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SPECIAL CONTRIBUTION

International Urogynecology Consultation Chapter 3 Committee 1 – Pessary Management

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Abstract

Introduction and Hypothesis This manuscript is part of the International Urogynecological Consultation (IUC) on Pelvic Organ Prolapse (POP), Chapter 3, Committee 1 focusing on pessary management of POP.

Methods A narrative review was conducted by an international, multi-disciplinary group of clinicians working in the field of pelvic health following a search of the literature using the MeSH terms "pelvic organ prolapse" OR "urogenital prolapse" OR "vaginal prolapse" OR "uterovaginal prolapse" AND "pessary" OR "support device" OR "intravaginal device." Relevant studies, as determined after review using the Covidence manuscript review platform, were included.

Results A total of 540 articles were reviewed, of which 313 were included for this narrative review. The reported pessary fitting success rate ranges from 41% to 96.6%, and the continuation of successful use rate varied from 21% to 97.7%. The most likely predictors of unsuccessful fitting trials were previous POP surgery, previous hysterectomy, short vaginal length, wide genital hiatus, and posterior compartment involvement. Following successful pessary placement in individuals with POP, vaginal bulge and pressure resolved in over 90%. A significant improvement in obstructive voiding was reported in 40–97% of participants, urinary urgency in 38%, urgency urinary incontinence in 29–77%, and stress urinary incontinence in 9–45%. Older age and women who can self-manage the pessary care or had family support were factors associated with pessary continuation. Common reasons reported for discontinuation included expulsion, vaginal pain/discomfort, unwillingness to continue, erosions, desire for surgery, bleeding, symptoms not improved with pessary, and incontinence. More serious complications (fistula, bowel obstruction, pessary impaction, and vaginal cancer) are rare, and occur usually in older women in whom pessary maintenance has been neglected. There is no high-quality evidence to guide pessary choice. The current literature lacks studies specifically focused on determining the role of preventative measures, i.e., estrogen, pessary type/material as regards to pessary-associated complications (PACs). The review identified a lack of information about the relevant and required training and education (for healthcare professionals and patients) for pessary provision, use, and management.

Conclusions There is a considerable body of published work on the use of pessaries for POP, including effectiveness, factors associated with success and failure, and complications. However, there is a dearth of published literature regarding how pessary types are selected by providers, how providers are trained, what defines competency in pessary provision, and what constitutes appropriate patient education related to pessary use and management.

Keywords Pessary · Pelvic organ prolapse · Vaginal device

Introduction

This narrative review is part of a four-chapter project, the International Urogynecology Consultation (IUC), sponsored by the International Urogynecology Association (IUGA). The IUC is a project dedicated to reviewing and summarizing the world's literature on pelvic organ prolapse (POP). The present report is one of three reports from the project's third chapter, which is devoted to the conservative

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management of the patient with pelvic organ prolapse (POP) and also includes reports on pelvic floor muscle training (physiotherapy, biofeedback) and weight loss/lifestyle modifications/mind body therapy (central desensitization). The other three prior and subsequent chapters covered: defining POP, evaluation of patients with POP, and surgical treatment of POP. The intent of the IUC is to produce a series of narrative review articles regarding POP with the aims to guide and inform clinical decision-making and best practice and to identify knowledge gaps and goals for future research. This article focuses on the role of pessaries in the management of POP.

POP is defined as an anatomical prolapse with descent of at least one of the vaginal walls to or beyond the vaginal hymen with maximal Valsalva effort with the presence either of bothersome characteristic symptoms, most commonly the sensation of vaginal bulge, or of functional or medical compromise due to prolapse without symptom bother [1, 2]. It is a prevalent condition that when symptomatic can have a significant negative impact of women's quality of life (QoL) [3]. Many women may experience bladder, bowel, and sexual symptoms that could be associated with but not caused by the prolapse [4]. Patients with POP have several treatment options, including observation, physical therapy (supervised pelvic floor muscle training), lifestyle modifications, pessary use, and surgery. Patients and their healthcare providers take many issues into consideration when selecting a treatment strategy. This narrative review will explore some of the issues around pessary management.

A pessary is a device inserted into the vagina to provide structural support to one or more of descending vaginal compartments, i.e., the uterus, anterior vaginal wall (and bladder), posterior vaginal wall (and rectum), and/or vaginal apex (with or without small intestine after a prior hysterectomy) [5], with the aim of relieving symptoms associated with POP. Pessary use has been documented in the literature for centuries, with half a pomegranate in the vagina being one of the earliest "pessaries," as described by Polybus, the Greek physician. Later in the sixteenth century, the first purpose-made device to be used as a pessary was described [6]. The use of pessaries in the management of prolapse has increased considerably in recent years as the benefits of nonsurgical management have been reinforced with evidence for their effectiveness. As awareness has increased about complications related to surgical repair particularly with synthetic meshes [7, 8], there has been a resurgence in interest in pessaries.

This manuscript does not include the use of pessaries for stress urinary incontinence, in pregnancy, or other pelvic floor disorders. This review will focus on three key areas: (1) populations and clinical outcomes; (2) evidence to guide practice and manage risks and complications; and (3) training and education of healthcare providers and pessary users.

Methods

The IUC committee generated a list of guiding questions and suggested search terms for the narrative review and presented these to the IUGA membership at an annual scientific meeting, after which both were revised. Figure 1 presents final key questions that guided the review within each focus area. The final search terms included ("Pelvic Organ Prolapse"[Mesh] OR "Uterine Prolapse"[Mesh] OR "Cystocele"[Mesh] OR "uterovaginal prolapse" OR "urogenital prolapse" OR "vaginal prolapse") AND ("Pessaries"[Mesh] OR "pessary" OR "intravaginal device"). The term "support device" did not add to the search results and was thus omitted. Data were updated during the review up to December 2021.

The search strategy included Ovid Medline, EMBASE, CINAHL, Cochrane, and Pubmed, filtered for articles with full text available in English. Identified articles were transferred into Covidence, which is a systematic reviews production tool for title/abstract screening, full-text screening, data abstraction, and quality assessment. Five committee members screened all the articles, with discrepancies managed by additional reviewers, to select the final articles included in the full review. The committee was then divided to focus on the synthesis of the review by section, with all members involved in the final manuscript development.

Results

A total of 547 articles were screened and 313 were included in the full review. The Prisma diagram for the search is displayed in Fig. 2.

Section 1 – Populations and Clinical Outcomes

What Patient Populations are Offered Pessaries and Who Provides Pessary Care?

Many patients diagnosed with POP are offered the option of a vaginal pessary for treatment [9, 10]. There is some variation in the literature on what characteristics make a patient more receptive to the option of pessary use. Patient factors associated with pessary uptake include fear of, or aversion to surgery [11], severity of symptom bother [12], and older age. Kapoor et al. reported the greatest uptake among women who were older and more sexually active [13]. Similar age-related associations were described in two other observational studies [12, 14]. In one retrospective

Fig. 1 Key questions related to pessary use for pelvic organ prolapse

Section 1: Populations and clinical outcomes

1. What patient populations are offered pessaries and who provides the pessary care?
2. What impact do pessaries have on symptoms of POP in the short and long term?
3. What are the indicators for success or failure with pessary fitting, use, and persistence with use?

Section 2: Evidence to guide practice to prevent/manage pessary-associated complications

1. What options exist in pessary material, shapes, and sizes and is there a correlation to different forms of prolapse?
2. What are the reported short-term and long-term complications associated with pessary use and how do they vary based on pessary type, duration of use and patient age?
3. What are the risk factors for developing complications and what is the evidence for their treatment and prevention?
4. What are the optimal recommendations for maintenance (both self-managed and managed by clinical providers)?
5. How do patients who opt for self-management differ from those who opt for clinical provider care for pessary management?

Section 3: Training and Education

1. What training and standards in pessary management exist for healthcare professionals, and what is the evidence behind them?
2. What is women's knowledge about pessaries and what is the training required for pessary self-management?

study of 72 women in China, not being sexually active was positively associated with pessary uptake [14]. In one study, univariate analyses found associations between aversion to pessary use and having previously seen a gynecologist, having a lower level of education, and having a more negative view of pessaries [15].

Provider characteristics

Patient age, medical comorbidities, prolapse severity, desire for future sexual activity, and attitudes about self-care are often cited as reasons why providers do or do not offer pessaries [9, 16–20]. In one study, surgeons were more likely to offer a pessary trial when symptoms exceeded the observed degree of prolapse [21]. Two studies found that surgeons were less likely to offer a pessary trial when patients needed treatment for both POP and incontinence [22, 23].

Few provider-specific factors have been reported to influence pessary prescription, patient uptake, and continuation. In a cross-sectional study of pessary prescribing in Brazil, Coelho et al. described greater prescription by providers who were younger, fellowship trained, and practiced in high-volume centers [16]. In another study, female health professionals were more likely than their male counterparts to fit pessaries for prolapse (38.5% vs 25.4%, $p < 0.01$) [17]. An International Urogynecology Association (IUGA) survey of physician members about their practice on the use of pessaries for the treatment of POP, as well as investigations prior to surgical repair of POP, found significant variability based on geographical region of practice [24]. Regional differences were noted from surveys of practice identified in this review of the literature: the USA [18], the UK [17], the Netherlands [9], Brazil [16], Africa [25], Japan [26], and France [8]. For example, in Africa fewer gynecologists offer pessaries as a first line option compared to those in France, Japan, the UK and USA. In France and Brazil care is generally provided by doctors but in the UK, USA and the Netherlands care is often provided by nurses or physiotherapists. However, comparisons between all these surveys are challenging as there are only a few common questions.

Numerous multidisciplinary care team models have been described for pessary fitting, maintenance, and complication management. In these multidisciplinary settings, advanced practice nurses [27] and physicians (primary care, gynecologists, urogynecologists) are most likely to manage pessaries, followed by physiotherapists [14, 28] and physician assistants [18], but not all professionals offer all aspects of pessary care. Bugge et al. reported that in the UK, initial pessary fitting was performed nearly three times more often by gynecologists when compared to continence nurses (98% vs 32%) [17]. In another study of pessary practices among doctors and nurses in the United States, a more equal distribution was reported for pessary fitting (72% of drs vs. 70% of nurses) and aftercare (71% vs. 79%) [18]. Rates of follow-up with a gynecologist after fitting were similarly high (86%) in a study of Dutch gynecologists [9]. In a retrospective review of women treated with pessary at a nurse-run continence clinic in Canada, it was suggested that physicians consider transferring their patients to

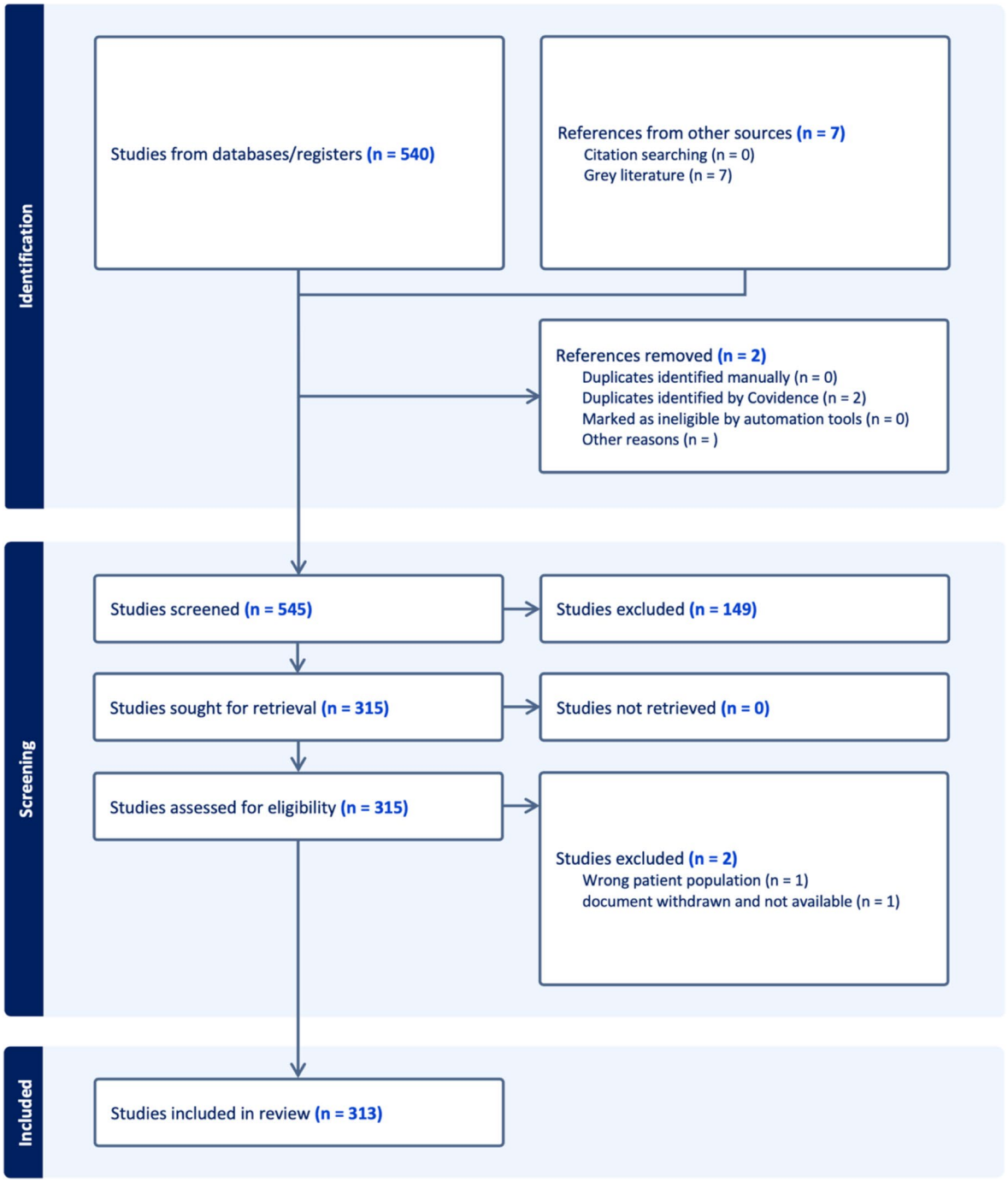

Fig. 2 Prisma diagram

skilled advance practice nurses for follow up pessary management given frequent concerns about time-consuming appointments [29]. Vasconcelos et al. described a model within a tertiary care hospital in Brazil where physicians routinely transfer patient care to advanced practice nurses for pessary fitting and follow-up. In this system, urogynecologists remained available for management of complications and failures [30]. Despite the description of various practice models there is little to no information on how these different practice models affect patient acceptance or persistence of pessary use.

What Impact Do Pessaries Have on Pelvic Floor Symptoms in the Short and Long Term?

In several studies looking at symptom change following successful pessary placement in individuals with POP, vaginal

bulge and pressure resolved in over 90%. A significant improvement in obstructive voiding was reported in 40–97% of participants, urinary urgency in 38%, urgency urinary incontinence in 29–77%, and stress urinary incontinence in 9–45% [23, 31–35]. New onset stress urinary incontinence may occur in roughly 25% and urgency urinary incontinence in 6% [31, 33]. Improvements in bowel symptoms have also been reported with reduction in difficult bowel evacuation (28%), fecal urgency (23%), and in urgency fecal incontinence (20%) [31, 36, 37]. In the Cochrane review on Pessaries for the management of POP, it was concluded that due to low numbers of women in trials and due to lack of methodological evidence, it is uncertain if pessary improve POP symptoms for women compared with no treatment or when compared to another active treatment such as PFMT, but pessaries in addition to PFMT probably improve women's symptoms and prolapse-specific quality of life [38].

Impact of Pessaries on Sexual Function

Data about the impact of pessary treatment for POP on sexual function are limited. Being sexually active is not a contraindication to pessary use, and studies have demonstrated that sexual function can improve with pessary use, including improvement in sexual satisfaction and frequency of intercourse based on the Pelvic Organ Prolapse Quality of Life Questionnaire [31]. In one observational study of pessary use for at least 6 months among sexually active women, 79% reported an improvement in sexual symptoms or enhanced relationship with their partner after using the pessary [39]. Sexual symptoms measured by the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire IUGA (PISQ) are improved with prolapse treatment, but this improvement is suggested to be greater in patients treated with surgery than those treated with pessary [40, 41]. Patients whose prolapse impacts their sexual function may be more likely to opt for surgical than pessary management [13].

Most studies that consider sexual function include women fitted with a ring pessary, as it can be left in place for intercourse [31, 37, 42–44]. Other pessaries that may be left in place during intercourse include the dish and Shaatz [45, 46], while space-occupying pessaries such as donut, Gellhorn, and cube would generally be removed for penetrative intercourse. While changing position or angle of penetration may be helpful for patients attempting intercourse with a pessary in place, partner dissatisfaction with pessary is one reason cited for discontinuation [45]. In a different study, being sexually active was positively associated with pessary continuation [20]. Patients using a cube pessary and vaginal estrogen reported increased sexual desire, lubrication, and satisfaction without impact on orgasm, according to the Female Sexual Function Index questionnaire [47].

While multiple studies have demonstrated improvement in sexual function in women using pessaries, it is necessary to note that some studies have demonstrated no significant change in sexual function with pessary use, especially when compared to surgical management of prolapse [37, 48].

Impact of Pessary Use on Pelvic Floor/Support

It has been postulated that repositioning POP by vaginal pessary may improve levator function and muscular support of the pelvic floor [49], though data are limited and conflicting. In one small study of 22 women using a ring pessary, Bø et al. found increased vaginal resting pressure but no difference in pelvic floor muscle contraction strength or endurance before and after insertion of pessary ring [50]. In a study of 50 women who used a ring pessary for at least 4 months and had it removed at least 72 h before repeat assessment, statistically significant improvements in median POPQ points Ba (+4 to +3), Bp (+3 to −1), C (+4 to −4), GH (6 to 5), and PB (2 to 3) were noted [51]; however, this was the only time point assessed. There are no studies looking at if and when a clinical examination of a POP may return after removal of a pessary.

What are the Indicators for Success or Failure with Pessary Fitting, Use, and Persistence?

Pessary Fitting

What constitutes a successful pessary fitting varies widely in the literature, largely based on the time duration used to define success. The various definitions of successful pessary fitting used by papers included in this review spanned from comfort and intent to continue use on the day of the fitting to continued use for at least 3 months following initial fitting. Generally, the reported pessary fitting success rate ranges from 41% to 96.6% [19, 23, 25, 30, 31, 37, 43, 52–75] (Table 1).

Different studies identified different factors associated with fitting success, and some areas were inconsistent (Table 2). The most commonly identified predictors of unsuccessful fitting trials were previous POP surgery, previous hysterectomy, short vaginal length, wide genital hiatus, and posterior compartment involvement. Parity and prolapse severity were not commonly associated with success rates. Data conflicted regarding hormone use, co-existing urinary incontinence, age, body mass index (BMI), smoking history, and sexual activity.

Pessary Use and Persistence

Similar to definitions of pessary fitting success, the literature about pessary use continuation varies widely depending on

the duration of follow-up, which ranges from 3 months after initial insertion to longer periods of 8–12 years. Therefore, it is not surprising that the continuation of successful use rate varies widely from 21% to 97.7% [76–87] (Table 3).

Commonly reported reasons for discontinuation included expulsion, vaginal pain/discomfort, unwillingness to continue, erosions, desire for surgery, bleeding, symptoms not improved with pessary, and incontinence.

Factors consistently associated with pessary persistence were older age, pessary self-management, and family support. Data conflicted about the association between continuation and history of hysterectomy, POP surgery, short vaginal length, larger genital hiatus, larger baseline perineal body measurements, and presence of concomitant or occult urinary incontinence. Hormone use, sexual activity, BMI, parity, type of pessary, type and severity of prolapse, menopausal status, occupation, comorbidities such as diabetes and smoking history were less likely to impact pessary persistence, though vaginal estrogen use has been associated with pessary continuation in a few studies [87–89]. A detailed description of findings regarding factors associated with pessary continuation is provided in Table 4.

Section 2 – Evidence to Guide Pessary Management

Management of pessaries revolves around finding the appropriate pessary and avoiding pessary related complications.

What Options Exist in Pessary Material, Shapes, and Sizes and is There a Correlation to Different Types of Prolapse?

There is a great variety of pessary shapes and sizes and evidence for each of these is limited by variations in use, knowledge, experience, availability, and cost. Pessaries may be classified as either support pessaries, such as ring or ring with support and Shaatz, or space-occupying pessaries, such as cube, Gellhorn, shelf, and donut. Pessaries are comprised of a variety of materials, most commonly silicone, polyvinyl chloride (PVC), or acrylic, and may be flexible or rigid. A guide was developed in the UK, with broad stakeholder endorsement, to consider all the pessary types, materials, and sizes available and how to fit and remove each type [90]. Most pessaries are made from medical grade silicone elastomer, which is considered a synthetic rubber, because of its non-allergenic, non-carcinogenic, non-absorbent, heat-resistant, and favorable pliable properties. In a 2020 survey among nine professional bodies representing pessary care providers in the United Kingdom, pessaries made from PVC or silicone were the most commonly used [28].

Across all the literature, ring pessaries are the most commonly used pessary shape. A survey by Cundiff et al. looking at trends in pessary use in the USA reported that support pessaries were more commonly used for anterior and apical defects, while space occupying pessaries were more commonly used for posterior defects and complete uterovaginal prolapse. The PESSRI study randomized individuals to a ring with support or a Gellhorn pessary and at 3 months found no difference in patient reported outcomes, suggesting equivalent short-term patient satisfaction with these two pessaries [91].

What are the Reported Short-Term and Long-Term Complications Associated with Pessary Use and How Do They Vary by Pessary Types, Duration of Use, and Patient Age?

While pessaries are often considered a low-risk intervention for management of POP, there are complications associated with pessary use. Most published research classifies complications as common versus uncommon and describe varying durations of pessary use before complications are experienced.

The most commonly reported side effects are vaginal discharge/bacterial vaginitis (rates 13–28%) [44, 92, 93], slipping or extrusion/expulsion (15–27%) [55, 56],vaginal discomfort/irritation/inflammation or erosion/ulceration (9–24%) [55, 56], vaginal bleeding (4–17%), vaginal odor (17%), and difficulty voiding or defecating (1–2%) [44, 55–57, 64]. Vaginal discharge may be related to inflammatory changes in the vagina and these changes can be seen as soon as 2 weeks after initiating pessary use [94]. De novo SUI is also reported. More severe complications, such as pessary migration into the cervix or uterus, fecal impaction, hydronephrosis, urosepsis, vesicovaginal or rectovaginal fistulas, and vaginal epithelial cancer, are much less common [95].

