-12). Women were randomized to either the pessary or PFMT groups. The first choice for pessary fitting was an open ring pessary followed by ring pessary with support. Shaatz or Gellhorn pessaries were tried in women who did not have successful fitting of the ring pessary. Women randomized to the PFMT group were referred to a pelvic floor physiotherapist for individualized training which address the specific pelvic floor diagnosis. Women received an average of seven treatments over 15.9 weeks. Both the pessary and PFMT groups showed improvement in pelvic floor symptoms as reported by a decrease in scores on the PFDI-20 at 24 months (59.8 to 50.5 in the pessary group and 65 to 62.6 in the PFMT group) as well as subjective report by the subjects. There was no significant difference in the PFDI-20 between the 2 groups. There was a significant difference in POPDI-6 scores between the 2 groups in favor of pessary use. The POPDI-6 scores improved by 24% in the pessary group during the first 3 months of treatment. There were also significant differences in favor of the pessary group for sexual functioning (PISQ-12) and in favor of the PFMT group for the physical component of general quality of life (PCS-12). Pessary use was found to be more cost effective than PFMT. Direct medical costs over the 2-year period of the study in the Netherlands were $309 per person in the pessary group and $437 in the PFMT group.
Strengths & Limitations	Strengths: - 2-year longitudinal study - Includes cost analysis of both treatment options - Used multiple outcome measures **Limitations:** - Only included women 55 years and older - Potential lack of consistency with PFMT due to lack of training protocol
Contribution	PFMT and pessary use are both effective options for treating POP. Pessary treatment may be more beneficial in reducing prolapse related symptoms compared to PFMT. PFMT scored higher in the general QOL measurements. In this protocol model pessary treatment is also a more cost-effective option than PFMT. The authors suggested exploring the effectiveness of combining PFMT and pessary treatment.

Citation	Wiegersma et al. Predictors of success for pelvic floor muscle training in pelvic organ prolapse. Phys Ther. 2019;99:109-117.
Link	https://academic.oup.com/ptj/article-abstract/99/1/109/5134171?redirectedFrom=fulltext
Summary of Article	This is a Dutch study aimed at finding predictors of successful pelvic floor muscle training in patients with POP. The study is a secondary analysis of two previous randomized control trials. • POPPS trial 1: women with mild POP (stage 1 or mild stage 2) received either PFMT (n=145) or watchful waiting (n=142) • POPPS trial 2: women with advanced POP (advanced stage 2 or stage 3) received either PFMT (n=79) or pessary treatment (n=81) Patients who were randomized to participate in PFMT in the previous trials were analyzed. 172 women all 55 years or older (median age of 63.5) were included. Women were screened for POP symptoms via a postal questionnaire and received a baseline assessment of POP. The participants considered in the secondary analysis were those who were randomized to a PFMT group in either of the POPPS trials and attended at least one PFMT session. Patients were referred to physical therapy so PFMT was individualized to each patient. Interventions included education about function of the pelvis and pelvic floor, instruction on contraction and relaxation of pelvic floor and lifestyle and toileting advice. They were advised to perform pelvic floor muscle training exercises 2 or 3 times per day, 3-5 times per week. Patients were seen an average of 9 visits. Success of PFMT was measured by subjective report of perceived change in POP symptoms rated as success or failure. These were patient centered definitions. Candidate predictors were gathered from literature reviews and expert panel responses that were available in the patient dataset. There were several candidate predictors that were unavailable to include in this study such as motivations, personality traits, cultural background, socioeconomic status etc. The PFDI-20 was used to measure symptom distress. On basis of participants perceived change in symptoms, PFMT was found to be a success in 55% (94 women) and a failure (same or worse) in 45% (78 women). The two factors found to be predicative of success with PFMT was younger age (mean age of 63.7 vs 66.2) and having had a previous obstetric trauma *(*Defined as the presence of 1 or more of the following factors: birth weight of heaviest child of ≥4000, episiotomy, perineal laceration during vaginal delivery, or instrumental delivery (forceps or vacuum extraction). According to this study, the odds of PFMT being successful continually decrease as a woman ages. The authors hypothesize that this was because the older women in this study were less able to build muscle strength.

	Furthermore, the study suggests that older women are more accepting of their condition and symptoms than are younger women and therefore may be less likely to adhere to home exercises, making treatment less effective. Although previous obstetric trauma and younger age were found to correlate with improved success of pelvic floor muscle training, these factors only accounted for 11.7% of the variance in outcomes. Given this data, it is not possible to accurately predict the outcomes of PFMT using these two factors alone.
Strengths & Limitations	**Strengths:** Identified that specific patient characteristics can influence outcomes of pelvic floor muscle training. Individualized PFMT program based on patient assessment. **Limitations:** Selection of predictors were based on expert opinion. It is possible there are other important factors which were not considered in this study that could be more effective predictors. Only included candidates for PFMT that were over 55 years old. The failed category included participants who reported they were the same and/or worse. The failed category therefore did not consider lack of symptom progression as a factor of PFMT. No measurements of exercise adherence to home exercises, lifestyle changes, or toileting habits.
Contribution	Given the relatively high rate of failure to perceive change when using PFMT in women over 55 years of age, it is important for clinicians to consider other forms of treatment for POP such as pessary use. It is difficult to determine whether a patient will have a successful outcome or not based on the personal factors considered in this study.