In the largest study to date, a 12-year retrospective cohort study of 304 women in Canada aged 65 years or older fitted with a ring or Gellhorn pessary for POP, vaginal erosion rates were higher in women 75 years or older and those with vaginal atrophy at baseline. The median duration of pessary use prior to erosion occurrence was 2.2 years and there was no correlation between erosion and pessary type [57]. In a study of 167 Australian women using ring pessaries for POP or UI over a 10-year period, complications were reported by 56%, and more than two-thirds of these experienced complications at more than one time-point during the 10 year study period [57]. In a smaller study of 104 ring pessary users in South Korea, 73% reported at least one mild complication, but 70% still reported being satisfied with the pessary and wanted to continue use; no severe complications were encountered [56].

The literature contains case reports of uncommon and severe complications of pessary use. These severe complications occur almost always in older women with years of pessary use and neglect in pessary maintenance. Neglected pessaries are usually Gellhorn or ring type, associated with older, frail, institutionalized women with advanced POP stage and many medical comorbidities, including memory impairment [96, 97]. Severe complications described include urosepsis and renal failure from urinary outlet obstruction [98–102], vesicovaginal, ureterovaginal, rectovaginal fistulas, and small bowel prolapse, incarceration, or bowel evisceration [103–108]. A 2015 systematic review examined complications by pessary shape, size, and type of material from 1952 to 2014 [109] found minor complications to be associated with all pessary types and materials. Fistulas occur more commonly with rubber or PVC pessaries when compared to polyethylene pessaries [110].

A published case series based on a literature search to identify major urinary and bowel complications from impacted pessaries requiring surgical intervention from 1950–2007 revealed 39 cases: eight vesicovaginal fistulas, five urologic complications, four rectovaginal fistulas, three bowel complications, and 19 impacted pessaries. All but two of these complications were related to a neglected pessary [104]. The two exceptions were cases of vesicovaginal fistulas in elderly women despite appropriate follow-up. Of note, almost all reported cases were related to Gellhorn and shelf pessaries, which are among the most difficult to remove and reinsert, but major complications can be reported with ring pessaries as well [98, 99, 111, 112]. A similar case series and literature review of 17 studies, including 23 cases of rectovaginal fistula associated with pessaries, also found that older women using space-occupying pessaries were at highest risk (median age 83 years, Gellhorn, shelf, and cube types most common), and cardiovascular disease was the most common medical morbidity in these women [110].

Miscellaneous complications such as concealed vaginal hemorrhage, rapid pessary incarceration, and vaginal cancer associated with shelf pessary use have also been reported in the literature [113–115]. The exact mechanism of carcinogenesis is unclear, but it is theorized that pessaries left in place for long periods of time can cause local irritation or infection that leads to dysplastic changes of the squamous mucosa.

What are the Risk Factors for Developing Complications and What is the Evidence for Treatment and Prevention?

Pessary Cleaning/Review

Data conflict about the impact of cleaning interval or pessary replacement on vaginal discharge. Some studies have reported more frequent removal and cleaning of a pessary may be associated with less bothersome vaginal discharge [72, 116] while others have not shown any difference in patient perceived vaginal discharge before and after cleaning as well as no difference in patient perceived vaginal discharge between self-maintenance and those electing for office care with cleaning intervals of 3 and 9 months [117]. One study specifically looking at vaginal microbiota demonstrated no significant differences when comparing women who removed and cleaned their pessary on a regular basis versus continuous use for 1 month [116]. There may be an increased presence of vaginal anaerobes in women who remove their pessary less than once a week, but this was not associated with any significant differences in pessary satisfaction or vaginal discharge symptoms [118]. It is important to note here that medical device regulations differ around the world and there are different classes that determine how long a pessary can be left inside the body. It is therefore essential to refer to manufacturers recommendation for every pessary.

Role of Topical Estrogens

The effect of supplemental topical vaginal estrogen on increasing epithelial thickness, elasticity, and lubrication is well established within the literature [4, 23, 119, 120] but its role in preventing pessary associated complications has less evidence. Despite its widespread use in clinical practice, the effect of topical estrogen in resolving pessary associated ulcerations has not been widely studied in the literature. A recent systematic review and meta-analysis failed to show any significant benefit to topical estrogen use with pessary use except for a possible reduction in bacterial vaginosis [89], but most trials included had small numbers and short-term follow-up.

While many case series describe treating ulcerations or erosions with vaginal estrogen and/or a pessary holiday (removal of the pessary for several weeks), trials to support these treatment strategies are lacking [56, 94] and we did not identify any trials focused on preventing pessary complications.

What are the Optimal Recommendations for Pessary Maintenance (Both Self-Managed and Managed by Clinical Providers)?

Most pessary care is performed by patients at home doing self-management or healthcare professionals providing that care in a clinic setting. Publications describing home-based or community pessary care highlight the challenges of its implementation [121–123].

Published recommendations on pessary maintenance and follow-up exist from Australia, Canada, the USA, and the UK [127, 144, 152]. These documents are based primarily

on expert opinion with limited scientific evidence. Studies that examine pessary maintenance are limited in providing broad guidelines given the variety of pessary shapes, variations in patient self-management, and vaginal tissue quality. All these publications highlight recommendations for regular follow-up in women using pessaries and provide adjustments based on patient ability to self-maintain their pessary.

These guidelines vary in their specific recommendations, but all recommend follow up at some point between 1 and 6 weeks after initial pessary fitting via in person or telehealth visit. The recommendations for intervals between subsequent maintenance follow-up visits range from 3 to 6 months for patients who cannot remove and insert their pessary independently and from 6 to 12 months for patients who can independently manage their pessary care [90, 124–126]. This follow-up care may be with a physician, advanced practice provider, nurse, or physiotherapist [5, 14, 28]. For elderly patients, family willingness and ability to participate in care with transportation to follow-up visits may impact feasibility of pessary use [92].

Pessary follow-up typically involves removing and cleaning the pessary and performing speculum exam to assess for vaginal tissue health, abrasions, and erosions [29, 127]. Cleaning may be with regular soap and water [18, 125, 128–130], but can also be done with just water [125, 127]. Pessary manufacturers issue recommendations about cleaning depending on pessary material. Bugge 2013 notes that in the United Kingdom, it is usual practice to insert a new pessary at follow-up visits rather than cleaning and reinserting the previously used pessary, but this is likely due to PVC ring pessaries being most commonly used [17]. Other authors suggest pessary replacement can be considered annually and additionally as needed for cracks or tears [128, 129].

In response to manufacturers and early publications recommending pessary checks every 3–6 weeks [131–133] a 1997 prospective cohort trial specifically examined feasibility and safety of pessary checks among women using ring or ring with support pessaries at an interval of every 3 months in the first year and every 6 months thereafter [60]. Patients who were using a cube pessary had a different follow-up protocol and those women who developed vaginal abrasions or erosions were seen on a more frequent basis. This protocol of follow-up every 3–6 months has been demonstrated to be acceptable in studies since then with a wider variety of pessaries, including Gellhorn [19, 29, 31, 35–37, 61, 71, 73, 82, 88, 134], Shaatz [29, 71, 120], donut [32, 37, 71, 135], Marland [81], and incontinence dish [29, 88], and has been reproduced in studies using ring and ring with support [31, 35–37, 42, 44, 61, 71, 73, 88, 120, 136]. Cube pessaries have typically been associated with more frequent follow-up, but intervals of 3–6 months have also safely been reported when patients have been taught self-management [32, 37, 82].

Among pessary studies published over the past 5 years, typically initial follow-up after the pessary fitting was within 1–2 weeks [19, 22, 30, 44, 61, 63, 135, 137], and then subsequent follow-up would vary between 3 and 6 months afterward [19, 30, 61, 63, 82, 135, 138]. Initial follow-up from fitting appointment has also been described with longer intervals, including 1 month [82], 3 months [117, 138], and 6 months [42, 139], without any significant complications. Additionally, follow-up intervals up to 9 months [117] or even 12 months [44] have been demonstrated to be feasible in women using a ring or ring with support pessary even if they cannot remove and clean the pessary on their own.

Survey studies have assessed provider patterns of pessary maintenance, which align with this follow-up interval of 3–6 months in genera [1, 17, 18, 140–142] with lengthening intervals of follow-up when patients are doing well [9, 17, 143]. When expert nurse providers in pessary care were asked to create guidelines on optimal management of pessary in an office setting and self-maintenance, they were unable to come up with a consensus. Some providers were accepting of annual surveillance with self-management, other providers recommended every 6 months. Without self-management, recommendations varied from monthly to every 3 to 6 months [130].

Some of the variability in clinic follow-up for pessaries is dependent on the ability of patients to self-manage their pessary. In the previously stated guidelines, follow-up can be extended to an annual basis if patients are self-managing their pessary [124–126]. Pessary self-management can be taught to patients at time of fitting or at their follow-up visits. Rates of routinely teaching pessary self-management, reported in survey data by providers, shows significant variability ranging from 18% to 96% [9, 17, 143].

Interval of Pessary Cleaning and Removal with Self-Management

If patients can self-manage their pessary at home, a commonly recommended maintenance schedule is removing the pessary once a week, leaving it out overnight, and then replacing the next morning [19, 29, 35, 61, 73, 116]. Shorter intervals have been described as often as daily [12, 116, 144] or twice weekly [144] based on patient preferences, pessary type, especially cube, and the presumed positive impact of daily removal on vaginal tissue health [116]. Reported frequency of removal and cleaning of pessary varies from 5% to 40%, few times a week to weekly 31–40%, less frequent than weekly or monthly 20–40% [117, 118, 145]. Reported rates of patients self-managing their pessary range from 32% to 89% [63, 72, 73, 88, 116, 117]. A theoretical model for pessary self-management, developed for the Treatment Of Prolapse with Self-care of pessarY (TOPSY) trial, included more patient autonomy in decisions about removal times (at

least once every 6 months) and if and when they needed a clinical review [123].

Concomitant Vaginal Estrogen Therapy

There is considerable variability in provider recommendation of concomitant estrogen therapy with pessary use. In one study, 13% of respondents were prescribed estrogen routinely and 73% only prescribed when there was evidence of vaginal atrophy [9]. The rate of routine prescription was significantly higher (59%) in a survey of members of the International Urogynecology Association and the British Society of Urogynecology [22]. Symptom-based prescription was performed by 45% for patients affected by severe vaginal atrophy, pressure ulcers, and erosions [18].

Protocols for pessary studies typically recommend vaginal estrogen use in women who are postmenopausal [14, 19, 61, 63, 135, 138] or have noted vaginal atrophy [22, 29, 37, 65, 117] without contraindications to vaginal estrogen use, though some studies recommend routine vaginal estrogen unless contraindications [35, 44, 73]. Generally, clinical recommendations suggest vaginal estrogen when vaginal atrophy is present on physical exam [124, 146]. Limiting use of vaginal estrogen to those who need it may simplify pessary use for patients [21].

How Do Patients Who Opt for Self-Management Differ from Those Who Opt for Clinical Care for Pessary Management?

Characteristics that have been demonstrated to be positively associated with self-management include younger age [116, 117, 145], married status [145], being sexually active [117], less concomitant stress urinary incontinence [116], and fewer comorbid conditions [145]. Decision to self-manage a pessary may be related to confidence regarding ability to remove and replace the pessary, comfort with touching one's genitals, and desire to have flexibility [147]. Women who have had positive experiences with tampons or diaphragms may also be more willing to learn self-management [128]. Other factors that may negatively impact the ability to self-manage a pessary include reduced dexterity, cognitive dysfunction, morbid obesity, arthritis, or other musculoskeletal disorders [117], or neurological diseases such as Alzheimers and Parkinson's disease which can impact mobility [82]. In women who are motivated to self-maintain a pessary but have difficulty with removal, the use of dental floss or monofilament suture tied to the pessary can help with removal [130, 146]. Pessary type also impacts self-management with Gellhorn and donut pessaries commonly being noted as more difficult for patients to remove and replace [45, 125].

There are limited data about interventions to support pessary self-management, such as having a dedicated nurse to teach pessary maintenance [22] and providing written materials [148]. If a patient is unable to self-maintain their pessary, their caregivers or family members can learn to assist with removal and insertion [14, 30, 63, 71]. Engaging home health nursing in pessary care may also decrease the burden of clinic visits [34].

The ability to self-maintain a pessary may not predict continued use of a pessary. One study demonstrated that women who switched from using a pessary to surgical management were all able to self-maintain their pessary [149]. Similarly, in another study comparing women who could self-care for their pessary and those who elected for office care, there was no significant difference in the number of women in each group considering surgical management [145].

Section 3 – Pessary Training and Education

What Training and Standards in Pessary Management Exist for Healthcare Professionals, and What is the Evidence Behind Them?

There is no single internationally recognized set of guidelines on the training required by health professionals to achieve competence in pessary management or provision. A Canadian Guideline, published in 2021 [150], did not include recommendations for levels of training and a recent UK guideline, developed and endorsed by key stakeholders, outlines a number of training competencies but there is currently no associated syllabus or curriculum [151]. A competency training framework developed from the Standards in the UK Guideline is in development.

Identified Standards documents for specialist medical training with references to training in pessary management have been published by the Education Committee of IUGA [152], the American Urogynecologic Society (AUGS) [153], and the International Federation of Gynaecology and Obstetrics (FIGO) Working Group [154]. However, limited details were presented on how the knowledge and skills could be acquired and no reports were identified on the extent to which the recommendations had been adopted by members of the various colleges and societies.

Knowledge varies about indications for pessary use among obstetrician–gynecologists [155], nurses and physiotherapists [17], and members of professional societies related to urogynecology [24, 143] and nursing [18]. International studies suggest that differences in training and experience with pessaries may explain the widespread variability in the uptake of pessaries by gynecologists and other health professionals [16, 18, 25, 123, 156–159].

This literature review identified significant variability in training for those managing pessaries in clinical practice. In

2018, research for the James Lind Alliance identified training of health professionals as one of ten shared research priorities in relation to pessaries for women with POP in the UK [160]. A review published in 2019 concluded that standardized and internationally accepted training in pessary management is needed [161]. Since the publication of this review, there has been considerable new literature indicating marked variability in pessary training across countries and across disciplines, providing ongoing evidence of the need for improved training internationally for the multidisciplinary healthcare professionals that manage pessaries, including urogynecologists [156], gynecologists [8, 16], gynecology residents [158], nurses, midwives, and physiotherapists [157].

One study found that nurses received their knowledge from a variety of sources: physician mentors, nurse mentors, national workshops, professional journals, academic education, and industry resources in descending order of frequency [18].

In Australia tertiary level training in pessary management is available for physiotherapists [162]. A competency-based framework for physiotherapy training in pessary management based on interdisciplinary and international consultation has detailed the range of knowledge and skills across a range of clinical and management roles [163].

We found two published competencies in women's health for physiotherapists in the public health sector in Australia (Vic Health) and for both private and public health sectors [164]. Both programs included prerequisite training requirements for physiotherapists to achieve advanced practice status in women's/pelvic health prior to undertaking training in pessary management.

Robust methods of assessment will be required for any training program as self-assessment of competence, compared with external assessment, was found to have limited accuracy among physicians, especially among those who were least skilled and were most confident [165, 166].

Preferred Methods of Learning

The survey of practice by Brown et al., which was carried out in the UK within the National Health Service, found that the preferred method of training was to observe a competent practitioner [28]. However, this may have limited application in other countries where there are different models of medical care. In Australia, for example, where, anecdotally, many physiotherapists deliver pessary management in private practices and not multidisciplinary teams, this option is not feasible for training and acquiring practical skills.

Live models have been used for training gynecological examinations [167] and also for pessary training [28] and while not the most popular, the method enhanced participants' confidence in delivering pessary care. Alternatively, use of a small-scale pelvic model [168] or a foam model [169] to practice pessary placement and fitting, was also found to improve trainees' confidence and skills. Each country will have its own unique medical system which will require versatility/flexibility in delivery models to suit their local health professionals. It appears that optimal teaching methods, based on sound pedagogy, have yet to be established for all disciplines.

Primary or Tertiary Care

We found little research on the topic of how and where pessary management should be delivered, although the predominant model was for gynecologist and/or nurse-delivered pessary management prior to 2013, when physiotherapists were first reported on in surveys of pessary management [17]. Studies suggest that the provision of pessary management in tertiary care setting is "cost-ineffective and inconvenient for patients" and that more women could be managed in primary care setting with appropriate training of primary care physicians [170] and other relevant health professionals [121].

An increase in the number of urogynecologists needed to treat the increasing number of women in the USA with pelvic floor dysfunction has been predicted [171]. One solution to this problem would be to increase the training of other providers of care, gynecologists, GPs, nurses, and physiotherapists to be able to administer pessary management in primary care where possible [172].

Such a primary care model currently lacks support from a health economics perspective but warrants further research and may suggest that pessary management could be made more widely available to women, especially outside tertiary centers. However, in some countries, a change in the model of access to pessary management from tertiary to primary care means that women are responsible for the costs of their care and the pessary, which may not be covered by private health insurers, if indeed women hold such insurance. To address issues of equity, consideration of public funding for pessaries should be investigated.

Future Training Needs

A move for pessary management to be more widely available for women would rely on close inter-disciplinary cooperation between the members of the broader multidisciplinary team. It would require standards of training to be established for any practitioner, who is not sufficiently competent in all the required skills of pessary management.

Nurses have provided ongoing pessary management in several settings in low-resource countries [173] after initial urogynecologist prescription, but further training for nurses and physiotherapists to extend their scope of practice could enable pessary prescription for women with less severe/

complex prolapse to make pessary management more widely available. Agreed standards of training would be needed to ensure patient safety and approved training programs would need to be readily available. Research would be needed into optimal methods and content for health professional training in different settings.

Future training needs will be dictated by the model of service delivery in the country under consideration, availability of local resources, the professional to be trained, and whether it occurs in a tertiary or primary care setting.

Gaps in Training Requirements – Low Resource Countries

Despite the heavy social and physical toll of prolapse in low resource countries [174], we found few studies exploring the training requirements in these countries. In a feasibility study of the use of pessaries in rural Nepal, Robert et al. highlighted the need for resources and infrastructure for education, staff training, and follow-up monitoring for pessaries to be more widely available [58].

Pessaries have been shown to be a feasible option for women with prolapse in Western Uganda but the training requirements to support such a service were not described. [173]

What is Women's Knowledge About Pessaries and What is the Training Required for Pessary Self-Management?

Vasconcelos et al. provided a comprehensive review of the current state of research into patients' (and practitioners') knowledge, attitudes, and practice in relation to pessaries. The review revealed few studies, mostly done within the past five years and predominantly from high-resource countries [30]. The lack of research from low-resource countries, where pessaries might play an important role in POP management, was highlighted [174, 175].

POP is associated with shame and embarrassment with women having a poor understanding about prolapse and limited information about their treatment options, regardless of their nationality [176]. The internet has not been a source of reliable or evidence-based information [177–179]. Most women rely on their healthcare professional [180, 181]; however, research suggests that gynecologists have suboptimal knowledge about pessaries [8, 9, 28, 30, 155, 160, 161, 170, 182] which has implications for women's choices about management options and pessary management in particular.

Women's Training in Pessary Self-Management

The evidence to support the concept of women self-managing their own pessary is currently low-level [183], is unclear [184], and is being investigated in an RCT to establish its effectiveness and cost-effectiveness [185]. QoL measures will be reported. However, it remains to be seen whether the findings will be generalizable to all countries with different health systems and with fewer and different resources.

Impact of Pessary Management on Women

Women identified the impact of a pessary on sexual function as their first research priority [160], and while the current research suggests that pessaries do not negatively impact sexual function in women [186], there is little information on this impact in women of different ages. Given the paucity of research on pessary use in younger women, this will continue to be a research priority, particularly if, anecdotally, physiotherapists continue to address the needs of younger women with prolapse and promote returning to physical activity with pessary use.

We were unable to identify to what extent the role of sexual function in counselling women and in considering a pessary was addressed in training courses.

Overview of Findings

Populations and Clinical Outcomes

The literature does not offer robust data about the proportion of women with POP who are offered pessary management versus other management strategies. Women who are older or have more medical comorbidities may be more likely to be offered pessary management; data conflict about whether sexually active women are more or less likely to be offered this option. There are limited data about pessary use for postnatal women. Providers may be less likely to offer pessary management for POP to patients who have concomitant incontinence for which surgical treatment is indicated. Pessary management, both initiation and continued management, may be performed by advanced practice nurses, physicians, physiotherapists, and physician assistants.

For women who are successfully fitted with a pessary for POP, most experience improvement in quality of life, with vaginal bulge and pressure symptoms being more likely to improve than urinary or bowel symptoms. A small proportion of women experience worsening urinary symptoms after being fitted with a pessary. Pessary use does not preclude sexual activity and improves sexual function for many women, but surgical management of POP may result in larger improvements in sexual function.

Rates of successful pessary fitting and persistence vary widely based on time points used to define success and persistence, ranging from 40% to over 95% for fitting success and from 20 to over 95% for persistence. Factors negatively associated with fitting success include prior hysterectomy or POP surgery, short vaginal length, widened genital hiatus,

and posterior compartment prolapse. Factors positively associated with pessary persistence include older age, ability to self-manage, and adequate family support. There are insufficient data to suggest that any patients with POP should not be offered a pessary, even if they have some factors that are more likely to be associated with unsuccessful fitting.

Evidence to Guide Pessary Management

While there are many studies on pessary maintenance and best practice, few are high quality, and much guidance is based on expert opinion. Surveys of pessary practitioners demonstrate significant variability in pessary use, teaching of self-management, follow-up intervals, and use of vaginal estrogen. Some limitations in providing broad statements regarding care are related to the various types of pessaries used which then create different challenges in terms of pressure on vaginal walls, ability for patients or their caregivers to remove, and functionality in terms of intercourse. Many studies include heterogeneous populations of pre- and postmenopausal women, some of whom are using vaginal estrogen. The different practice patterns based on country of origin in terms of choice of pessary shape and involvement of family members and caregivers in pessary management impacts the ability to make generalized recommendations.

The ring pessary is widely used, but there is a paucity of evidence to support use of one pessary type over another. A single randomized trial found no difference in outcomes at 3 months in patients being treated with a ring with support versus Gellhorn pessary. Commonly reported complications of pessary use (vaginal discharge, odor, or erosion, pessary slipping or extrusion) are mild and self-limited. Most long-term pessary users will experience at least one of these mild complications. More serious complications (fistula, bowel obstruction, pessary impaction, and vaginal cancer) are rare, occur usually in older women in whom pessary maintenance has been neglected, and may require surgical intervention. Risk factor stratification by pessary shape, type of material, management patterns, and use of vaginal estrogen is lacking. Similarly, prospective studies are lacking about the impact of prevention and treatment strategies, ideal intervals for pessary cleaning and clinical follow-up, and concurrent use of vaginal estrogen.

Training and Education

As with data about pessary use and management, there is significant variability in descriptions of pessary training and education in the literature. We did not identify evidence to guide standardized training requirements for healthcare professionals in pessary management, nor evidence of established standards for pessary management and reporting. There was a similar lack of information from the available studies about women's level of knowledge about pessaries and requirements for training for self-management. The heterogeneity of the data in the included studies limit their synthesis.

Conclusions and Research Recommendations

There is a considerable body of published work on the use of pessaries for POP, including effectiveness, factors associated with success and failure, and complications. However, there are concerns regarding the quality of these data and variations in definitions, etc., make comparisons challenging. There is a dearth of published literature regarding how pessary types are selected by providers, how providers are trained, what defines competency in pessary provision, and what constitutes appropriate patient education related to pessary use and management. Future recommendations for research are provided below in box 1.

Box 1. Future research recommendations

We suggest that future research clearly describe who provides pessary care and with what frequency, and that health services research aims to characterize patterns of care delivery for pessary care

We suggest that researchers continue to use validated instruments to assess patient-reported outcomes related to pessary use and recognize a role for additional information about the impact of pessary use on sexual health

We suggest that future studies use a standard definition for successful pessary fitting that includes not just intent to use but also continued pessary use for at least 1 week from initial fitting date, with those who decline additional fitting attempts or do not want to continue use beyond 1 week being designated as failed pessary fittings. We suggest that persistence be assessed at 3 months, 6 months, and then yearly following initiation of pessary treatment, to more readily allow for comparisons across studies

Future research should clarify factors associated with complications of pessary use and pessary neglect as well as optimal methods for their prevention, with a particular need for prospective and long-term studies with some homogeneity

We suggest development of a quantifiable system for reporting and categorizing severity of pessary complications and prospective studies to evaluate the impact of treatment and prevention strategies, ideally stratified by pessary type and menopausal and estrogen status

Randomized, controlled trials evaluating various cleaning and clinical follow-up intervals and the use of vaginal estrogen in women with a standardized pessary type would provide more robust evidence on which to base guidelines and recommendations

Future research should define competence and identify minimum training standards for pessary management, and should evaluate the impact of flexible training curricula for the different healthcare professionals who participate in pessary care

Similarly, future research should evaluate key elements for patient education to facilitate pessary self-management to allow evidence-based guidance for practitioners providing this education

Adjuncts to pessary management that should be incorporated into training curricula require further research, e.g., estrogen use, self-management, and adherence strategies

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Declarations

Conflicts of Interest None.

References

1. Collins SA, O'Shea M, Dykes N, et al. International urogynecological consultation: clinical definition of pelvic organ prolapse. Int Urogynecol J. 2021;32:2011–9. https://doi.org/10.1007/s00192-021-04875-y
2. Haylen BT, Maher CF, Barber MD, Camargo S, Dandolu V, Digesu A, Goldman HB, Huser M, Milani AL, Moran PA, Schaer GN, Withagen MI. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic organ prolapse (POP). Int Urogynecol J. 2016;27(2):165–94. https://doi.org/10.1007/s00192-015-2932-1
3. Robinson D, Prodigalidad LT, Chan S, et al. International urogynaecology consultation chapter 1 committee 4: patients' perception of disease burden of pelvic organ prolapse. Int Urogynecol J. 2022;33:189–210.
4. Harvey MA, Chih HJ, Geoffrion R et al. International urogynecology consultation chapter 1 committee 5: relationship of pelvic organ prolapse to associated pelvic floor dysfunction symptoms: lower urinary tract, bowel, sexual dysfunction and abdominopelvic pain. Int Urogynecol J. 2021;32:2575–2594. https://doi.org/10.1007/s00192-021-04941-5
5. Lamers BH, Broekman BM, Milani AL. Pessary treatment for pelvic organ prolapse and health-related quality of life; a review. Int Urogynecol J. 2011;6:637–44.
6. Oliver R, Thakar R, Sultan AH. The history and usage of the vaginal pessary: a review. Eur J Obstet Gynecol Reprod Biol. 2011;156(2):125–30.
7. Sultana CJ. Non-surgical and Surgical management of pelvic organ prolapse in the older woman. Curr Geriatrics Rep. 2017;6(2):81–9.
8. Vardon DMR, Martin-Lasnel M, Agostini A, Fauvet R, Pizzoferrato A-C, Vaginal pessary for pelvic organ prolapse: a survey among french gynecological surgeons. J Gynecol Obstet Hum Reprod. 2020;50
9. Velzel J, Roovers JP, Van der Vaart CH, Broekman B, Vollebregt A, Hakvoort R. A nationwide survey concerning practices in pessary use for pelvic organ prolapse in The Netherlands: identifying needs for further research. Int Urogynecol J. 2015;26(10):1453–8. https://doi.org/10.1007/s00192-015-2697-6
10. van Geelen JM, Dwyer PL. Where to for pelvic organ prolapse treatment after the FDA pronouncements? A systematic review of the recent literature. Int Urogynecol J. 2013;24(5):707–18. https://doi.org/10.1007/s00192-012-2025-3.
11. Sevilla C, Wieslander CK, Alas A, Dunivan G, Khan A, Maliski S, Rogers R, Anger JT. The pessary process: Spanish-speaking Latinas' experience. Int Urogynecol J. 2013;24(6):939–46.
12. Heit M, Rosenquist C, Culligan P, Graham C, Murphy M, Shott S. Predicting treatment choice for patients with pelvic organ prolapse. Obstet Gynecol. 2003;101(6):1279–84. https://doi.org/10.1016/s0029-7844(03)00359-4
13. Kapoor DS, Thakar R, Sultan AH, Oliver R. Conservative versus surgical management of prolapse: what dictates patient choice? Int Urogynecol J. 2009;20:1157–61.
14. Ko PC, Lo TS, Tseng LH, Lin YH, Liang CC, Lee SJ. Use of a pessary in treatment of pelvic organ prolapse: quality of life, compliance, and failure at 1-year follow-up. J Minim Invasive Gynecol. 2011;18(1):68–74. https://doi.org/10.1016/j.jmig.2010.09.006
15. Brown LK, Fenner DE, DeLancey JO, Schimpf MO. Defining patient knowledge and perceptions of vaginal pessaries for prolapse and incontinence. Female Pelvic Med Reconstr Surg. 2016;22(2):93–7. https://doi.org/10.1097/SPV.0000000000000252
16. Coelho SA, Brito LGO, Araújo CC, Aguiar LB, Haddad JM, Giraldo PC, Juliato CRT. Factors associated with the prescription of vaginal pessaries for pelvic organ prolapse. Clinics (Sao Paulo). 2019;74:e934. https://doi.org/10.6061/clinics/2019/e934
17. Bugge C, Hagen S, Thakar R. Vaginal pessaries for pelvic organ prolapse and urinary incontinence: a multiprofessional survey of practice. Int Urogynecol J. 2013;24(6):1017–24. https://doi.org/10.1007/s00192-012-1985-7.
18. O'Dell K, Atnip S, Hooper G, Leung K. Pessary practices of nurse-providers in the United States. Female Pelvic Med Reconstr Surg. 2016;22(4):261–6. https://doi.org/10.1097/SPV.0000000000000268
19. Deng M, Ding J, Ai F, Zhu L. Clinical use of ring with support pessary for advanced pelvic organ prolapse and predictors of its short-term successful use. Menopause. 2017Aug;24(8):954–8. https://doi.org/10.1097/GME.0000000000000859
20. Brincat C, Kenton K, Pat Fitzgerald M, Brubaker L. Sexual activity predicts continued pessary use. Am J Obstet Gynecol. 2004;191(1):198–200. https://doi.org/10.1016/j.ajog.2004.03.083
21. Culligan PJ. Nonsurgical management of pelvic organ prolapse. Obstet Gynecol. 2012;119(4):852–60. https://doi.org/10.1097/AOG.0b013e31824c0806
22. Yimphong T, Temtanakitpaisan T, Buppasiri P, Chongsomchai C, Kanchaiyaphum S. Discontinuation rate and adverse events after 1 year of vaginal pessary use in women with pelvic organ prolapse. Int Urogynecol J. 2018;29(8):1123–8. https://doi.org/10.1007/s00192-017-3445-x
23. Clemons JL, Aguilar VC, Tillinghast TA, Jackson ND, Myers DL. Patient satisfaction and changes in prolapse and urinary symptoms in women who were fitted successfully with a pessary for pelvic organ prolapse. Am J Obstet Gynecol. 2004;190(4):1025–9. https://doi.org/10.1016/j.ajog.2003.10.711
24. Kammerer-Doak D, Svabik K, Bazi T. 2015 IUGA membership practice pattern survey for the surgical treatment of pelvic organ prolapse and stress urinary incontinence. Int Urogynecol J Pelvic Floor Dysfunction. 2016;27(1):S63-S64
25. Abdool Z. Evaluation of vaginal pessary use by South African gynaecologists. South African J Obstet Gynaecol. 2011;17(3):64–7.
26. Takamatsu K, Kitawaki J. Annual report of the Women's Health Care Committee, Japan Society of Obstetrics and Gynecology, 2017. J Obstet Gynaecol Res. 2018;44(1):13–26
27. Geoffrion R, Zhang T, Lee T, Cundiff GW. Clinical characteristics associated with unsuccessful pessary fitting outcomes. Female Pelvic Med Reconstr Surg. 2013;19(6):339–45. https://doi.org/10.1097/SPV.0b013e3182a26174
28. Brown CA, Pradhan A, Pandeva I. Current trends in pessary management of vaginal prolapse: a multidisciplinary survey of UK practice. Int Urogynecol J. 2021;32(4):1015–22. https://doi.org/10.1007/s00192-020-04537-5
29. Hanson LA, Schulz JA, Flood CG, Cooley B, Tam F. Vaginal pessaries in managing women with pelvic organ prolapse and urinary incontinence: patient characteristics and factors

contributing to success. Int Urogynecol J Pelvic Floor Dysfunct. 2006;17(2):155–9. https://doi.org/10.1007/s00192-005-1362-x
30. Vasconcelos CTM, Gomes MLS, Geoffrion R, Saboia DM, Bezerra KC, Vasconcelos Neto JA. Pessary evaluation for genital prolapse treatment: from acceptance to successful fitting. Neurourol Urodyn. 2020;39(8):2344–52. https://doi.org/10.1002/nau.24493
31. Fernando RJ, Thakar R, Sultan AH, Shah SM, Jones PW. Effect of vaginal pessaries on symptoms associated with pelvic organ prolapse. Obstet Gynecol. 2006;108(1):93–9.
32. Komesu YM, Rogers RG, Rode MA, Craig EC, Gallegos KA, Montoya AR, Swartz CD. Pelvic floor symptom changes in pessary users. Am J Obstet Gynecol. 2007;197(6):620-e1.
33. Manchana T, Bunyavejchevin S. Impact on quality of life after ring pessary use for pelvic organ prolapse. Int Urogynecol J. 2012;23:873–7.
34. Griebling TL. Vaginal pessaries for treatment of pelvic organ prolapse in elderly women. Curr Opin Urol. 2016;26(2):201–6.
35. Ding J, Song XC, Deng M, Zhu L. Which factors should be considered in choosing pessary type and size for pelvic organ prolapse patients in a fitting trial? Int Urogynecol J. 2016;27(12):1867–71.
36. Brazell HD, Patel M, O'Sullivan DM, Mellen C, LaSala CA. The impact of pessary use on bowel symptoms: one-year outcomes. Female Pelvic Med Reconstr Surg. 2014;20(2):95–8.
37. Lone F, Thakar R, Sultan AH. One-year prospective comparison of vaginal pessaries and surgery for pelvic organ prolapse using the validated ICIQVS and ICIQ-UI (SF) questionnaires. Int Urogynecol J. 2015;26(9):1305–12.
38. Bugge C, Adams EJ, Gopinath D, Stewart F, Dembinsky M, Sobiesuo P, Kearney R. Pessaries (mechanical devices) for managing pelvic organ prolapse in women. Cochrane Database System Rev. 2020;11(11):CD004010.
39. Zeiger BB, da Silva Carramão S, Del Roy CA, da Silva TT, Hwang SM, Auge APF. Vaginal pessary in advanced pelvic organ prolapse: impact on quality of life. Int Urogynecol J. 2022;33(7):2013–20.
40. Mamik MM, Rogers RG, Qualls CR, Komesu YM. Goal attainment after treatment in patients with symptomatic pelvic organ prolapse. Am J Obstet Gynecol. 2013;209(5):488.e1-5.
41. Van der Vaart LR, Vollebregt A, Milani AL, Lagro-Janssen AL, Duijnhoven RG, Roovers JP, Van der Vaart CH. Pessary or surgery for a symptomatic pelvic organ prolapse: the PEOPLE study, a multicentre prospective cohort study. BJOG: Int J Obstet Gynaecol. 2022;129(5):820–829.
42. Coelho SCA, Marangoni-Junior M, Oliveira BLG, Castro EB, Juliato CRT. Quality of life and vaginal symptoms of postmenopausal women using pessary for pelvic organ prolapse: a prospective study. Rev Assoc Med Bras. 2018;64(12):1103–7.
43. Abdool Z, Thakar R, Sultan AH, et al. Prospective evaluation of outcome of vaginal pessaries versus surgery in women with symptomatic pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct 2011;22(3):273Y278.
44. Dueñas JL, Miceli A. Effectiveness of a continuous-use ring-shaped vaginal pessary without support for advanced pelvic organ prolapse in postmenopausal women. Int Urogynecol J. 2018;29:1629–36.
45. Atnip s O'Dell K. Vaginal support pessaries: indications for use and fitting strategies. Urol Nurs. 2012;32:114–124
46. Rantell A. Vaginal pessaries for pelvic organ prolapse and their impact on sexual function. Sex Med Rev. 2019;7:597e603.
47. Kuhn A, Bapst D, Stadlmayr W, Vits K, Mueller MD. Sexual and organ function in patients with symptomatic prolapse: are pessaries helpful? Fertil Steril. 2009;91(5):1914–8.
48. Lowenstein L, Gamble T, Sanses TVD, Van Raalte H, Carberry C, Jakus S, Pham T, Nguyen A, Hoskey K, Kenton K. Changes in sexual function after treatment for prolapse are related to the improvement in body image perception. J Sexual Med. 2010;7(2_Part_2):1023–1028.
49. Handa VL, Jones M. Do pessaries prevent the progression of pelvic organ prolapse? Int Urogynecol J. 2002;13:349–52.
50. 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 Urogynecol J. 2012;23:573–7.
51. Mendes LC, Bezerra LRPS, Bilhar APM, Neto JAV, Vasconcelos CTM, Saboia DM, Karbage SAL. Symptomatic and anatomic improvement of pelvic organ prolapse in vaginal pessary users. Int Urogynecol J. 2021;32:1023–9.
52. Nguyen JN, Jones CR. Pessary treatment of pelvic relaxation: factors affecting successful fitting and continued use. J Wound Ostomy Continence Nurs. 2005;32(4):255–61.
53. Mutone MF, Terry C, Hale DS, Benson JT. Factors which influence the short-term success of pessary management of pelvic organ prolapse. Am J Obstet Gynecol. 2005;193(1):89–94.
54. Maito JM, Quam ZA, Craig E, Danner KA, Rogers RG. Predictors of successful pessary fitting and continued use in a nurse-midwifery pessary clinic. J Midwifery Womens Health. 2006;51(2):78–84.
55. Nemeth Z, Nagy S, Ott J. The cube pessary: an underestimated treatment option for pelvic organ prolapse? Subjective 1-year outcomes. Int Urogynecol J. 2013;24:1695–701.
56. Ramsay 2016, Ramsay S, Tu lM, Tannenbaum C. Natural history of pessary use in women aged 65–74 versus 75 years and older with pelvic organ prolapse: a 12-year study. Int Urogynecol J. 2016;27:1201–1207.
57. Dengler EG, Mounsey LA, Gines F, Agha M, Long T, Geller EJ. Defecatory dysfunction and other clinical variables are predictors of pessary discontinuation. Int Urogynecol J. 2019;30:1111–6.
58. Nemeth Z, Farkas N, Farkas B. Is hysterectomy or prior reconstructive surgery associated with unsuccessful initial trial of pessary fitting in women with symptomatic pelvic organ prolapse? Int Urogynecol J. 2017;28:757–61.
59. Robert M, Govan AJ, Lohani U, Uprety A. Feasibility of using pessaries for treatment of pelvic organ prolapse in rural Nepal. Int J Gynecol Obstet. 2017;136(3):325–30.
60. Manchana T. Ring pessary for all pelvic organ prolapse. Arch Gynecol Obstet. 2011;284:391–5.
61. Deng 2017–2: Deng M, Ding J, Ai F, Zhu L. Successful use of the Gellhorn pessary as a second line pessary in women with advanced pelvic organ prolapse. Menopause. 2017;24(11):1277–1281
62. Ma C, Xu T, Kang J, Zhang Y, Ma Y, Liang S, Zhu L. Factors associated with pessary fitting in women with symptomatic pelvic organ prolapse: a large prospective cohort study. Neurourol Urodyn. 2020;39(8):2238–45.
63. Mao 2018: Mao M, Ai F, Zhang Y et al. Predictors for unsuccessful pessary fitting in women with symptomatic pelvic organ prolapse: a prospective study. BJOG. 2018;125:1434-1440
64. Yang J, Han J, Zhu F, Wang Y. Ring and Gellhorn pessaries used in patients with pelvic organ prolapse: a retrospective study of 8 years. Arch Gynecol Obstet. 2018;298:623–9.
65. 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;22(5):478–82.
66. Mao M, Ai F, Kang J, Zhang Y, Liang S, Zhou Y, Zhu L. Successful long-term use of Gellhorn pessary and the effect on symptoms and quality of life in women with symptomatic pelvic organ prolapse. Menopause. 2019;26(2):145–51.
67. Miceli A, Dueñas-Diez JL. Effectiveness of ring pessaries versus vaginal hysterectomy for advanced pelvic organ prolapse A cohort study. Int Urogynecol J. 2019;30:2161–9.

68. Radnia N, Hajhashemi M, Eftekhar T, Deldar M, Mohajeri T, Sohbati S, Ghanbari Z. Patient satisfaction and symptoms improvement in women using a vginal pessary for the treatment of pelvic organ prolapse. J Med Life. 2019;12(3):271.
69. Lone F, Thakar R, Sultan AH, Karamalis G. A 5-year prospective study of vaginal pessary use for pelvic organ prolapse. Int J Gynecol Obstet. 2011;114(1):56–9.
70. Yamada T, Matsubara S. Rectocoele, but not cystocoele, may predict unsuccessful pessary fitting. J Obstet Gynaecol. 2011;31(5):441–2.
71. Sitavarin S, Wattanayingcharoenchai R, Manonai J, Sarit-apirak S, Chittacharoen A. The characteristics and satisfaction of the patients using vaginal pessaries. J Med Assoc Thai. 2009;92(6):744–7.
72. Lekskulchai O, Wanichsetakul P. Factors affecting successfulness of vaginal pessary use for the treatment of pelvic organ prolapse. J Med Assoc Thai. 2015;98(Suppl 3):S115-20.
73. Ding J, Chen C, Song XC, Zhang L, Deng M, Zhu L. Successful use of ring pessary with support for advanced pelvic organ prolapse. Int Urogynecol J. 2015;26:1517–23.
74. Shayo BC, Masenga GG, Rasch V. Vaginal pessaries in the management of symptomatic pelvic organ prolapse in rural Kilimanjaro, Tanzania: a pre-post interventional study. Int Urogynecol J. 2019;30:1313–21.
75. Turel Fatakia F, Pixton S, Caudwell Hall J, Dietz HP. Predictors of successful ring pessary use in women with pelvic organ prolapse. Aust N Z J Obstet Gynaecol. 2020;60(4):579–84.
76. Palmieri S, Cola A, Milani R, Manodoro S, Frigerio M. Quality of life in women with advanced pelvic organ prolapse treated with Gellhorn pessary. Minerva Ginecol. 2018;70(4):490–2.
77. Bulchandani S, Toozs-Hobson P, Verghese T, Latthe P. Does vaginal estrogen treatment with support pessaries in vaginal prolapse reduce complications? Post Reprod Health. 2015;21(4):141–5.
78. Chan MC, Hyakutake M, Yaskina M, Schulz JA. What are the clinical factors that are predictive of persistent pessary use at 12 months? J Obstet Gynaecol Can. 2019;41(9):1276–81.
79. Cheung RYK, Lee JHS, Lee LL, Chung TKH, Chan SSC. Levator ani muscle avulsion is a risk factor for expulsion within 1 year of vaginal pessary placed for pelvic organ prolapse. Ultrasound Obstet Gynecol. 2017;50(6):776–80.
80. Cheung RY, Lee LL, Chung TK, Chan SS. Predictors for dislodgment of vaginal pessary within one year in women with pelvic organ prolapse. Maturitas. 2018;108:53–7.
81. Friedman S, Sandhu KS, Wang C, Mikhail MS, Banks E. Factors influencing long-term pessary use. Int Urogynecol J. 2010;21:673–8.
82. Hsieh MF, Tsai HW, Liou WS, Lo CC, Lin ZH, An YF, Lin HY. Long-term compliance of vaginal pessaries: does stress urinary incontinence matter? Medicine. 2019;98(14):e15063.
83. Jones K, Yang L, Lowder JL, Meyn L, Ellison R, Zyczynski HM, Moalli P, Lee T. Effect of pessary use on genital hiatus measurements in women with pelvic organ prolapse. Obstet Gynecol. 2008;112(3):630–6.
84. Lewthwaite BJ, Staley D, Girouard L, Maslow K. Characteristics of women with continued use of vaginal pessaries. Urologic Nurs. 2013;33(4):171-6.
85. Li B, Chen Q, Zhang J, Yu C, Zhang L, Chen L. A prospective study of pessary use for severe pelvic organ prolapse: 3-year follow-up outcomes. Arch Gynecol Obstet. 2020;301:1213–8.
86. Manonai J, Sarit-Apirak S, Udomsubpayakul U. Vaginal ring pessary use for pelvic organ prolapse: continuation rates and predictors of continued use. Menopause. 2019;26(6):665–9.
87. Wolff B, Williams K, Winkler A, Lind L, Shalom D. Pessary types and discontinuation rates in patients with advanced pelvic organ prolapse. Int Urogynecol J. 2017;28(7):993–7.
88. Dessie SG, Armstrong K, Modest AM, Hacker MR, Hota LS. Effect of vaginal estrogen on pessary use. Int Urogynecol J. 2016;27:1423–9.
89. Ai F, Wang Y, Wang J, Zhou L, Wang S. Effect of estrogen on vaginal complications of pessary use: a systematic review and meta-analysis. Climacteric. 2022;25(6):533–42.
90. https://thepogp.co.uk/_userfiles/pages/files/pessary_types_guide.pdf. Accessed Mar 2022.
91. Cundiff GW, Amundsen CL, Bent AE, Coates KW, Schaffer JI, Strohbehn K, Handa VL. The PESSRI study: symptom relief outcomes of a randomized crossover trial of the ring and Gellhorn pessaries. Am J Obstet Gynecol. 2007;196(4):405-e1.
92. Bai S. Survey of the characteristics and satisfaction degree of the patients using a pessary. Int Urogynecol J. 2005;16:182–6.
93. Sarma S. Long-term vaginal ring pessary use: discontinuation rates and adverse events. Int J Obstet Gynecol. 2009;116:1715–21.
94. Collins S, Beigi R, Mellen C, et al. The effect of pessaries on the vaginal microenvironment. Am J Obstet Gynecol. 2015;212:e1-6.
95. Hooper G. Person-centered care for patients with pessaries. Nurs Clin N Am. 2018;53:289–301.
96. Roberge RJ, McCandlish MM, Dorfsman ML. Urosepsis associated with vaginal pessary use. Ann Emerg Med. 1999;33(5):581–3.
97. Wilhelm P, Rolinger J, Falch C, Kirschniak A, Reisenauer C. Therapy of pessary-induced rectovaginal fistula and pelvic organ prolapse in elderly patients by vaginal approach and modified LeFort colpocleisis: a case series. Arch Gynecol Obstet. 2020;302(2):283–287.
98. Meinhardt W. Bilateral hydronephrosis with urosepsis due to neglected pessary case report. Scand J Urol Nephrol. 1993;27(3):419–20.
99. Dasgupta P. Uraemia due to ureteric obstruction of a solitary kidney by a vaginal ring pessary. Scand J Urol Nephrol. 1996;30:493–4.
100. Roberge R. Urosepsis associated with vaginal pessary use. Ann Emerg Med. 1996;33(5):581–3.
101. Wheeler L. Lesson of the week: perils of pessaries. Age Ageing. 2004;33:510–1.
102. Ho M. Unilateral acute pyelonephritis associated with a neglected pessary. Am Geriatrics Soc. 2011;59(10):1962-3.
103. Grody MHT. Intravesical foreign body and vesicovaginal fistula: a rare complication of a neglected pessary. Int Urogynecol J. 1999;10:407–8.
104. Beatriz E. Complications of neglected vaginal pessaries: case presentation and literature review. Int Urogynecol J. 2008;19:1173–8.
105. Dmitry F. Ureterovaginal fistula linked to a retained pessary. Int Urogynecol J. 2014;25:1283–5.
106. Ott R. Small bowel prolapse and incarceration caused by a vaginal ring pessary. Br J Surg. 1993;80:1157.
107. Sinha A. Bowel evisceration through a ring pessary. Int J Obstet Gynaecol. 2004;111:1023–4.
108. Rubin R. Vaginal evisceration during pessary fitting and treatment with immediate colpocleisis. Am College Obstet Gynecol. 2010;116:496–8.
109. Abdulaziz M, Stothers L, Lazare D, Macnab A. An integrative review and severity classification of complications related to pessary use in the treatment of female pelvic organ prolapse. Can Urol Assoc J. 2015;9(5–6):E400.
110. Pereira GMV, Brito LGO, Slongo H, de Araújo CC, de Castro EB, Juliato CRT. Rectovaginal fistula in women with pessary for pelvic organ prolapse: a case series and literature review. J Low Genit Tract Dis. 2021;25(4):318–25.

111. Arias BE, Ridgeway B, Barber MD. Complications of neglected vaginal pessaries: case presentation and literature review. Int Urogynecol J Pelvic Floor Dysfunct. 2008;19:1173–8.
112. Powers K, Grigorescu B, Lazarou G, Greston WM, Weber T. Neglected pessary causing a rectovaginal fistula: a case report. J Reprod Med. 2008;53(3):235–7.
113. Andrikopoulou M. Rare case of neglected pessary presenting with concealed vaginal hemorrhage. Female Pelvic Med Reconstr Surg. 2015;21(1):e1–2.
114. Whitworth J. Rapid incarceration of a ring pessary with its safe and immediate removal. Gynaecol Case Rep. 2002;22(2):225–226.
115. Jain A. How innocent is the vaginal pessary? Two cases of vaginal cancer associated with pessary use. J Obstet Gynaecol. 2006;26(3):829–8.
116. Yoshimura K, Morotom N, Fukuda K, Kubo R, Taniguch H. Changes of intravaginal microbiotia and inflammation after self-replacement ring pessary therapy compared to continuous ring pessary usage for pelvic organ prolapse. J Obstet Gynaecol Res. 2020;46(6):931–8.
117. Thys SD, Hakvoort RA, Asseler J, Milani AL, Vollebregt A, Roovers JP. Effect of pessary cleaning and optimal time interval for follow-up: a prospective cohort study. Int Urogynecol J. 2020;31:1567–74.
118. Fregosi NJ, Hobson DTG, Cl K, Gaskins JT, Stewart JR, Meriwether KV. Changes in the vaginal microenvironment as related to frequency of pessary removal. Female Pelvic Med Reconstr Surg. 2018;24:166–71.
119. Wilkinson KH, Thomas A, Theobald J. Pelvic organ prolapse: an unusual cause of small bowel obstruction. Am J Emerg Med. 2019;37(9):1809.e5-1809.e6. https://doi.org/10.1016/j.ajem.2019.06.037
120. Wiegersma M, Panman CM, Kollen BJ, Vermeulen KM, Schram AJ, Messelink EJ, Berger MY, Lisman-Van Leeuwen Y, Dekker JH. 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):168–73. https://doi.org/10.1016/j.maturitas.2013.10.014
121. Hall CEJ, Kay V. Shifting care closer to home: Limitations and challenges of implementing a community vaginal pessary service'. J Obstet Gynaecol. 2010;30(7):754
122. Wilson M, Bellefeuille L-A, D'Amore A, Mitchell EKL. Establishing a continence nurse-led pessary clinic as a new model of care for women in rural Victoria. Australian New Zealand Continence J. 2015;21(3):75–83.
123. Dwyer L, Bugge C, Hagen S, Goodman K, Agur W, Dembinsky M, Graham M, Guerrero K, Hemming C, Khunda A, McClurg D. Theoretical and practical development of the TOPSY self-management intervention for women who use a vaginal pessary for pelvic organ prolapse. Trials. 2022;23(1):742.
124. International Centre for Allied Health Evidence. Guidelines for the use of support pessaries in the management of pelvic organ prolapse. Available at: http://w3.unisa.edu.au/cahe/Resources/GuidelinesiCAHE/THE%20PESSARY%20GUIDELINE_18%207%202012.pdf. Accessed Mar 2022.
125. Robert M, Schulz JA, Harvey MA; Urogynaecology Committee. Technical update on pessary use. J Obstet Gynaecol Can. 2013;35(7):664–74.
126. Pelvic organ prolapse. ACOG Pract Bull no. 214. American college of obstetricians and Gynecologists. Obstet Gynecol. 2019;134:e126–42.
127. Wu V, Farrell SA, Baskett TF, Flowerdew G. A simplified protocol for pessary management. Obstet Gynecol. 1997;90(6):990–4.
128. Palumbo M. Pessary placement and management. Ostomy Wound Manag. 2000;46:40–5.
129. Vieira AJ, Larkins-Pettigrew M. Practical use of the pessary. Am Fam Physician. 2000;61(9):2719–26.
130. Hooper GL, Atnip S, O'Dell K. Optimal pessary care: a modified Delphi consensus study. MidwiferyWomens Health. 2017;62:452–61.
131. Pratt JP. Geriatric office practice. Pessaries; atrophic vaginitis, gynecologic aspects of osteoporosis. Clin Obstet Gynecol Mar. 1962;5:286–97.
132. Zeitlin MP, Lebherz TB. Pessaries in the geriatric patient. J Am Geriatr Soc. 1992;40(6):635–9.
133. Fritzinger KG, Newman DK, Dinkin E. Use of a pessary for the management of pelvic organ prolapse. Lippincotts Prim Care Pract Sep-Oct. 1997;1(4):431–6.
134. Wiegersma M, Panman CM, Kollen BJ, BergerMY, Lisman-Van Leeuwen Y, Dekker JH. Effect of pelvic floor muscle training compared with watchful waiting in older women with symptomatic mild pelvic organ prolapse: randomized controlled trial in primary care. BMJ. 2014;349:g7378.
135. Bodner-Adler B, Bodner K, Stinglmeier A, Kimberger O, Halpern K, Koelbl H, Umek W. Prolapse surgery versus vaginal pessary in women with symptomatic pelvic organ prolapse: which factors influence the choice of treatment? Arch Gynecol Obstet Mar. 2019;299(3):773–7.
136. Cheung RY, Lee JH, Lee LL, Chung TK, Chan SS. Vaginal pessary in women with symptomatic pelvic organ prolapse: a randomized controlled trial. Obstet Gynecol. 2016;128:73–80.
137. Panman CM, Wiegersma M, Kollen BJ, Burger H, Berger MY, Dekker JH. Predictors of unsuccessful pessary fitting in women with prolapse: a cross-sectional study in general practice. Int Urogynecol J. 2017;28(2):307–13.
138. Fatakia FT, Pixton S, Hall JC, Dietz HP. Predictors of successful ring pessary use in women with pelvic organ prolapse. Aust N Z J Obstet Gynaecol. 2020;60:579–84.
139. Propst K, Mellen C, O'Sullivan DM, Tulikangas PK. Timing of office-based pessary care: a randomized controlled trial. Obstet Gynecol. 2020;135(1):100–5.
140. Gorti M, Hudelist G, Simons A. Evaluation of vaginal pessary management: a UK-based survey. J Obstet Gynaecol. 2009;29:129–31.
141. Pott-Grinstein E, Newcomer J. Gynaecologists' patterns of prescribing pessaries. J Reprod Med. 2001;46:205–8.
142. Khaja A, Freeman RM. How often should shelf/Gellhorn pessaries be changed? A survey of IUGA urogynaecologists. Int Urogynecol J. 2014;25:941–6.
143. Cundiff GW, Weidner AC, Visco AG, et al. A survey of pessary use by members of the American Urogynecologic Society. Obstet Gynecol. 2000;95:931–5.
144. Weber AM, Richter HE. Pelvic organ prolapse. Obstet Gynecol. 2005;106(3):615–34.
145. Tenfelde S, Tell D, Thomas TN, Kenton K. Quality of life in women who use pessaries for longer than 12months. Female Pelvic Med Reconstr Surg. 2015;21(3):146–9.
146. Trowbridge ER, Fenner DE. Conservative management of pelvic organ prolapse. Clin Obstet Gynecol. 2005;48(3):668–81.
147. Storey S, Ashton M, Price S, et al. Women's experiences with vaginal pessary use. J Adv Nurs. 2009;65(11):2350–7.
148. Murray C, Thomas E, Pollock W. Vaginal pessaries: can an educational brochure help patients to better understand their care? J Clin Nurs. 2017;26:140–7.

149. Sullivan SA, Davidson ERW, Bretschneider CE, Liberty AL, Gelle EJ. Patient characteristics associated with treatment choice for pelvic organ prolapse and urinary incontinence. Int Urogynecol J. 2016;27(5):811–6.
150. Harvey MA, Lemieux MC, Robert M, Schulz JA. Guideline no. 411: vaginal pessary use. J Obstet Gynaecol Canada. 2021;43(2):255–266.
151. UK Clinical Guideline for best practice in the use of vaginal pessaries for pelvic organ prolapse, 2021, https://thepogp.co.uk/_userfiles/pages/files/resources/uk_pessary_guideline_final_april21.pdf. Accessed Mar 2022
152. Drutz HP & IUGA Education Committee. IUGA guidelines for training in female pelvic medicine and reconstructive pelvic surgery (FPM-RPS): updated guidelines 2010. Int Urogynecol J. 2010;21(12):1445-1453.
153. Kenton K, Valaitis S, Nihira M et al. Resident learning objectives submitted by the AUGS education committee. 2013. https://www.augs.org/assets/1/6/Resident_learning_objectives_(1).pdf
154. Contreras Ortiz O, Rizk DEE, Falconi G, Schreiner L, Gorbea Chávez V. Guidelines and enabling objectives for training primary healthcare providers, gynecologists and obstetric and gynecology residents in female pelvic floor medicine and reconstructive surgery. Neurourol Urodyn. 2017;36(2):514–7.
155. Kassis N, Hale DS, Heit M. A survey of obstetrics and gynecology residents assessing perception of training and knowledge regarding pessaries. J Minimally Invasive Gynecol. 2014;21(2):S41–2.
156. Profft N. Ausbildungsstand der Urogynäkologie', Doctoral dissertation, Imu. 2019.
157. Pizzoferrato AC, Nyangoh-Timoh K, Martin-Lasnel M, Fauvet R, de Tayrac R, Villot A. Vaginal pessary for pelvic organ prolapse: a French multidisciplinary survey. J Women's Health. 2021;27:27.
158. Martin-Lasnel M, Nyangoh-Timoh K, Fauvet R, Pizzoferrato AC. The use of pessaries for treatment of pelvic organ prolapse: a survey from gynecologists and urologists residents. Gynecologie Obstetrique Fertilite et Senologie. 2021;49(10):763–6.
159. Dwyer L, Stewart E, Rajai A. A service evaluation to determine where and who delivers pessary care in the UK. Int Urogynecol J. 2021;32:1001–6.
160. Lough K, Hagen S, McClurg D, Pollock A. Shared research priorities for pessary use in women with prolapse: results from a James Lind Alliance Priority Setting Partnership. BMJ Open. 2018;8(4):e021276.
161. Dwyer L, Kearney R, Lavender T. A review of pessary for prolapse practitioner training. British J Nurs. 2019;28(9):S18–24.
162. https://study.unisa.edu.au/short-courses/professional-certificate-in-conservative-management-of-pelvic-organ-prolapse/. Accessed 4.1.2023.
163. Neumann P, Radi N, Gerdis TL, Tonkin C, Wright C, Chalmers KJ, Nurkic I. Development of a multinational, multidisciplinary competency framework for physiotherapy training in pessary management: an E-Delphi study. Int Urogynecol J. 2021;33(2):253–65.
164. 6-pessaries-competency (1).doc https://www.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/a/advanced-practice-continence-womens-health/06-pessaries-competency.doc 07-review-and-refit-pessary-competency (2).doc https://www.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/a/advanced-practice-continence-womens-health/07-review-and-refit-pessary-competency.doc
165. Rezaiefar P, Forse K, Burns JK, Johnston S, Muggah E, Kendall C, Archibald D. Does general experience affect self-assessment? Clin Teach. 2019;16(3):197–202.
166. Davis DA, Mazmanian PE, Fordis M, Harrison RV, Thorpe KE Perrier L. Accuracy of physician self-assessment compared with observed measures of competence. JAMA. 2006;296(9).
167. Wånggren, Pettersson G, Csemiczky G, Gemzell- Danielsson K. Teaching medical students gynaecological examination using professional patients—evaluation of students' skills and feelings. Med Teacher. 2009;27(2):130-5.
168. Escobar P, Laudano M, Harroche J, Carlos D, Downing KT, Leegant A. Simulation training on a vaginal vault model to educate residents in pessary placement for pelvic organ prolapse: a pilot study'. Female Pelvic Med Reconstruct Surg. 2017;23 (5 Suppl 1): S94.
169. Clancy AA, Pascali D, Khalil H. Pessary education for residents, 23, Sep/Oct, p. e32. 2017.
170. Kantharooban Umachanger J, Marcussen M, Bogild H, Kjaergaard N, Glavind K. First-line treatment of pelvic organ prolapse. Int Urogynecol J. 2018;29 (Suppl 1):S60.
171. Serdinšek T. How to train a future urogynecologist. Int Urogynecol J. 2021;33(1):1–2.
172. Kuncharapu I, Majeroni BA, Johnson DW. Pelvic organ prolapse. Am Fam Physician. 2010;81(9):1111–7.
173. Goh JTW, Thayalan K, Krause HG. An audit of vaginal support pessaries for pelvic organ prolapse in Western Uganda'. Australian New Zealand Continence J. 2020;26(2):46–50.
174. Khadgi J, Poudel A. Uterine prolapse: a hidden tragedy of women in rural Nepal. Int Urogynecol J. 2018;29(11):1575–8.
175. Clarke M, Whitson N, Williams C, Robson SJ. A silent burden—prolapse, incontinence, and infertility in Australian Aboriginal and Torres Strait Islander women: a systematic search and narrative review. Int J Gynecol Obstet. 2021;155(2):268–74.
176. Dunivan GC, Anger JT, Alas A, Rogers R. Pelvic organ prolapse: a disease of silence and shame. Female Pelvic Med Reconstr Surg. 2014;20(6):322–7.
177. Grimes CL, Balk EM, Crisp CC, Antosh DD, Murphy M, Halder GE, Jeppson PC, Lebrun EEW, Raman S, Kim-Fine S, Iglesia C, Dieter AA, Yurteri-Kaplan L, Adam G, Meriwether KV. a guide for urogynecologic patient care utilizing telemedicine during the COVID-19 pandemic: review of existing evidence. Obstet Gynecol Surv. 2020;75(8):469–70.
178. Herbert AS, Pace L, Munir A, Malik RD. Instagram's pelvic organ prolapse content discusses limited treatment options leaving users susceptible to biased information. J Consumer Health Internet. 2020;24(4):360–9.
179. Kakos AB, Lovejoy DA, Whiteside JL. Quality of information on pelvic organ prolapse on the Internet. Int Urogynecol J Pelvic Floor Dysfunct. 2014;25(4):551-5.
180. Abhyankar P, Uny I, Semple K, Wane S, Hagen S, Wilkinson J, Guerrero K, Tincello D, Duncan E, Calveley E, Elders A, McClurg D, Maxwell M. Women's experiences of receiving care for pelvic organ prolapse: a qualitative study. BMC Womens Health. 2019;19(1):45–57.
181. Alas A, Wieslander C, Sevilla C, Khan A, Mittal B, Maliski S, Anger J. The pessary process: Spanish-speaking Latinas' experience. Neurourol Urodynam. 2012;31 (2):260.
182. Kandadai P, McVay S, Larrieux JR, O'Dell K. Knowledge and comfort with pessary use: a survey of US obstetrics and gynecology residents. Female Pelvic Med Reconstr Surg. 2016;22(6):491–6.

183. Kearney R, Brown C. Self-management of vaginal pessaries for pelvic organ prolapse. BMJ Qual Improve Rep. 2014;3(1):u206180.w2533.
184. Bugge C, Dembinsky M, Kearney R, Hagen S. Does self-management of vaginal pessaries improve care for women with pelvic organ prolapse?. BMJ. 2021;372.
185. Hagen S, Kearney R, Goodman K, Melone L, Elders A, Manoukian S, Agur W, Best C, Breeman S, Dembinsky M, Dwyer L. Clinical and cost-effectiveness of vaginal pessary self-management compared to clinic-based care for pelvic organ prolapse: protocol for the TOPSY randomised controlled trial. Trials. 2020;21:1–13.
186. Wharton L, Athey R, Jha S. Do vaginal pessaries used to treat pelvic organ prolapse impact on sexual function? A systematic review and meta-analysis. Int Urogynecol J. 2022;33(2):221–233.

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ORIGINAL ARTICLE

International urogynecology consultation chapter 3 committee 2; conservative treatment of patient with pelvic organ prolapse: Pelvic floor muscle training

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Abstract

Introduction and hypothesis This manuscript from Chapter 3 of the International Urogynecology Consultation (IUC) on Pelvic Organ Prolapse (POP) describes the current evidence and suggests future directions for research on the effect of pelvic floor muscle training (PFMT) in prevention and treatment of POP.

Methods An international group of four physical therapists, four urogynecologists and one midwife/basic science researcher performed a search of the literature using pre-specified search terms on randomized controlled trials (RCTs) in Ovid Medline, EMBASE, CINAHL, Cochrane, PEDro and Scopus databases for publications between 1996 and 2021. Full publications or expanded abstracts in English or in other languages with abstracts in English were included. The PEDro rating scale (0–10) was used to evaluate study quality. Included RCTs were reviewed to summarize the evidence in six key sections: (1) evidence for PFMT in prevention of POP in the general female population; (2) evidence for early intervention of PFMT in the peripartum period for prevention and treatment of POP; (3) evidence for PFMT in treatment of POP in the general female population; (4) evidence for perioperative PFMT; (5) evidence for PFMT on associated conditions in women with POP; (6) evidence for the long-term effect of PFMT on POP. Full publications in English or in other languages with abstracts in English and expanded abstracts presented at international condition specific societies were included. Internal validity was examined by the PEDro rating scale (0–10).

Results After exclusion of duplicates and irrelevant trials, we classified and included 2 preventive trials, 4 trials in the postpartum period, 11 treatment trials of PFMT for POP in the general female population in comparison with no treatment or lifestyle interventions, 10 on PFMT as an adjunct treatment to POP surgery and 9 long-term treatment trials. Only three treatment studies compared PFMT with the use of a pessary. The RCTs scored between 4 and 8 on the PEDro scale. No primary prevention studies were found, and there is sparse and inconsistent evidence for early intervention in the postpartum period. There is good evidence/recommendations from 11 RCTs that PFMT is effective in reducing POP symptoms and/or improving POP stage (by one stage) in women with POP-Q stage I, II and III in the general female population, but no evidence from 9/10 RCTs that adding PFMT pre- and post -surgery for POP is effective. There are few long-term follow-up studies, and results are inconsistent. There are no serious adverse effects or complications reported related to PFMT.

Conclusions There are few studies on prevention and in the postpartum period, and the effect is inconclusive. There is high-level evidence from 11 RCTs to recommend PFMT as first-line treatment for POP in the general female population. PFMT pre- and post-POP surgery does not seem to have any additional effect on POP. PFMT is effective and safe but needs thorough instruction and supervision to be effective.

Keywords Long-term · Pelvic floor muscle training · Physical therapy · Pelvic organ prolapse · Postpartum · Surgery

Introduction

This report is part of a series of articles that are the product of the International Urogynecology Consultation (IUC) sponsored by the International Urogynecological

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Association (IUGA). This is a 4-year, 4-chapter project with 16 reports dedicated to reviewing and summarizing the world's literature on pelvic organ prolapse (POP). This report is from the third year and chapter of the project, which is dedicated to reviewing the literature on non-surgical management of POP. Years 1 and 2 were dedicated to defining the epidemiology of POP and the evaluation of patients with POP. The fourth or final chapter will evaluate the surgical treatment of POP. This report focuses on reviewing the literature on conservative treatment of patient with POP employing pelvic floor muscle training.

POP is a common condition in women. The reported prevalence varies widely (1–65%) based on whether its presence is ascertained by symptoms (1–31%), pelvic examination (10–50%) or both (20–65%) [1]. POP may negatively affect quality of life, participation in physical activities, body image and sexual function [2]. Multiple factors contribute to the development of primary and recurrent POP. These factors include childbirth, constipation, strenuous work and heavy lifting, congenital connective tissue weakness, obesity, menopause, chronic increased intra-abdominal pressure (IAP) and iatrogenic causes [1, 3]. Available treatments are watchful waiting, lifestyle interventions such as avoiding constipation and straining, pelvic floor muscle training (PFMT), pessaries or surgery.

POP is caused by a combination of impairment of the pelvic floor muscles (PFM) and the connective tissue [4]. The association between a decrease in levator plate angle, increase in levator hiatus area and presence of POP has been confirmed in several studies [5–13]. Women with POP have shown to have PFM impairment [4, 6, 8–16], and damage to the PFMs is three times more likely to be found in women with POP than in those without [4]. A recent systematic review by Siahkal et al. (2021) [10] summarized 21 studies in a meta-analysis and concluded that the dimensions of the levator hiatus are greater both at rest and during Valsalva maneuver in women with POP compared to women without POP. An increased levator hiatus area, measured by ultrasound, is associated with a low vaginal resting pressure, measured with manometry [17], and major tears of the PFM after vaginal birth result in a 50% reduction in muscle strength [18]. Women with Pelvic Organ Prolapse Quantification system (POP-Q) stage II or more have 40–62% reduced PFM strength [14, 19], 53% reduced PFM endurance and lower vaginal resting pressure compared to matched controls with normal supports, defined as POP-Q stage 0 and I [19]. When measuring PFM strength with manometry one longitudinal cohort study found that for every 5-cmH_2O increase in pressure during maximal voluntary contraction, the odds for prolapse was reduced by 13% (OR 0.87, 95% CI 0.81, 0.94) [15].

Kegel (1952) [20] postulated that "With adequate PFMT the woman learns to maintain the perineum, bladder and uterus in a higher position, the slack in the supportive muscles will be taken up, and the vagina will become longer and tighter." Today there is evidence for two mechanisms of how PFMT may be effective in prevention and treatment of SUI [21, 22], and the same mechanisms apply for the effect of PFMT to prevent and treat POP. The two mechanisms are:

(1) Women learn to consciously contract the PFM before and during increases in intra-abdominal pressure (IAP) (also termed 'bracing' or 'performing the Knack') and continue to perform such voluntary contractions as a behavior modification to prevent descent of the pelvic floor during these episodes.

(2) Women are taught to perform regular strength training to improve 'firmness' and structural support of the pelvic floor over time. These two hypotheses co-exist as they both build on an anatomical and biomechanical understanding of the function of the PFM, i.e., a voluntary contraction of the PFM constricts the levator hiatus, elevates and stabilizes the pelvic floor into a higher position. This results in an immediate effect during the PFM contraction of lifting the bladder neck and stabilizing the pelvic floor [23, 24]. This may also have an effect over time. Strength training has been shown to promote hypertrophy of targeted muscles, increasing constriction of the levator hiatus, shortening the PFM and lifting of the pelvic floor and reversing some of the changes associated with POP [25].

This narrative review summarizes the current evidence for PFMT in the treatment and prevention of POP with the following research questions:

1. What is the evidence for PFMT in prevention of POP in the general female population?
2. What is the evidence for early intervention of PFMT in the peripartum period for treatment of POP?
3. What is the evidence for PFMT in treatment of POP in the general female population?
4. What is the evidence for PFMT pre- and post POP surgery?
5. What is the evidence for PFMT on associated conditions in women with POP?
6. What is the evidence for long-term effect of PFMT in treatment of POP?

Methods

To complete an exhaustive literature search on this topic, the authors brainstormed search terms they felt most relevant to POP and selected the items listed below. This list of terms was presented at the IUGA annual scientific meeting in 2020 for input from the general membership. No additional terms were suggested as a result of that meeting. The search strategy included the following: Ovid Medline, EMBASE,

CINAHL, Cochrane, PEDro and Scopus databases were searched for period January 1, 1996, to December 31, 2021, to identify studies. The keywords were combinations of "pelvic organ prolapse" or "urogenital prolapse" and "bulge" or "heaviness," "exercise therapy," "hypopressive exercise," "kegel," "long term," "pelvic floor muscle training," "pelvic floor exercise," "peripartum," "postpartum," "pregnancy," "prevention," "symptomatic prolapse" and "treatment outcome". Limitation was set on fully published randomized controlled trials (RCTs) or full publications with at least an English language abstract. The search also included the extended abstracts from International Continence Society (ICS) meetings. Finally, the authors hand-searched publications from International Consultation on Incontinence (ICI) [26], NICE (2019) [27] and the book chapter on PFMT for POP from Bø and Frawley (2015) [28]. Reference lists from studies initially selected were also searched to identify any additional relevant studies not identified by the electronic searches. RCTs using other exercise programs than PFMT and comparison between PFMT and other exercise programs for POP are excluded from this review and will be published in a separate manuscript.

The PEDro rating scale, widely used in physical therapy and rehabilitation science [29, 30], was applied to assess the risk of bias (internal validity) for the RCTs. Table 1 shows the ten criteria used in this rating scale. Criteria E (eligibility) concerns external validity (generalizability). A total PEDro score less than four is considered poor, four to five fair, six to eight good and nine to ten excellent [31]. The PEDro scale (Table 1) has been found to be a reliable and valid tool to evaluate methodological quality in clinical trials [30, 32, 33].

Methods, definitions, and units conform to the standards jointly recommended by the International Urogynecological Association and the ICS except where specifically noted [34–36].

Results

Outcome measures

A plethora of different outcome measures have been used in published studies on PFMT to treat POP. Table 2 gives an overview of the different measures found in the included studies. Most of the studies reported on training adherence, using appointment attendance and self-reported daily diary entries as outcome measures. Less than half reported on adverse events/complications related to PFMT. For primary outcome measures most of the studies used validated, condition-specific, self-reported questionnaires for symptoms, and the Pelvic Organ Prolapse Quantification (POP-Q) exam results for anatomic description. Few studies assessed muscle morphology using ultrasonography. A minority of the studies focused on cost analyses or need for further POP treatment.

Evidence for pelvic floor muscle training in prevention of POP

We found no primary prevention studies (interventions to stop prolapse from developing in asymptomatic women) of PFMT on POP. However, two studies focused on secondary prevention, as they included women who had not sought health care for assessment or treatment of the condition [37, 38] and a third published [39] 2-year follow-up of one of these [38] (Table 3).

In the unblinded RCT of Wiegersma et al. (2014) [38] PFMT was conducted individually over 3 months with a specialized physical therapist according to each participant's PFM function assessed by vaginal palpation. Participants completed median 7 (range 5-9) visits with the physical therapist and were asked to do home exercises 3-5 times per week 2-3 times per day. They also received lifestyle advice to

Table 1 PEDro quality scores of RCTs

E: Eligibility criteria specified
1. Subjects randomly allocated to groups
2. Allocation concealed
3. Groups similar at baseline
4. Subjects blinded
5. Therapist administering treatment blinded
6. Assessors blinded
7. Measures of key outcomes obtained from > 85% of subjects
8. Data analysed by intention to treat
9. Statistical comparison between groups conducted
10. Point measures and measures of variability provided

+: criterion is clearly satisfied, -: criterion is not satisfied, ?: not clear if the criterion was satisfied. Total number is determined by counting the number of criteria that are satisfied, except "eligibility criteria specified" score is not used to generate the total score. Total scores are out of 10

Table 2 Outcome measure used in randomized controlled trials (RCTs) of pelvic floor muscle training to prevent or treat pelvic organ prolapse. Classification according to primary/secondary measures

Primary outcome:

- Stage of POP
  1. POPQ (Braekken 2010b, Panman 2017, Wiegersma 2014, Hagen 2014, Barber 2014, Weidner 2017, Jelovsek 2018, Nyhus 2020, Due 2016a, Due 2016b, Hagen 2009, Stüpp 2011, McClurg 2014, Kashyap 2013, Pauls 2013, Pauls 2014, Panman 2016)
- Positions of organs (imaging, observation)
  1. Position of bladder and rectum by 3D-transperineal ultrasound (Braekken 2010b, Braekken 2010a, Nyhus 2020)
  2. Anatomic failure/surgical failure (combined outcome: POPQ and no re-treatment) (Barber 2014, Wiedner 2017, Jelovsek 2018)
- Symptoms of POP (not bladder symptoms)
  1. Specific questions yes/no
  2. POP-SS (Hagen 2017, Hagen 2014, Hagen 2009, McClurg 2014, Kashyap 2013)
  3. Validated POP-specific questionnaire to describe frequency and bother of prolapse (Braekken 2010b, Braekken 2015)
  4. PFDI-20/*UDI-6/POPDI-6/CRADI-8* (Panman 2016, Panman 2017, Wiegersma 2014, Barber 2014, Jelovsek 2018, Duarte 2020, Due 2016a, Due 2016b, Cheung 2016, Pauls 2013, Pauls 2014)
  5. Number of days with prolapse symptoms in the previous 4 weeks (Hagen 2014)
  6. VAS 0-100 POP symptoms (Nyhus 2020, Kashyap 2013)
  7. Rating of women's perception of health benefit (better, same, worse). (Hagen 2017, Hagen 2014, Hagen 2009)/symptoms same/better/worse (Wiegersma 2014, Cheung 2016)
  8. PGI-I (Panman 2016, Panman 2017, Weidner 2017, Jelovsek 2018, Duarte 2020, Due 2016a)
  9. VAS 0-10 improvement/deterioration (Wiegersma 2014)
  10. Bulge/lump, pelvic heaviness, backache of P-QoL (Stüpp 2011)
  11. Obstructive symptoms of POP as detailed of UDI-19 (Frawley 2010)
- Muscle morphology by transperineal ultrasound (TPUS)
  1. Levator ani muscle trauma (Nyhus 2020)
  2. Cross-sectional area levator ani muscle by 2D transperineal ultrasound and 3D TPUS (Braekken 2010a)
  3. Levator ani muscle length at rest and during max Valsalva by 3D TPUS (Braekken 2010a)
  4. Pubovisceral muscle thickness at rest by 3D-TPUS (Braekken 2010a)
- Quality of life
- POP-qual (Brandt and Janse Van Vuuren, 2020)
- Cost analyses and need of POP-treatment
  1. The use of absorbent pads (Panman 2016, Panman 2017)
  2. EuroQoL 5D-3L/SF-6-→ QUALY/ICER/ ICUR (Panman 2016, Panman 2017, Hagen 2017)
  3. Use of health services in primary and secondary care (Hagen 2014)
  4. Uptake of treatment for prolapse symptoms during the follow-up [Hagen 2017, Hagen 2014, Barber 2014, Jelovsek 2018 (combined outcome: POPQ and no re-treatment), Due 2016a, Due 2016b, Panman 2016, Panman 2017]

Secondary outcomes:

- Sexual symptoms/ dysfunction
  1. ICIQ-VS (Hagen 2017, Hagen 2014, Hagen 2009)
  2. PISQ12 (Hagen 2017, Panman 2016, Panman 2017, Wiegersma 2014, Hagen 2014, Weidner 2017, Duarte 2020, Due 2016a, Due 2016b, McClurg 2014, Pauls 2013, Pauls 2014)
  3. Validated POP-specific questionnaire to describe frequency and bother of sexual symptoms (Braekken 2015)
  4. Frequency of sexual intercourse, satisfaction with the frequency of intercourse, and the extent of their sexual issues, reasons for not having sex (Braekken 2015)
  5. Semi-structured interview (changes in sexual desire, orgasm frequency, intensity, ability to achieve orgasm); perception of dryness, burning or discomfort/pain; self-confidence regarding sex, and/or if there were any other changes they experienced (Braekken 2015)
  6. FSFI (Pauls 2013, Pauls 2014)
- Bladder/urinary symptoms (pad test, questionnaire)
  1. Bladder diary (Pauls 2013, Pauls 2014, Frawley 2010)
  2. Pad test (Frawley 2010)
  3. ICIQ-IU-SF (Hagen 2017, Braekken 2010b, Hagen 2014, Hagen 2009, McClurg 2014)
  4. UDI-6 (Panman 2017, Wiegersma 2014, Barber 2014, Panman 2016, Pauls 2014, Jelovsek 2018, Due 2016a, Due 2016b, Panman 2016, Duarte 2020, Cheung 2016)
  5. UDI-19 (Frawley 2010)

Table 2 (continued)

6. Validated POP-specific questionnaire to describe frequency and bother of bladder (Braekken 2010b, Braekken 2015)
7. ISI (Barber 2014, Jelovsek 2018)
8. Bladder symptoms of P-QoL (Stüpp 2011)

• Bowel symptoms

1. CRADI-8 (Panman 2017, Wiegersma 2014, Panman 2016, Pauls 2014, Barber 2014, Jelovsek 2018, Due 2016a, Due 2016b, Panman 2016, Duarte 2020, Cheung 2016)
2. ICQ-BS (Hagen 2017, Hagen 2014, Hagen 2009, McClurg 2014)
3. Modified Wexner score (Frawley 2010)
4. Constipation scoring system (Frawley 2010)
5. Validated POP-specific questionnaire to describe frequency and bother of bowel (Braekken 2010b, Braekken 2015)
6. Bowel symptoms of P-QoL (Stüpp 2011)

• QoL

1. P-QoL (Stüpp 2011)
2. SF-12 (Hagen 2017, Hagen 2014, Hagen 2009, McClurg 2014, Pauls 2014)
3. SF-36 (Weidner 2017)
4. PFIQ-**7**/*UIQ-7/POPIQ-7/CRAIQ-7* (Panman 2016, Panman 2017, Wiegersma 2014, Weidner 2017, Jelovsek 2018, Duarte 2020, Due 2016a, Due 2016b, Cheung 2016, Kashyap 2013, Pauls 2013, Pauls 2014)
5. MOS-SF12/*PCS-12/MCS-12* (Panman 2016, Panman 2017, Wiegersma 2014)
6. Quality of life: interference/bother of prolapse symptoms with everyday life, scored 0 [not at all] to 10 [a great deal]): VAS (Hagen 2014, Hagen 2009, Cheung 2016)
7. World Health Organization Quality of Life (WHOQOL)-BREF (Pauls 2013, Pauls 2014)
8. IIQ-7 (Frawley 2010)
9. Assessment of Quality of Life (AQoL) score (Frawley 2010)

• Changes of lifestyle

1. Lifestyle changes (Hagen 2017, Hagen 2014)

• Body image

1. Normalized body image questionnaires (Weidner 2017)

• Need of treatment for dyspareunia, urinary symptoms

1. Uptake of treatment for urinary symptoms during the follow-up (Barber 2014, Jelovsek 2018)
2. Uptake of treatment for dyspareunia during the follow-up (Weidner 2017)
3. Desired treatment before any intervention/end treatment: patient's preference (Cheung 2016)

Independent variables/outcomes:

• PFM function/impairment

1. By manometry (Braekken 2010b, Braekken 2015, Duarte 2020, Nyhus 2020, Frawley 2010)
2. By surface electromyography during the rest and during the maximum voluntary contraction (Resende 2012, Nyhus 2020, Stüpp 2011, Pauls 2013, Pauls 2014)
3. By digital palpation of:

• Maximum voluntary contraction/modified Oxford scale and muscular endurance/PERFECT (Resende 2012, Nyhus 2020, Hagen 2009, Stüpp 2011, McClurg 2014, Pauls 2013, Pauls 2014, Frawley 2010)
• Normal/underactive/overactive/inactive (Panman 2017, Wiegersma 2014, Panman 2016)
• Strength Brink grading system (Barber 2014, Weidner 2017)

4. By transperineal ultrasound (TPUS)

• Change in levator ani muscle length at rest and during max Valsalva by 3D TPUS (Braekken 2010a)
• Change in levator hiatal dimensions from rest to maximum PFM contraction by 3D transperineal ultrasound (Braekken 2010a, Nyhus 2020)
• Training diary

1. Appointments attendence and self-reported daily diary (Hagen 2017; Braekken 2010b, Braekken 2010a, Braekken 2015; Hagen 2014; Barber 2014, Weidner 2017, Jelovsek 2018; Duarte 2020; Nyhus 2020; Hagen 2009; Stüpp 2011; McClurg 2014; Kashyap 2013; Frawley 2010)

• Complications regarding PFMT treatment including bother of PFMT

1. Complications/adverse events (Cheung 2016, Braekken 2010b, Braekken 2010a, Braekken 2015, Hagen 2014, Panman 2017, Wiegersma 2014, Hagen 2017, Panman 2016, Weidner 2017, McClurg 2014, Jelovsek 2018)
2. Bother of PFMT by numeric rating scale 0–10 (due 2016a, due 2016b)

Table 3 Short- and long-term effect of pelvic floor muscle training (PFMT) compared with no treatment or lifestyle advice on pelvic organ prolapse in the general female population (POP)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Piya-Anant et al. -03 [40] Thailand	Unblinded RCT/654 women > 60 years	Anterior vaginal wall POP	PFMT (n = 330), vaginal palpation: 2 years of 30 contractions per day + eat more fruit and vegetables and drink 2 l of water per day. Ability to contract assessed by vaginal palpation. Follow-up every 6th months Control (n = 324): no intervention, same follow-up	Drop-out: 28% Adherence: No report of PFMT adherence or change in fruit/vegetable intake	Primary outcome: No, mild or severe prolapse assessed by Valsalva on vaginal examination	PFMT: 27% worsening; Control: 72% worsening; p = 0.005. Effect only seen in women with severe prolapse No long-term follow-up	4
Ghroubi et al.-08 [41] Tunisia	RCT/ 47 women, mean age 53.4 (SD 11) No information about blinding	Stages I and II anterior vaginal wall POP	12 weeks, all had vaginal palpation PFMT (n = 27): 2 times per week for 5 weeks with individual PFMT + advice on healthy living by PT; home training 20 contractions per day for 7 weeks Control (n = 20): no treatment	Drop-out: 0 Adherence: not reported	Primary outcome: symptom of heaviness Secondary outcome; "Measurement of Urinary handicap scale" MUH; urodynamic tests; Ditrovie Quality of Life scale; patient satisfaction (VAS)	Heaviness after treatment: PFMT: 18.5%; Control: 70%, p < 0.001 Significantly better report on "MUH" in PFMT Uroflowmetry showed significant improvement in maximum flow rate **Two-year long-term follow-up:** benefits maintained in 20 of 27 (only 20 assessed) women in the PFMT group. No information on control group	6
Hagen et al.-09 [42] UK	Assessor blinded RCT/47 women, mean age 56 years (SD 9)	Symptomatic stages I and II POP (all types)	16 weeks 1: PFMT 5 visits with PT. Information of anatomy and PFMT + "the Knack" home exercise: 6 sets of max 10 contractions per day, use of diary + lifestyle advice sheet 2: Lifestyle advice sheet only	Drop-out: at 20 weeks: 13%, at 26 weeks: 15%. POP-Q data missing for 27/47 short term Adherence: 91% attended at least 3 PT sessions, 65% attended 5 visits. 61% rated as good/moderate compliers	Primary outcome: POP-Q; prolapse symptoms Secondary outcome: QoL/ interference of daily living; self-report of change in POP; sexual function by ICIQ-VS, urinary and bowel symptoms by ICIQ-UI and ICIQ-BS Independent variable: Modified Oxford grading for PFM strength only in exercise group	PFMT significantly more likely to have improved POP stage (45% vs 0%, p = 0.04), significantly greater decrease in POP symptoms (3.5 vs 0.1, p = 0.021), significantly more likely to say their POP was better (63% vs 24%) Oxford grading (n = 15): significant improvement in exercise group: mean 0.5 (95% CI: 02–0.8). No effect on sexual function or urinary or bowel symptoms No long-term follow-up reported further than 26 weeks as above by questionnaire data	6

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Brækken et al.-10 [25] a) and b) Brækken et al.-10 [43] Norway	Assessor blinded RCT/109 women, mean age 48.8 years (SD 11.8)	POP-Q stages I, II and III with and without symptoms. All types of POP	6 months, all had vaginal palpation and assessment of PFM strength and endurance PFMT: information on not to strain on toilet + 'the Knack;' 3 sets of 8–12 contractions per day, diary; weekly visits with PT for 3 months, every second week for 3 months Control: information on not to strain on toilet; 'the Knack'	Drop-out: One drop-out in each group (1.8% of each) Adherence: 79% adhered to ≥ 80% of exercise sessions 86% attended all PT sessions and 89% adherence to home training program 10% control group reported that they had performed more PFMT than they did before baseline	Primary outcome: POP-Q; ultrasound of bladder and rectal position at rest; symptoms and bother (Mouritsen and Larsen-03) Secondary outcome ICIQ UI-SF; sexual dysfunction and bowel symptoms (Mouritsen and Larsen-03). Semi-structured interview on sexual function Independent variable: muscle strength by manometry	POP-Q stage: 11 (19%) in the PFMT vs 4 (8%) controls improved one stage ($p = 0.04$) Elevation of the bladder neck: ↑2.3 mm vs ↓0.6 mm; diff. 3.0 mm (95% CI: 1.5–4.4), $p < 0.001$ Elevation of rectal ampulla: ↑4.4 mm vs ↓1.1 mm, diff. 5.5 mm (95% CI: 1.4–7.3), $p = 0.02$ Symptoms: Vaginal bulging/heaviness: ↓ frequency 32/43 vs 8/26, $p < 0.01$; ↓ bother 29/43 vs 11/26, $p < 0.01$ ICIQ UI-SF. Effect size 0.62 in favor of PFMT, diff. 2.40 (95% CI: 0.90–3.80), $p = 0.002 < 0.01$ Bowel symptoms: no effect on emptying or solid FI Flatus: frequency diff. 31.2% (95% CI: 0.7–55) $p < 0.01$; bother diff. 25.3% (95% CI: 1.5–49.1) $p < 0.01$. Loose FI: frequency diff. 68.6% (95% CI: 40.2–97.0), $p < 0.01$; bother diff. 64.3% (95% CI: 39.2–89.4), $p < 0.01$ PFM strength ($p < 0.01$): PFMT: ↑13.1 cmH_2O (95% CI: 10.6–15.5); Control: ↑1.1 cmH_2O (95% CI: 0.4–2.7). Effect size: 1.21 Endurance ($p < 0.01$): PFMT: ↑107 cmH_2O s (95% CI: 77.0–136.4); Control: ↑8 cmH_2O s (95% CI: − 7.4–24.1). Effect size: 0.96 No long-term follow-up	8

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Stüpp et al.-11 [44] Brazil	Assessor blinded RCT/37 women, mean age 55 years (SD 8)	Stage II POP. 56.7% had anterior vaginal wall POP, 10.8% posterior and 32.4% combination	14 weeks Group 1 (n = 21): PFMT 7 visits with PT. Use of quick pull of a vaginal cone and stretch reflex followed by active PFM contraction. Use of Knack during different tasks. Home exercise: 3 sets of 8–12 maximum voluntary contractions held for 6–10 s. PTs called patients every fortnight. Global stretching and lifestyle: weight loss, fluid intake, constipation, avoidance of heavy lifting Group 2 (n = 16): Control: taught how to perform PFM contractions with no protocol. Same lifestyle and global stretching as PFMT group	Drop-out: 0% Adherence: 100% in intervention and 76.2% in control. 91% adherence to home training program	Primary outcome: POP-Q Secondary outcome: Urinary and bowel symptoms by P-QoL Independent variable: Modified Oxford grading, PERFECT, sEMG	POP-Q stage: significantly greater improvement in training group (anterior vaginal wall: $p < 0.001$, posterior vaginal wall: $p = 0.025$) QoL: significant difference in favor of PFMT Symptoms: SUI significant difference in favor of PFMT ($p = 0.002$), straining to empty bladder ($p = 0.031$). No effect on vaginal bulge interfering with emptying bowel ($p = 0.250$) PFM variables: significant difference in favor of PFMT No long-term follow-up	5
Frawley et al.-12 [45] Australia ICS Abstract	Assessor-blinded multicenter RCT/168 women, mean age 55.9 years (SD 9.9)	Symptomatic POP-Q stage I, II, III. 80% had stage II POP, 73% had anterior POP	16 weeks PFMT: 5 appointments with PT, home exercise (see Hagen, 2009) + lifestyle advice Control: lifestyle advice	Drop-out at 6 months: PFMT – 14.3%; Control – 10.7%. Drop-out at 12 months: PFMT – 5.6%; Control – 21.3%. Adherence: 82.1% attended 4 or 5 PT sessions	Primary: prolapse symptom severity (POP-SS) Secondary: POP-Q stage Independent variable: Modified Oxford grading by vaginal palpation, manometry strength and endurance	Significant difference in symptoms in favor of PFMT at 6 and 12 months in favor of PFMT No difference between groups in POP-Q stage Significant difference in POP-Q points Ap and Bp at 6 months and Ap and Bp relative to hymen in favor of PFMT Significant better PFM strength in PFMT group measured by palpation at 6 months, but not at 12 months. No difference in manometry Long-term follow-up: 8 months with no supervised training or incentives as above	7

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Kashyap et al.-13 [46] India	Unblinded RCT/140 women, mean age 47 years (SD 12)	POP-Q stage I-III. 63.5% had POP-Q stage I	24 weeks All had vaginal palpation Group A: one-to-one PFMT instruction + self-instruction manual. 6 follow–up visits at week 1, 3, 6, 12, 24. Home exercise one set of 10 contractions held for 10 s ×3 per day. Diary Group B: self-instruction manual + home training program. 3 follow-up visits at week 6, 18, 24	Drop-out: Loss to follow-up week 6: A: 27.1%, B: 12.9% Week 18: A: 22.9%, B: 31.4%. Week 24: Group A: 7.1%; Group B: 21.4% Adherence: not reported	Primary outcome: POP-Q stage POP symptom scale, VAS, QoL (PFIQ-7)	Significant improvement in POP-Q stage I and II and bulging at week 6, 18 and 24 in favor of PFMT. Significant difference between groups in favor of PFMT in VAS at week 18 and 24 Complete relief of symptoms in 24.5% in the PFMT group compared to 0 in the group B No long-term follow-up	6

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Hagen et al.-14 [47] UK, NZ, Australia	Assessor-blinded multi-center RCT/447 women, mean age 56.8 years (SD 11.5)	Symptomatic POP-Q stage I, II, III 72% had stage II	16 weeks PFMT (n = 224): 5 appointments with PT + home exercise (see Hagen, 2009) and lifestyle advice Control: (n = 222): life-style advice	Drop-out at 6 months: PFMT: 16%; Control: 14% Adherence: 80% attended 4 or 5 PT sessions 40% responded to ques-tionnaire at 18 months follow-up after cessation of training	Primary: POP symptom severity (POP-SS) Secondary: POP-Q, perceived change of POP, uptake of further treatment, cost-effective-ness, Sexual function: ICIQ-VS and PISQ-12 Urinary and bowel symptoms by ICIQ-UI and ICQ-BS	Significantly greater decrease in POP symptoms at 6 and 12 months in PFMT group (mean reduction in POP-SS from baseline 3.77 [SD 5.62] vs 2.09 [5.39]; adjusted difference 1.52, 95% CI 0.46–2.59; p = 0.0053) Symptom of bulging at 6 months: PFMT – 13.8% reduction in n; Control – 3.4% reduction in n Bulging at 12 months: PFMT – 20.5% reduction in n; Con-trol – 17.0% reduction in n POP stage: PFMT – 20% improved; Control – 12% improved; p = 0.052 Uptake of further treatment: PFMT – 30%; Control – 55%; p < 0.001 No significant difference between groups in propor-tion with improved POP stage (27% vs 20%, p = 0.10) Significantly more likely to say their POP was better (62% vs 17% at 6 months, 57% vs 45 at 12 months) Uptake of further treatment: 24% PFMT, 50% Control (risk ratio 2.1, 1.5–2.9, p < 0.0001) Significantly better for aspects of bladder (UI: p = 0.01, ICIQ-UI: p < 0.001 and fecal urgency (p = 0.041 but not FI. Results diminished at 12 months Overall, the net cost of the intervention per woman was £170·24–£38·63 = £131·61 Adverse effect in 8 participants in the PFMT group unrelated to the intervention Long-term follow-up, see McClurg 2019	8

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Wiegersma et al.-14 [38] Panman et al.-17 [39] same study, 2-year follow-up The Netherlands	Assessor blinded RCT/287 women, mean age 64.2 (SD 6.6)	Symptomatic POP-Q stage I and II	3 months Both groups had vaginal palpation. "Watchful waiting" or PFMT PFMT: Information of the pelvic floor. Individualized, not standardized following vaginal palpation, weekly visit to start with + home exercise	Drop-out: 26 in PFMT, 10 in watchful waiting; 87% completed follow-up Adherence: not reported	Primary outcome: POP-Q and overall symptoms Secondary outcome PFDI-20, PFIQ-7, PISQ-12 Independent variable: Vaginal palpation: normal, underactive, overactive, inactive	No difference in POP-Q. Significant improvement in PFDI-20 in PFMT vs control; 57% in PFMT vs 13% in control reported overall improvement in symptoms UDI-6 significant (0.007) but POPDI-6 (0.110) and CRAD-8 (0.165) not significant PFDI-urinary symptoms: sign difference in favor of PFMT: -6.0 (95% CI: -9.1 to -2.9), $p < 0.001$ No sign difference between groups in PISQ-12 or anorectal symptoms NB. Below the presumed level of clinical relevance (15 point) No effect of PFM variables Long-term follow-up:12 months follow-up of Wiegersma et al.-14 and 2 years Panman et a.-17 with no further incentives: PFMT greater pelvic floor symptom improvement, lower absorbent pad costs and was more effective in women experiencing higher symptom stress	5
Alves et al.-15 [48] Brazil	Assessor blinded RCT/46 postmenopausal women, mean age 65.9 years	Anterior and posterior POP on POP-Q, some women did not have POP	6 weeks All had vaginal palpation. All women performed a fitness program based on global muscle stretching, endurance and functional exercises PFMT: in addition to general program: 12 group sessions, 30 min, twice a week (four series of ten fast contractions together with four series of ten sustained contractions, lasting for 8 s) Control: general exercise program	Drop-out: 34.8% Adherence: not reported	Primary outcome: sEMG, Modified Oxford grading by vaginal palpation Secondary outcome: POP-Q, ICIQ	PFM contractility increased after PFMT, evaluated by sEMG ($p = 0.003$) and vaginal palpation ($p = 0.001$) Decrease in urinary symptoms ($p < 0.001$ for ICIQ-OAB scores $p = 0.036$ for ICIQ UI-SF) and anterior pelvic organ prolapse ($p = 0.03$) No long-term follow-up	6

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Due et al.-16a) [49], Due et al.-16 b) [50], same study, b) 9-month follow-up Denmark	Assessor blind RCT/109 women, mean age 60 years (range: 33-79)	Symptomatic POP-Q ≥ stage II	3 months PFMT: one individual session with PT to learn PFM contraction, 6 group visits with PT, Knack + lifestyle + home exercise 3 sets of 10 contractions/day compared to Control: lifestyle: 6 group sessions	Drop-out: 18% at 3 months, 22% at 6 months Adherence: not reported 31/42 women completing the PFMT handed in their training dairies (74 %) 9 months after cessation of training: data available for 83/109, but not reported	Primary outcome: Global improvement scale, POP symptoms, POP-Q Secondary outcome: Sexual function by PISQ-12 Urinary and bowel symptoms by PFDI-20	Significantly better results in global improvement scale and POP symptoms in PFMT. No difference in POP-Q stage No effect on sexual function, urinary or bowel symptoms Long-term follow-up: 9 months after cessation of training; no difference between groups, but 13/43 (30%) control and 21/40 (52%) of PFMT group had not sought further treatment ($p = 0.05$)	7, 4
Ahadi et al.-17 [51] Iran	Pilot assessor blind RCT/40 women, mean age not reported	Stage I (42%) and II (58%) POP	12 weeks. Both groups did home PFMT for 12 weeks (10 repetitions of a 5-s squeeze followed by a 5-s release). In addition: 4 weeks of 1. PFMT and lifestyle advice in addition to biofeedback twice a week in clinics 2. Lifestyle advice sheet and PFMT without biofeedback at home only.	Drop-out: 2 = 5% Adherence: Not reported	Primary outcome: P-QOL questionnaire Secondary outcome: stage of POP by POP-Q Independent variable: manometry	P-QOL: Significant difference in favor of supervised PFMT No significant difference between groups in POP-Q No significant difference between groups in manometry assessment No complications No long-term follow-up	7

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
Hagen et al.-17 [37] UK, NZ	Assessor-blinded multi-center RCT 412 women, mean age 56.8 years (SD 11.5)	Women who had not sought help for POP Symptomatic POP-Q stage I, II, III 74.5% had stage II (all types)	16 weeks Intervention group: PFMT 5 appointments with PT over 16 weeks + home exercise (see Hagen, 2009) and lifestyle advice and Pilates-based pelvic PFMT classes and a DVD for home use + appointments at 1 and 2 years Control group: lifestyle advice leaflet (by post)	Drop-out: 21% at 1 year and 16% at 2 years (no difference PFMT vs Control) Adherence PFMT group: 74% attended 3 or 4 PT sessions Exercises last month (at 2 years): 77% PFMT vs 53% control group (odds ratio 3·22, 95% CI 1·94–5·32; p < 0·0001)	Primary outcome: POP-SS Secondary outcome: Sexual function by ICIQ-VS and PISQ-12, urinary and bowel symptoms by ICIQ-UI and ICIQ-BS, respectively	The mean POP-SS score at 2 years was 3·2 (SD 3·4) in the intervention group versus 4·2 (SD 4·4) in the control group (adjusted mean difference −1·01, 95% CI −1·70 to −0·33; p = 0·004) At 2 years, ICIQ-UI was significantly greater in the control group than in the intervention group (MD -0.83, 95% CI, -1.44 to -0.22; p = 0.008). Proportion of patients who had any urine leakage or severe incontinence did not differ between groups Bowel symptoms did not differ significantly between groups at 2 years, but interference associated with bowel symptoms was less frequent in the intervention group (MD -0.51, 95% CI -0.96 to -0.06; p = 0.026) Sexual symptoms did not differ between groups at 2 years 3 adverse effects all in intervention group (not related to PFMT): fall, pain in tailbone, chest pain and shortness of breath	6

Table 3 (continued)

	Design/n	Prolapse	Training program	Drop-out/adherence	Outcome	Results	PEDro score (0–10)
McClurg et al. (ICS abstract-19) [52] Scotland	Multicenter RCT 8-10-year follow-up study of PFMT for Scottish part only (Hagen et al.-14)	See Hagen et al. 2014. POP stage I-III. No further incentives during follow-up time	See Hagen et al. 2014. No further incentives for PFMT during follow-up at 8-10 years Outpatient and inpatient hospital data linkage for subsequent treatment related to PFD (POP, UI, FI)	Drop-out: 310 of originally 447 participants from 11 of originally 23 centers Linked data available for 293 participants from the Scottish part of the original study only Adherence: not reported	Primary outcome: Any treatment relating to POP, UI, FI received during follow-up period Secondary outcome: treatment specifically for related surgery, conservative treatment (pessary or neurostimulation) or time to first treatment	Lower proportion of intervention group (43.6%) received treatment than the control group (52.8%). Difference was statistically significant in a mixed effect model (aOR 0.61, 95% CI 0.37 to 0.99 95% p = 0.047) and on multiple imputation (aOR 0.60, 95% CI 0.36 to 0.98, p = 0.042) Median time to first treatment or censoring in the intervention group was 3008 days (IQR = 589-3396) vs control group:2242 days (IQR = 628.5-3279. Significant hazard ratio in favor of the PFMT group: 0.65 (95% CI: 0.46-0.94, p = 0.020) No significant difference between groups in use of pessary or neurostimulation or undergoing any type of related surgery	Not applicable

Table 4 Randomized controlled trials comparing pelvic floor muscle training (PFMT) and pessary for pelvic organ prolapse (POP)

	Design	Prolapse	Intervention	Drop-out/adherence	Outcome	Effect	PEDro score (0-10)
Manonai et al.-12 [59] India	Assessor blinded RCT 91 women, mean age 44 years (SD 8.9)	POP stage I and II	16 weeks: *Colpexin +PFMT *Colpexin sphere alone Vaginal assessment and Colpexin pull test every 4 week	Drop-out: 6; 6.6 % Adherence: 2 women in Colpexin + PFMT adhered to < 80% adhered to Colpexin use No further report of adherence to PFMT or Colpexin	PFM strength QoL POP stage	No change in POP-Q stage No difference between groups No long-term follow-up	8
Cheung et al.-16 [60] China	Assessor blinded RCT comparing PFMT alone with PFMT + pessary 276 women, mean age 62.6 years (SD 9.6)	Symptomatic POP stage I-III, all types. Mostly stage II (69% intervention vs 67% control) and anterior (64.7% intervention vs 66.4% control) on waiting list for surgery	16 weeks Intervention: Ring pessary (3 fit attempts) + PFMT: Nurse led: one teaching session, 3 individual sessions 4-8-16 weeks + daily home exercise daily with at least 2 sets of 8–12 preset exercise Repetitions per day, with 8–10 exercises per session at least two times per week Control: PFMT alone	Drop-out: Pessary + PFMT: 9.8% PFMT: 11.3% Adherence (at least 2 times a day/3 times/week at 12 months: Pessary + PFMT: 53.3% PFMT: 43.1% No information of pessary use	Primary outcome: change of POP symptoms and quality of life by PFDI-20; POPDI; PFIQ Secondary outcomes: *bothersome of prolapse symptoms *desired treatment *any complications	Sign higher decrease in POPDI/PFIQ in pessary group: PFDI-20: -29.7 compared with -4.7, P < 0.01; PFIQ: -29.0 compared with 3.5, P < 0.01) No difference in complication rates between groups. 66% were successfully fitted with pessary, 60% at 12 months De novo SUI: 48% in Pessary +PFMT vs 22.4% in PFMT alone No long-term follow-up	7

Table 4 (Continued)

	Design	Prolapse	Intervention	Drop-out/adherence	Outcome	Effect	PEDro score (0-10)
Panman et al.-16 [61] The Netherlands	Unblinded RCT on 162 women, mean age: 65.6 years (SD 6.4) with - 2-year follow-up	Symptomatic POP stage II (74%) and III (26%)	Two years Pessary + PFMT, median of treatments was 7 (IQR 6-10); over a median timeframe of 15.9 weeks (IQR 12-29.5 wk) (FUP 3-12-24 months) Group 1 (N = 82): pessary (open ring or ring with support or Gellhorn/Shaatz) fitted by trained research physician during 2 weeks (maximum 3 attempts) + appointments every 3 months Group 2 (N = 80): PFMT initial informative sessions + Same exercise regime (later tailored-based examination) 3-5 times a week, 2 or 3 times each day (during face-to-face contact and at home) + lifestyle and toilet advices + "the knack" +/- myofeedback or electric stimulation if needed	Drop-out: Pessary 8 (9.8%), PFMT 9 (11.3%) Did not receive randomized treatment: pessary 35 (34 unsuccessful fit); PFMT 4 Discontinued treatment: pessary 12, PFMT 10 Adherence: not reported	Primary: POP symptoms (PFDI-20, POPDI-6, PGI-I), POP stage (POPQ), costs (EuroQoL 5D 3L, QUALY, ICUR) Bladder and bowel symptoms (UDI-6, CRAD-8); specific and generic QoL (PFIQ-7, MOS-SF12, PCS-12, MCS12), sexual symptoms (PISQ12), adverse events Independent variable: vaginal palpation: normal, underactive, overactive or inactive	No difference between groups in overall PFDI-20 POP symptom score sign in favor of pessary (mean difference -3.2 points [95% CI, -6.3 to -0.0; P = 0.05]) Cost over 2 years PFMT: 437 $ Pessary:309 $ Pessary fitting fails in considerable portion of women Pessary treatment associated with more side effects than PFMT	6

AI, anal incontinence; *A-QoL*, Assessment of Quality of Life; *C*, Control; *CG*, control group; *CRADI-8*, Colorectal-Anal Distress Inventory-8; *EMG*, electromyography; *EURO-QoL 5D-3L*, Euro-Qol five dimensions-three-level Quality of Life Instrument; *FSFI*, female sexual function index; *I*, intervention; *IG*, intervention group; *ICIQ-UI-SF*, International Consultation on Incontinence Questionnaire-Urinary incontinence short form; *ICIQ-VS*, International Consultation on Incontinence Questionnaire Vaginal Symptoms; *ICIQ-BS*, International Consultation on Incontinence Questionnaire-Bowel symptoms; *ICIQ-FLUTS*, International Consultation on Incontinence Questionnaire-female lower urinary tract symptoms; *IIQ-7*, Incontinence Impact Questionnaire-7; *ISI*, Incontinence Severity Index Questionnaire; *LAG*, Lifestyle advice group; *MCS-12*, Mental Component Summary-12; *MOS-SF12*, Mental Health Component Summary-Short Form-12; *NMES*, neuromuscular electrostimulation; *PCS-12*, Physical Components Summary-12; *PFMT*, pelvic floor muscle training; *PISQ-12*, Pelvic Organ Prolapse Incontinence Sexual Questionnaire-12; *PFDI-20*, pelvic floor distress inventory questionnaire-20; *PFIQ-7*, Pelvic Floor Impact Questionnaire-7; *PGI-I*, Patient Global Impression of Improvment; *POP*, pelvic organ prolapse; *POP-Q*, Pelvic Organ Prolapse Quantification System; *POPDI-6*, Pelvic Organ Prolapse Distress Inventory-6; *POP-SS*, Pelvic Organ Prolapse Symptom Score; *P-QoL*, Prolapse Quality of Life Questionnaire; *PT*, physical therapist; *QUALY*, quality-adjusted life year; *ICER*, incremental cost-effectiveness ratio; *RCT*, randomized controlled trial; *sEMG*, surface EMG; *SF*, sexual function; *SF-6*, 6-Item Short Form Health Survey; *SF-12*, 12-Item Short Form Health Survey; *SF-36*, 36-Item Short Form Health Survey; *SUI*, stress urinary incontinence; *TPUS*, transperineal ultrasound; *TTNS*, transcutaneous tibial nerve stimulation; *UDI-6*, Urinary Distress Inventory 6; *UDI-19*, Urogenital Distress Inventory-19; *UI*, urinary incontinence; *VAS*, visual analog scale; *WHOQoL*, World Health Organization quality of life questionnaire

lose weight and improve toilet habits. In the assessor-blinded RCT by Hagen et al. (2017) [37] women were randomized to receive either printed lifestyle advice or 5 appointments with a physical therapist over 16 weeks and two blocks of once/week Pilates classes for 6 weeks. The Pilates class included specific PFMT in addition to the regular Pilates exercises

Both studies found statistically significant positive short-term effects on symptoms of POP, but not on POP-Q stage. Significant differences were maintained in some of the measures of symptoms at the 2-year longitudinal follow-up [39].

Evidence for PFMT to treat POP in the peripartum period

Wu et al. (2018) [53] reported results from a systematic review of PFMT in the peripartum period for pelvic floor disorders and found 15 RCTs. Some of these studies reported on UI, AI and sexual dysfunction only and some also included electrical stimulation. Three RCTs [54–56] reported on PFMT for POP symptoms (dichotomous outcome; presence/absence of bothersome vaginal bulging) and were included in a meta-analysis. The authors concluded that there is very low-quality evidence that structured PFMT reduces POP symptoms at 6 to 12 months postpartum. Furthermore, they reported that there is moderate-quality evidence that structured PFMT did not change POP stage up to 12 months postpartum. The authors pointed out that evidence remains scarce on the long-term effects of structured postpartum PFMT on pelvic floor outcomes. A 12-year follow-up of an RCT comparing PFMT with control found no effect of PFMT on symptoms or prevalence of POP [57]. However, POP was not reported as an outcome in the original study [58].

In the secondary analysis of an assessor-blinded RCT with PFMT alone compared with only teaching and assessment of PFM strength for UI, 175 primiparous women with and without POP 6 weeks postpartum were included [54]. No effect was found in symptoms of bulging, bladder neck position or POP-Q stage after 4 months of group PFMT + everyday PFMT home training, starting at 6 weeks postpartum. The women diagnosed with POP had POP-Q stage I and II.

Evidence for PFMT in treatment of POP in the general population

Table 3 shows RCTs assessing PFMT to treat anatomical POP or POP symptoms in the general female population. Eleven RCTs including women from 12 different countries were analyzed. Studies included POP of POP-Q stages I-III and results were generally reported for all stages together and not separately for each stage. Four studies compared PFMT with no treatment [40, 41, 44, 48]. The others compared PFMT with lifestyle intervention against lifestyle advice alone. Lifestyle advice included use of precontraction of the PFM before and during an increase in IAP ("the Knack") and advice to avoid straining during defecation [25, 43] or general lifestyle advice only [42, 45, 47, 49]. Brækken et al. (2010a) [25] was the only study reporting on morphology and did not find any effect of advice to use "the Knack" on PFM strength or morphology. Adherence to the use of the Knack was not reported.

Quality of the interventions, dose response issues

There is some variation in the content of the PFMT interventions for POP in these trials. All the PFMT programs for POP included strength training of the PFM. In the study of Wiegersma et al. (2014) [38], the participants did strength training, but also many other exercise modalities and the chosen exercise program was up to the physical therapist with no standardization of the training protocol. All research groups included vaginal palpation to determine correctness of PFM contractions and some studies used additional biofeedback with the PFMT (Tables 3 and 4).

The training period varied between 4 weeks and 2 years, and number of visits with the physical therapist varied between 4 and 18. PFMT was taught individually in all but one trial [49], who did group training. Supervised PFMT was always combined with a home training program. Drop-outs were low and adherence high in most studies. The highest number of visits with the physical therapist was in the study of Brækken et al. (2010a, 2010b) [25, 43], which included 18 visits over 6 months. No studies compared different training dosages. Overall, more intensive and supervised programs showing better results, both for symptoms and POP-Q stage of POP.

For short-term effect of PFMT, the RCTs showed PFMT to be effective in treating POP, demonstrating statistically significant improvement in POP symptoms [41–46, 48, 49] and/or anatomical POP, assessed by POP-Q stage [40, 42–44, 46, 48] compared to the comparison group. The results typically show that PFMT can improve POP-Q exams by one stage (from I to 0, II to I and III to II). Frawley et al., (2012) [45], Due et al. (2016) [49] and Ahadi et al. (2017) [51] did not find a significant change in POP stage, but significant improvements were found in some of the individual POP-Q measurements (POP-Q points Ap and Bp) in the study by Frawley et al. (2012) [45]. Methodological scores on PEDro ranged from 4 to 8, with five of the studies scoring 7–8 (Table 3).

Table 4 reports RCTs that compared PFMT with a pessary. Three RCTs were found, but the studies used different pessaries and different PFMT protocols. One study did not find any differences in outcome between PFMT and PFMT + pessary [59] while two studies found significant differences

Table 5 Evidence for pelvic floor muscle training (PFMT) in connection with pelvic organ prolapse (POP) surgery

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Frawley et al.-10 [65] Australia	Assessor blinded RCT 58 women, mean age 56.5 (SD 10.5)	Women of any age undergoing vaginal or laparoscopic-assisted vaginal surgery for either POP repair (primary or recurrent) and/or hysterectomy (94% POP surgery)	10 months Intervention (N = 30): PFMT+ lifestyle advice + the "knack" during 8 sessions with PT. 1 preoperatively (set of 6–8" contractions, with a rest period in between each contraction, repeated 8–12 times, 3 times/day; variety of positions) and 7 postoperatively at 3d-7w-7w-8w-10w-12w and 9 months (reduction dosage/intensity immediate postoperative period and gradual increase to the preoperative intensity by 6 weeks postoperatively and maintenance of an intensive level of PFMT for 3–6 m, then reduction in frequency of exercise sets to 1–2 sets/day by 12 month) Control (N = 28): pre- and postoperatively advice by gyn and nurse+lifestyle advice +/- PFM exercise without PT supervision	Drop-out = 12.1% (3 in intervention, 4 in control) Did not receive allocated group: 6 intervention + 1 control Adherence: *89% to physiotherapy visits *67% reported home training: 22% at < 1/week, 23% training 1–6 days/week, 22% training daily	Primary: Prolapse symptoms (obstructive symptoms of POP as detailed in the UDI) Secondary: bladder symptoms (UDI-19), QoL (IIQ-7, AQoL), bowel symptoms (Wexner, Constipation Scoring System), 3-day bladder diary, 48-h pad test Independent variable: Modified Oxford grading by vaginal palpation and manometry	12-month postoperative no difference in prevalence of the primary outcomes (ORs 1.2, 1.3). No significant differences between groups on change scores of UDI (mean: 44.1 [5.1]; 54.0 [5.4], P = 0.20) nor the IIQ (median: 0.0 [9,14]; 10.0 [5,19], P = 0.09) PFM strength significant in favor of intervention on (vaginal testing and manometry) No further follow-up	6

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Pauls et al.-13 [73] Pauls et al.-14 [71] Same study US	Assessor blinded RCT N = 57 women, mean age: 58 (SD 10.5) years	Symptomatic POP (all types) undergoing reconstructive POP surgery	12 weeks Long term at 24 weeks = 3 months after end treatment) Intervention (n = 29): PFMT 2 weeks pre-operatively and 2-4-6-8 and 12 weeks postoperatively, in conjunction with a physician assessment Control (n = 28): physician assessment alone at all postoperative intervals	Drop-out: 5 PFMT vs 3 Control Adherence: not reported	Primary: WHOQOL-BREF Secondary outcome: POP symptoms (PFDI 20), POP stage (POPQ), bladder and bowel symptoms (voiding diaries, PFDI20), QoL (PFIQ7, SF-12), sexual symptoms (FSFI, PISQ12) Independent variables: Modified Oxford grading by vaginal palpation, intravaginal sEMG	At 12 weeks (Pauls et al.-13) No statistically significant difference between groups in POP symptoms, QoL or sexual, urinary or bowel symptoms POP stage not shown PFM variables: no difference in Modified Oxford grading between groups, significant difference in sEMG at rest at 12 weeks in favor of PFMT Long- term follow-up at 6 months after surgery (Pauls-14): no difference between groups	5, 5

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Barber et al.-14 [62] US	Assessor blinded multicenter, 2 × 2 factorial RCT (randomizations: 1: perioperative PFMT or usual care; 2: SSLF or ULS) N = 374 women,mean age: 57.5 years (SD 10.9) PFMT vs 56.9 years (SD 10.9) Control	Stage II (39%), III (57%) or IV (4%) symptomatic POP (all types) + SUI undergoing POP surgery.	12 weeks PFMT (n = 186): 5 visits. First 2-4 weeks before surgery (45 contractions/day, initial contraction 1 – 3," increasing 1-2" per week to a maximum of 7" and instructions for resuming exercises postoperatively). 4 visits after surgery (2, 4-6, 8, 12 weeks). Individualized progressive PFMT (maximum 45–60 contractions per day and maximum 10 s of each contraction) + educational behavioral strategies. Maintenance program of 15 contractions per day at the maximum contraction duration achieved Control group (n = 188): Usual care: routine perioperative teaching and standardized postoperative instructions	Drop-out: 6 months; 6 PFMT vs 8 Surgery alone 24 months: 34 (18.3%) PFMT vs 24 (12.8%) surgery alone p = 0.15. Adherence: 93.4% (6 months) and 81,4% (24 months) to home training program 4.3% of surgery group received supervised PFMT outside of the study (24 months)	Primary outcome surgery: POP stage (POP-Q), POP symptoms (POPDI-6, PFDI-20, PGI-I), anatomic failure as composite outcome of position of organs + retreatment (1) descent of the vaginal apex more than one-third into the vaginal canal or (2) anterior or posterior vaginal wall descent beyond the hymen or (3) retreatment for prolapse) PFMT: primary outcome at 6 months: UDI and at 2 years: POPDI and anatomic success Independent variables: Vaginal palpation by Brink grading Adverse events	PFMT was not associated with greater improvements in POP scores than control group [treatment difference −8.0 (95% CI −22.1, 6.1) at 24 months] PFMT was not associated with greater anatomic success (24 months) PFMT was not associated with greater improvements in urinary or bowel scores (6-12-24 months) than control group or in QoL scores No differences in PISQ-12 or body image scores between groups at any point Baseline PFM strength mean score: 8 (Brink range 3–12). At 24 months, mean Brink scores were 8.2 and 8.0 in PFMT and usual care groups respectively (p = 0.27) Long-term effect: as above for 2 years after surgery; no effect Severe adverse events: Surgery: 16.5% and 16.7 in each surgery group PFMT: no adverse events reported	6

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Weidner et al.-17 [72] US	Same as Barber et al. 2014	See Barber et al.-14	See Barber et al.-14	See Barber et al.-14	Secondary outcome of Barber et al.-14: Primary outcome of present study: change in body image and in Pelvic Floor Impact Questionnaire (PFIQ) short-form subscale, 36-item Short-Form Health Survey (SF-36), Pelvic Organ Prolapse-Urinary Incontinence Sexual Questionnaire short form (PISQ-12), Patient Global Impression of Improvement (PGII) Independent variable: Vaginal palpation by Brink scores	No statistically significant differences between groups in PFIQ, SF-36, PGII, PISQ-12, body image scale measures or Brink score	4

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
McClurg et al.- 14 [69] UK	Multicentre feasibility pilot RCT 57 women, median age: 60 (range 35–80) years	Symptomatic POP Stage I (8%), II (63%), III (27%), (50% anterior POP) undergoing primary POP surgery	12 weeks 1 pre- and 6 postoperative sessions PFMT (n = 28): Preoperative: information of PFM by PT+ "the knack" + daily PFMT consisting of 3 sets of 10 maximum contractions (up to 10-s hold)/day with 4 s rest between sets, following by a 1-min rest followed by 10 fast contractions + lifestyle advice Same sessions postoperative Control (n = 29): only lifestyle advice postoperative	Drop-out: 7% PFMT and 7% control after surgery, 18% (50% examination) intervention and 14% (72% examination) control 6 months; 50% (82% examination) intervention and 56% (83% examination) control 12 months. Numbers attending for assessment were TG = 14/28 (50%) and CG = 11/29 (28%); at 12 months, 5/28 (18%) and 5/29 (17%) attended Adherence: Intervention group attended 80% of treatment sessions. Home exercise: overall good adherence in those recording (but only 28% recorded)	Primary outcome: POP symptoms score (POP-SS) Secondary outcome: POP stage (POP-Q) Bladder (ICIQ-IU-SF) and bowel (ICIQ-BS) symptoms, sexual symptoms (PISQ-12), QoL (SF-12) Independent variables: Modified Oxford grading by vaginal palpation, adverse events	Significant difference in POP-SS between groups in favor of PFMT at 12 months [MD 3.94; 95 % CI 1.358–6.750; t = 3.248, p = 0.006) Significant difference in SF-12 in favor of PFMT at 12 months (MD −6.88333; 95% CI −11.344 to −2.431, t = −3.218, p = 0.004) No differences in ICIQ or PISQ-12 scores POP stage changes and PFM variables no interpretation due to missing data (only 10 women examined at 12 months) Long-term follow-up: 6 and 12 months after surgery; as above No adverse events reported	7

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Jelovsek et al.-18 [67] (follow-up of Barber et al.-14 [62] and Weidner et al.-17 [72]	5-year follow-up of OPTIMAL trial, see Barber et al. 2014 and Weidner et al. 2017	See Barber 2014 and Weidner et al.-2017	See Barber et al. 2014 and Weidner et al. 2017	374 originally participated At 5 years: 244 completed the extended trial Adherence: no report of adherence at 5 years or during time elapsed from surgery	See Barber et al.-14Primary surgical outcome: POP-Q and symptoms of bother Primary PFMT outcomes: time to anatomic failure and Pelvic Organ Prolapse Distress Inventory scores (range: 0-300)	Long-term follow-up 5 years after surgery: no differences between surgery with PFMT and surgery without neither on primary or secondary outcomes. No change since 24-month follow-up Estimated surgical failure rate was 61.5% and 70.3% in the two surgical groups Estimated anatomic failure rate was 45.6% in the PFMT group and 47.2% in the usual care group (adjusted difference, −1.6% [95% CI, −21.2 to 17.9]) Improvements in Pelvic Organ Prolapse Distress Inventory scores were −59.4 in the BPMT group and −61.8 in the usual care group (adjusted mean difference, 2.4 [95% CI, −13.7 to 18.4])	Not applicable

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Brandt & Janse Van Vuuren-20 [63] South Africa	Double blind 3-arm RCT 81 women, 18-75 years	POP Stage I-III scheduled for reconstructive POP surgery	3 months 4 sessions with PT in group 1 and 2 within 6 months 1. PFMT including vaginal palpation, ultrasound, observation and sEMG of contraction 8-10 contractions once 5 days a week in progressive positions 2. PFMT + abdominal training (TrA) 3. Usual care, taught to pre-contract the PFM, no clinical assessment	Drop-out: 8.6% 2 in PFMT 2 in abdominal training 3 in control Adherence: 60% PFM exercises at 3 months, 55% at 6 months. Non-sig difference between group 1 and 2	Primary: The Prolapse Quality of Life questionnaire, two-dimensional ultrasound, PERFECT (palpation: power, endurance, repetitions, fast contractions, every contraction timed), sEMG, Sahrmann scale, and manometry Urinary frequency at 3 months, bulging at 6 months Discomfort at 6 months LA at 6 months Sahrmann 6 months Secondary: *adherence *lumbar and pelvic health	No effect on Prolapse Quality of Life or POP symptoms PFMT: Significant Improved power, number of fast contractions, amount of movement, endurance, and Sahrmann and manometry measures – compared with the control group. PFMT + Abdominal training: Significant improvement in number of PFM contractions, Sahrmann and manometry measures compared with the control condition Significant ($p < 0.05$) increase in bulging and discomfort Both groups showed significantly increased urinary frequency ($p < 0.05$) compared with control No adverse effects of either interventions No report of long-term effect above 6 months	8

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Duarte et al.-20 [64] Brazil	Assessor blind RCT 96 women, age: 66.7% > 60 years, 28.1% 40-60 years, 5.2% 37-40 years	Symptomatic POP II (43%), III, IV (all types) undergoing POP surgery	9 weeks Both groups had vaginal palpation and manometry PFMT (n = 48): 4 preoperative (within 2 weeks preoperatively) and 7 postoperative supervised sessions with PT Postoperative PFMT started at day 40 after surgery with 7 postoperative weekly sessions Each session: 4 sets of 10 repetitions of maximum voluntary contractions with a 7 s hold/7 s rest (supine, sitting, kneeling and standing) + 5 quick contractions Same protocol at home at least 3 times/week Control (n = 48): only surgery	Drop-out: 2 (4%) in PFMT, 0 in control Adherence: 93% Intervention > 75% of the supervised sessions. 76% home training on 75-100% of the days prescribed	Primary outcome: POP symptoms (PFDI-20, PGI-I), Secondary: bladder and bowel symptoms, QoL (PFIQ-7), sexual symptoms (PISQ-12), perception of improvement Independent variables: PFM strength and endurance by manometry	No substantial difference in POP symptoms between the intervention and control at day 40 (adjusted mean difference -6, 95% CI -25 to 13) or day 90 (adjusted mean difference -4, 95% CI -23 to 14) The experimental group perceived marginally greater global improvement than the control group [mean difference -0.4 (95% CI -0.8 to -0.1) at day 90] PFMT was not associated with better improvements in urinary, bowel, sexual or QoL scores than control group No difference in PFM variables between groups No report of further long-term effect	8

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Nyhus et al.-20 [70] Norway	Assessor blind RCT 159 women, mean age: PFMT+ surgery 60.1 (SD 11.2) vs surgery: 60.6 (SD 10.9)	Symptomatic POP II, III, IV (60% ≥ III) (all types) undergoing POP surgery	Mean 22 weeks waiting for surgery PFMT (n = 81): Preoperatively: vaginal palpation + written information leaflet and asked to daily PFMT consisting of 8–12 contractions, each held for 6–8 s, three times a day + lifestyle advice + "the knack" Two personal visits with PT at 2 and 6 weeks after inclusion preoperatively including vaginal palpation Optional weekly PFMT in groups with PT Control (n = 78): only surgery	95% women completed the study intervention = 75, controls = 76) Drop-out: 6 in Intervention vs 2 in Control Adherence: 60 (80%) women in the PFMT group adhered to ≥ 70% to the intervention None of the participants met for the voluntary weekly group training sessions	Primary: POP symptoms (bulge sensation, VAS), POP stage (POP-Q), position of organs and muscle morphology (ultrasound 3D -TPUS) Secondary: anatomical POP Independent variables: Modified Oxford grading by vaginal palpation, 3D-TPUS, manometry, sEMG	No difference was found between surgery + PFMT and control with respect to PFM contraction assessed by Modified Oxford grading: 2.4 vs 2.2;P = 0.101), manometry (19.4 vs 19.7 cmH_2O; P = 0.793), surface EMG (33.5 vs 33.1 mV; P = 0.815) and ultrasound (change in hiatal APD, 20.9% vs 19.3%; P = 0.211). Sensation of vaginal bulge: no difference between groups (VAS, 7.4 vs 6.0 mm; P = 0.598), POP distance from the hymen in the dominant prolapse compartment (−1.8 vs−2.0 cm; P = 0.556) and sonographic descent of the bladder (0.5 vs 0.8 cm; P = 0.058), cervix (−1.3 vs −1.1 cm; P = 0.569) and rectal ampulla (0.3 vs 0.4 cm; P = 0.434) No further long-term effect reported	7

Table 5 (continued)

	Design	POP	Exercise intervention	Drop-out/adherence	Outcome	Results	PEDro score (0-10)
Mathew et al.-21 [68] Norway	RCT/159 women >18 yrs Same study as Nyhus et al. 2020	See Nyhus et al. 2020	See Nyhus et al. 2020.	See Nyhus et al. 2020	Primary outcomes: Symptoms of urinary and colorectal-anal distress assessed by validated PFDI sub-scales: UDI-6 and CRADI-8. Secondary outcome: patient reported quality of life related to urinary and colorectal-anal symptoms using the PFIQ sub-scales: UIQ and CRAIQ	No added effect of preoperative PFMT on symptoms or QoL related to urinary and colorectal-anal distress: no difference in mean postoperative symptom and QoL scores (95% CI) between the intervention and control group: UDI-6 16 (12–21) vs. 17 (13–22), CRADI-8 15 (11–18) vs. 13 (10–16), UIQ 11 (7–15) vs. 10 (6–13) and CRAIQ 5 (2–7) vs. 6 (4–9), all p > 0.05	

in favor of pessary use. Both Panman et al. (2016) [61] and Cheung et al. (2016) [60] found that pessary fitting fails in a considerable number of women; 40% reported at 12 months [60]. De novo stress urinary incontinence was higher in the pessary group than in the PFMT group, 48% vs 22%, respectively [60].

Evidence for PFMT pre- and post-POP surgery

Table 5 shows the published RCTs on PFMT in connection with POP surgery. Eleven full publications or meeting abstracts which were published from 2005 until 2021 [62–72] were included. We excluded one study because of inclusion of SUI and POP surgery as well as lack of reports of symptoms or stage of POP [66]. PFMT started preoperatively in all studies with between one to four sessions and continued with individual visits post-surgery.

Only one of the RCTs showed any benefit of adding PFMT to surgery for POP [69]. The latter was a pilot feasibility study with 67 participants randomized to either PFMT or usual care in connection with surgery and showed that the training group had fewer prolapse symptoms at 12 months.

Evidence for PFMT in women with POP on sexual dysfunction, bladder and anorectal symptoms

The results of PFMT on sexual dysfunction, bladder and anorectal symptoms for women with POP are presented in Tables 3, 4 and 5. None of the studies had sexual function or bladder and anorectal symptoms as the primary outcome. The size of the studies varied from 57 [71] to 374 participants [72]. One study included women with POP-Q stage I, II and III, regardless of POP symptoms [74], while the others included women with symptoms.

Sexual dysfunction

Tables 3, 4 and 5 include studies reporting the effect of PFMT on sexual function in women with POP. Two studies found some effect of PFMT on sexual function [74, 75]. The short-term improvement of Pelvic Organ Prolapse Incontinence Sexual Questionnaire-12 (PISQ-12) and Female sexual function index (FSFI) scores described by Pauls et al. (2013) [75] was lost after 24 weeks [71]. Braekken et al. (2015) [74] using a validated questionnaire from Mouritsen et al. (2003) [73] found no significant change in the number of sexually active women and no significant differences between groups regarding change in satisfaction with frequency of intercourse. However, interview data showed that 19 (39%) of women in the PFMT group reported improved sexual function compared to only two participants (5%) in the control group ($P < 0.01$). Some participants reported increased control, strength and awareness

of the pelvic floor, improved self-confidence, sensation of a "tighter" vagina, improved libido and orgasms, resolution of pain with intercourse and heightened sexual gratification for partners. Additionally, the study found that participants who described improved sexual function obtained the greatest increases in pelvic floor muscle (PFM) strength (mean 16 ± 10 cmH_2O) and endurance (mean 150 ± 140 cmH_2O s) ($P < 0.01$).

Bladder and bowel symptoms

The results related to PFMT on bladder and bowel symptoms in women with POP are shown in Tables 3, 4 and 5. Eight studies found that PFMT improved bladder symptoms [38, 39, 43, 44, 47, 60, 61, 74] and five studies found improvement of anorectal symptoms [39, 43, 44, 47, 61, 74]. Braekken et al. (2010b) [43] and Braekken et al. (2015) [74] report from the same RCT using different outcome measures.

Long-term effect of PFMT in treatment of POP

We defined "long term" as follow-up of at least 6 months after cessation of the intervention conducted in the original RCTs. There are a limited number of studies on the long-term effects of PFMT for POP (Tables 3, 4 and 5). The follow-up period varied between 6 months and 8 to 10 years, and there were no reminders or follow-up of PFMT during the follow-up period. Long-term effect was found in the findings of Panman et al. 2017 [39] and McClurg et al. 2019 [52], but not of Barber et al. 2015 [62], Jelovsek et al. 2018 [67] and Due et al. 2016b [50]. The studies with no long-term effect did not show any short-term effect.

Adverse effects of PFMT in women with POP are almost non-existent, and, if present, mostly not related to the PFMT.

Discussion

This narrative review found no primary prevention RCTs on PFMT for POP and sparse evidence on early interventions in the general female population and the peripartum period. PFMT has been shown to significantly improve POP symptoms and associated pelvic floor complaints. Anatomic POP has been shown to improve by one POP-Q stage. It is unclear how clinically relevant this is because there are insufficient data describing the elevation of the leading edge of prolapse from beyond to above the hymen with PFMT. Studies included women with POP-Q stage I to III POP, and the effect was generally reported for all stages together, and not separated between stages, possibly because of low sample sizes. One pilot feasibility RCT showed significant benefits of PFMT as an adjunct to surgery but this was not proven in the nine other studies. Long-term data are sparse, and results are inconsistent.

Prevention and early peripartum intervention

Given the anatomical and biomechanical rationale and evidence for PFMT to change pelvic floor morphology [25], it is theoretical to assume that PFMT would be effective in prevention of POP. Regular PFMT and early intervention to stop development and worsening of POP (primary prevention) would probably be the best health care investment to reduce suffering and cost of this prevalent female condition. If PFMT is provided as group training, it could be more cost-effective than individual training [22]. However, evidence from robust RCTs in prevention of POP is lacking. Furthermore, RCTs on PFMT in prevention of POP should optimally proceed over 20–30 years and include one PFMT training and one non-training group. It would be costly, time-consuming and probably not possible to keep women adhering to an exercise training program for such long time, nor would asking women not to do PFMT be ethically acceptable. The two included studies on secondary prevention in our review [37, 38] could have been classified as treatment as some of the included women had symptoms of POP, but as the participants had not sought help for POP, we chose to classify them as preventive studies. The results of these RCTs showed some benefit, but the effects were not that convincing [37, 38]. Lack of large effect sizes can be attributed to low training dosage (mode of exercise, frequency, intensity, duration and adherence to training) [76]. The idea of including correct PFMT into general exercise classes for women would probably be the only option to enable women adhere to regular PFMT for the purpose of preventive exercise [22]. However, that would only apply for women who are regularly physically active, and many of them would exercise independently and not in exercise classes.

Somewhat surprisingly, studies have found that POP is also prevalent in nullipara women [77]. As vaginal birth is a main risk factor for the condition, PFMT should be offered at an early stage either during pregnancy or after childbirth [78]. However, since there is insufficient evidence to suggest this based on results from RCTs, this would be based on expert opinion only. Some of the studies in the systematic review of Wu et al. (2018) [53] on postpartum PFMT for PFD were not registered in PubMed [55, 56, 79, 80], and only three RCTs were included in the meta-analysis of PFMT for POP. Three of the RCTs included electrical stimulation in addition to PFMT [79, 81]. The inclusion of these confounders means that we cannot conclude the effect of PFMT alone in these postpartum studies. The conclusion of Wu et al. (2018) [53] is that there is very low-quality evidence that structured PFMT reduces POP symptoms at 6 or

12 months postpartum, which is based on the two RCTs not found in PubMed [55, 56]. Additionally, the evidence for a positive effect in the postpartum period is not supported by results from Bø et al. (2015) [54] or the 12-year follow-up of conservative management of postnatal urinary and fecal incontinence and POP outcomes by Glazener et al. (2014) [57]. The training dosage and level of supervision might have been too low in the Glazener study (2001) [58] but was quite high in the study by Bø et al. (2015) [54]. However, the primary outcome of Bø et al. [54] and Glazener et al.'s [58] RCTs was UI, and both studies included women with and without POP; thus, the sample size may have been too small to detect significant differences for POP. In addition, in the Bø et al. RCT [54], a substantial number of the participants had major levator ani tears, which may have made it more difficult to achieve positive results. Higher IAP with lifting of a newborn infant and baby equipment may further explain difficulties in achieving positive effect of PFMT in the postpartum period. Further RCTs are warranted to investigate the effect of early prevention and treatment using PFMT on women with symptomatic POP in the peripartum period.

General population

The effect of PFMT in the general female population with POP showed overall positive short-term results on POP symptoms, and in most of the studies measuring anatomical POP, the prolapse improved one stage [40, 42–44, 46, 48]. The studies with no effect on POP-Q stage had a lower training dosage compared with studies finding statistically significant improvement in anatomical POP [45, 49, 51]. Interventional quality of exercise training studies is dependent on training dosage [22, 76]. We did not find any RCT comparing different training dosages. Ahadi et al. (2017) [51] claimed to compare PFMT with or without biofeedback but added 4 weeks of PFMT with biofeedback to home exercise. Hence, this is not an equivalent comparison. For UI, no additional effect of adding biofeedback was found in an RCT with equal dosage and supervision of PFMT [82]. Kashyap et al. (2013) [46] compared six visits over a 6-month training period using a self-instruction manual only to one-on-one PFMT plus instruction manual, and the results showed the same overall beneficial effect on symptoms and POP-Q stage in the one-on-one PFMT group as Brækken et al. [25, 43]. As for all exercise training programs, this review found that there is a dose-response relationship with more intensive and supervised programs showing better overall results, both for symptoms and POP-Q stage of POP.

This review found only three RCTs comparing PFMT with a pessary, highlighting the need for further high-quality RCTs for this comparison. The level of evidence for pessaries as an effective intervention for POP was level three evidence in the 2017 ICI systematic review [26] and this corresponds with the latest Cochrane review [83]. As wearing a pessary over time may unmask occult stress urinary incontinence, this should not be considered a complication of pessary use [84].

Sexual, bladder and anorectal comorbidities

Many of the RCTs on PFMT in women with POP also evaluated the effect on comorbidities such as sexual dysfunction, bladder and anorectal symptoms and found positive results. However, none of the studies had these comorbidities as primary outcomes and the studies included women with and without these symptoms. The power of the studies not finding an effect may be too low for these secondary analyses. Most studies used general validated instruments for the overall conditions, and more detailed information on the effect of UI and AI was not always available.

Sexual dysfunction in women is frequently associated with pelvic organ prolapse (POP) [85]. In a systematic review [86], the authors found only Level 2 evidence that PFMT can improve women's sexual function, and the literature is scarce about the effect of PFMT on sexual function in women with POP. As for other comorbidities, the training duration in some of the studies was short because it was done as an adjunct to surgery [64, 71], had a limited number of supervised sessions which may have limited adherence to the training protocol [49, 72] and included women both with and without sexual dysfunction. There is some evidence that women without sexual dysfunction have increased PFM strength compared to women with sexual dysfunction [87]. However, sexual function is influenced by several interpersonal, contextual, personal, psychological and biological factors including POP. Partner factors may adversely affect sexual function and diminish the benefit of PFMT [86]. We found that only two RCTs which showed some positive effects of PFMT on sexual function of women with POP [71, 74]. There is need for new RCTs specially designed to investigate the effect of PFMT in specific types of sexual dysfunction in women with POP.

Some of the studies assessing bladder and anorectal symptoms had a relatively short duration of the PFMT protocol as they were investigating perioperative PFMT [64, 71, 75] or a limited number of supervised sessions that could have limited the adherence to training protocol [37, 42, 47, 49, 69, 72]. The two RCTs offering supervised PFMT for a longer time showed improvement in bladder and anorectal symptoms in women with POP [25, 39, 74]. Future high quality RCTs are therefore still needed to investigate the

impact of intensive supervised PFMT protocols on bladder and anorectal symptoms in women with POP.

Effect of PFMT pre- and post-POP surgery

It is somewhat counterintuitive that PFMT does not seem to be effective pre- and post-POP surgery. This is despite evidence that it is effective in the treatment of POP [26]. However, women included in surgical studies may be a selected group with more severe POP resulting from major PFM tears, perineal tears or higher hiatal area ballooning. In addition, it may be difficult to show additional effect of PFMT if surgery alone is effective, and a possible effect of PFMT may only be expected to be seen after many years of continuous PFMT. The longest follow-up period was 5 years after surgery, but there were no incentives for continuous PFMT during the follow-up period after the last training session 12 weeks post-surgery, and there was no report on adherence to maintenance training [67]. Furthermore, there was no effect of the original training program in this study [62], and a long-term effect may therefore not be expected. The lack of effect of PFMT in connection to POP surgery warrants that such studies should be analyzed separately from treatment trials in the general population and not be merged in meta-analyses.

Furthermore, the recurrence rate following traditional surgery for POP is approximately 30% [88, 89], and surgery for prolapse can be associated with various adverse events and potentially poorer quality of life than the original condition [90, 91]. Mesh is one option for surgical treatment of stress urinary incontinence (SUI) and POP. However, some women experience serious complications [88, 89], and mesh is now the subject of intense global scrutiny after reports of serious negative long-term effects [92]. The National Institute for Health and Care Excellence (NICE) Guidelines (2019) [27] state that there is some evidence of benefit for all surgical procedures for POP recommended in their guideline, including mesh procedures, but limited evidence on long-term effectiveness and adverse effects. They conclude that "the true prevalence of long-term complications is unknown." Although the rate of severe complications may be low [90], due to high surgery rates, a substantial number of women will suffer after POP surgery worldwide [92]. Non-invasive treatments, such as lifestyle interventions and PFMT, should therefore be considered before surgical interventions [26, 27].

Long-term studies

There are general challenges to long-term studies of any intervention due to loss-to follow-up, co-interventions, treatment switching and competing events [93, 94]. For exercise training there are additional challenges such as non-adherence to maintenance training [93, 94]. In a systematic review of long-term effect of PFMT for SUI/MUI 19 studies with follow-up ranging from 1–15 years were found [93]. Only two studies provided follow-up incentives for continuous PFMT during follow-up and long-term adherence to PFMT varied between 10% and 70%. For the POP studies found in the present review, there were no incentives for continuous PFMT after cessation of the original intervention, and only Barber et al. (2014) [62] reported long-term adherence to PFMT. They found that 93.4% reported to adhere to PFMT 6 months after the intervention and 81.4% at 2 years. However, there was no effect of PFMT in this study on either PFM strength or POP. In the 5-year follow-up of the Barber et al. study (2014) [62], Jelovsek et al. (2018) [67] reported that the estimated surgical failure rate was 61.5% and 70.3% in the two surgical groups, respectively. They concluded that rates of surgical failure increased during the follow-up period, although prolapse symptom scores remained improved.

There are challenges in adherence to long-term PFMT when there is no structured follow-up regimen or encouragement for further training after the initial supervised PFMT. This could explain the diminishing effect. Furthermore, if there was no short-term effect of a PFMT program [49, 50, 62, 67, 71, 75], then long-term effects are unlikely. Long-term success of any exercise training program relies on maintenance training. When women are left alone to do PFMT with no further incentives this is a challenge to some. The promotion of PFMT from a women's health perspective should include strategies to support building PFMT into their general exercise/physical activity programs and/or daily routines. However, today < 30% of the adult population follows the WHO's recommendations for participation in physical activity and exercise training, and it is likely that only those who are already physically fit and motivated for general training will attend structured exercise classes which could include specific PFMT [95–97]. New ways of reaching women with information on why and how to perform PFMT in addition to more general physical activity are needed. Due to injuries and weaknesses of the PFM and inability to contract correctly, PFMT may be even more difficult to adhere to than other exercise. More work is required to improve women's long-term adherence to pelvic floor rehabilitation programs.

At present, one can question whether today's health services for non-surgical interventions for POP are optimal. In a focus group study of 22 women receiving prolapse care through urogynecology services in the UK [98], the authors found that women often delayed seeking help for their symptoms because of lack of awareness, embarrassment and stigma. When they did present to their family doctors, their symptoms were often dismissed and unaddressed until they became more severe, and the women reported receiving

little or no choice in treatment decisions. Choices were often influenced by health professionals' preferences and inconsistent with women's preferences and needs. Physical therapy-based interventions were reported as helping women regain control over their symptoms and life.

The results of the present narrative review support the conclusion of the ICI 2017 with 1A evidence/recommendation for PFMT in treatment of POP in the general female population [26]. In addition, the NICE guidelines (2019) [27] recommend considering a program of supervised PFMT for at least 16 weeks as a first option for women with symptomatic POP-Q stage I or stage II. If the program is beneficial, they recommend advising women to continue PFMT. There is no strong evidence for strength training maintenance programs, but intensity of the contraction seems to be the main factor. We therefore recommend 1–2 sessions a week with 8–12 close to maximum contractions. The overall best results found in our review were in an RCT with 18 supervised training sessions over a 6-month training period [25, 43]. We were only able to find one study on predictors of success of PFMT in women with POP [99]. They found that young age and having ≥ 1 indicators of obstetric trauma were predicting factors but discussed that many factors such as PFM function were not included in the analysis. We agree with the authors that there is a need for further studies on this important clinical question.

Clinical recommendations for effective PFMT for POP

*Provide proper information about the pelvic floor, exercise physiology and evidence for how PFMT can improve pelvic floor morphology and POP

*Teach proper PFM contraction technique and assess whether the woman can do a correct contraction (vaginal palpation, manometry, dynamometry, ultrasound) and give immediate feedback of performance

*Use validated outcome measures to assess POP symptoms, stage of POP (POP-Q) and comorbidities before and after treatment

*Offer individual weekly visits or group training with a physical therapist for at least 6 months with additional home training

*Teach women at risk for POP strategies to reduce IAP during activities of daily living

*Use motivational strategies to favor adherence

*Strength training regimens should follow general principles for strength training (3 sets of 8-12 close to maximum contractions at least 3-4 times/week and continue for at least 4 months)

*Register adherence to both supervised PFMT and home training

*Assess PFM variables (resting value, PFM strength and endurance) before and after treatment

*Recommend a suitable PFMT maintenance program with intensity of the contraction being the most important factor (8-12 contractions 1-2 times/week)

Recommendations for further studies

*Primary and secondary prevention studies in the general female population and studies in women with POP within 12 months after childbirth

*Monitoring long-term adherence and study predictors of success of PFMT for POP including pelvic floor biological/anatomical factors

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Declarations

Conflicts of interest None.

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References

1. Brown HW, Hegde A, Huebner M, Neels H, Barnes HC, Marquini GV, et al. International urogynecology consultation chapter 1 committee 2: Epidemiology of pelvic organ prolapse: prevalence, incidence, natural history, and service needs. Int Urogynecol J. 2022;33(2):173–87. https://doi.org/10.1007/s00192-021-05018-z.
2. Lowenstein L, Gamble T, Sanses TV, van Raalte H, Carberry C, Jakus S, et al. Sexual function is related to body image perception in women with pelvic organ prolapse. J Sex Med. 2009;6(8):2286–91. https://doi.org/10.1111/j.1743-6109.2009.01329.x.
3. Deprest JA, Cartwright R, Dietz HP, Brito LGO, Koch M, Allen-Brady K, et al. International Urogynecological Consultation

(IUC): pathophysiology of pelvic organ prolapse (POP). Int Urogynecol J. 2022;33(7):1699–710. https://doi.org/10.1007/s00192-022-05081-0.
4. DeLancey JO. What's new in the functional anatomy of pelvic organ prolapse? Curr Opin Obstet Gynecol. 2016;28(5):420–9. https://doi.org/10.1097/GCO.0000000000000312.
5. DeLancey JO, Hurd WW. Size of the urogenital hiatus in the levator ani muscles in normal women and women with pelvic organ prolapse. Obstet Gynecol. 1998;91(3):364–8. https://doi.org/10.1016/s0029-7844(97)00682-0.
6. Dietz HP, Franco AV, Shek KL, Kirby A. Avulsion injury and levator hiatal ballooning: two independent risk factors for prolapse? An observational study. Acta Obstet Gynecol Scand. 2012;91(2):211–4. https://doi.org/10.1111/j.1600-0412.2011.01315.x.
7. Ghetti C, Gregory WT, Edwards SR, Otto LN, Clark AL. Severity of pelvic organ prolapse associated with measurements of pelvic floor function. Int Urogynecol J Pelvic Floor Dysfunct. 2005;16(6):432–6. https://doi.org/10.1007/s00192-004-1274-1.
8. Hoyte L, Jakab M, Warfield SK, Shott S, Flesh G, Fielding JR. Levator ani thickness variations in symptomatic and asymptomatic women using magnetic resonance-based 3-dimensional color mapping. Am J Obstet Gynecol. 2004;191(3):856–61. https://doi.org/10.1016/j.ajog.2004.06.067.
9. Hsu Y, Summers A, Hussain HK, Guire KE, Delancey JO. Levator plate angle in women with pelvic organ prolapse compared to women with normal support using dynamic MR imaging. Am J Obstet Gynecol. 2006;194(5):1427–33. https://doi.org/10.1016/j.ajog.2006.01.055.
10. Siahkal SF, Iravani M, Mohaghegh Z, Sharifipour F, Zahedian M, Nasab MB. Investigating the association of the dimensions of genital hiatus and levator hiatus with pelvic organ prolapse: a systematic review. Int Urogynecol J. 2021;32(8):2095–109. https://doi.org/10.1007/s00192-020-04639-0.
11. Singh K, Jakab M, Reid WM, Berger LA, Hoyte L. Three-dimensional magnetic resonance imaging assessment of levator ani morphologic features in different grades of prolapse. Am J Obstet Gynecol. 2003;188(4):910–5. https://doi.org/10.1067/mob.2003.254.
12. Volløyhaug I, Morkved S, Salvesen KA. Association between pelvic floor muscle trauma and pelvic organ prolapse 20 years after delivery. Int Urogynecol J. 2016;27(1):39–45. https://doi.org/10.1007/s00192-015-2784-8.
13. Xuan Y, Friedman T, Dietz HP. Does levator ani hiatal area configuration affect pelvic organ prolapse? Ultrasound Obstet Gynecol. 2019;54(1):124–7. https://doi.org/10.1002/uog.20210.
14. DeLancey JO, Morgan DM, Fenner DE, Kearney R, Guire K, Miller JM, et al. Comparison of levator ani muscle defects and function in women with and without pelvic organ prolapse. Obstet Gynecol. 2007;109(2 Pt 1):295–302. https://doi.org/10.1097/01.AOG.0000250901.57095.ba.
15. Handa VL, Roem J, Blomquist JL, Dietz HP, Munoz A. Pelvic organ prolapse as a function of levator ani avulsion, hiatus size, and strength. Am J Obstet Gynecol. 2019;221(1):41 e1–7. https://doi.org/10.1016/j.ajog.2019.03.004.
16. Huebner M, Margulies RU, DeLancey JO. Pelvic architectural distortion is associated with pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2008;19(6):863–7. https://doi.org/10.1007/s00192-007-0546-y.
17. Braekken IH, Majida M, Engh ME, Bo K. Are pelvic floor muscle thickness and size of levator hiatus associated with pelvic floor muscle strength, endurance and vaginal resting pressure in women with pelvic organ prolapse stages I-III? A cross sectional 3D ultrasound study. Neurourol Urodyn. 2014;33(1):115–20. https://doi.org/10.1002/nau.22384.
18. Hilde G, Staer-Jensen J, Siafarikas F, Gjestland K, Ellstrom Engh M, Bo K. How well can pelvic floor muscles with major defects contract? A cross-sectional comparative study 6 weeks after delivery using transperineal 3D/4D ultrasound and manometer. BJOG. 2013;120(11):1423–9. https://doi.org/10.1111/1471-0528.12321.
19. Braekken IH, Majida M, Ellstrom Engh M, Holme IM, Bo K. Pelvic floor function is independently associated with pelvic organ prolapse. BJOG. 2009;116(13):1706–14. https://doi.org/10.1111/j.1471-0528.2009.02379.x.
20. Kegel AH. Stress incontinence and genital relaxation; a nonsurgical method of increasing the tone of sphincters and their supporting structures. Ciba Clin Symp. 1952;4(2):35–51.
21. Bø K. Pelvic floor muscle training is effective in treatment of female stress urinary incontinence, but how does it work? Int Urogynecol J Pelvic Floor Dysfunct. 2004;15(2):76–84. https://doi.org/10.1007/s00192-004-1125-0.
22. Bø K. Physiotherapy management of urinary incontinence in females. J Physiother. 2020;66(3):147–54. https://doi.org/10.1016/j.jphys.2020.06.011.
23. Miller JM, Perucchini D, Carchidi LT, DeLancey JO, Ashton-Miller J. Pelvic floor muscle contraction during a cough and decreased vesical neck mobility. Obstet Gynecol. 2001;97(2):255–60. https://doi.org/10.1016/s0029-7844(00)01132-7.
24. Peschers UM, Fanger G, Schaer GN, Vodusek DB, DeLancey JO, Schuessler B. Bladder neck mobility in continent nulliparous women. BJOG. 2001;108(3):320–4. https://doi.org/10.1111/j.1471-0528.2001.00066.x.
25. Braekken IH, Majida M, Engh ME, Bo K. Morphological changes after pelvic floor muscle training measured by 3-dimensional ultrasonography: a randomized controlled trial. Obstet Gynecol. 2010;115(2 Pt 1):317–24. https://doi.org/10.1097/AOG.0b013e3181cbd35f.
26. Dumoulin C, Adewuyi T, Booth J, Bradley C, Burgio K, Hagen S, et al. Adult Conservative Management. In: Abrams P, Cardozo L, Wagg A, Wein A, editors. 6th International Consultation on Incontinence. ICI-ICS. Bristol: International Continence Society; 2017. p. 1443–628.
27. Excellence NIfHaC. NICE guideline. Urinary incontinence and pelvic organ prolapse in women: management [NG123]
28. Bø K, Frawley H. Pelvic floor muscle training in prevention and treatment of pelvic organ prolapse. In: Bø K, Berghmans B, Mørkved S, Van Kampen M, editors. Evidence based physical therapy for the pelvic floor Bridging science and clinical practice. 2nd ed. Edinburgh: Elsevier; 2015. p. 234–42.
29. Kamper SJ, Moseley AM, Herbert RD, Maher CG, Elkins MR, Sherrington C. 15 years of tracking physiotherapy evidence on PEDro, where are we now? Br J Sports Med. 2015;49(14):907–9. https://doi.org/10.1136/bjsports-2014-094468.
30. Sherrington C, Herbert RD, Maher CG, Moseley AM, PEDro. A database of randomized trials and systematic reviews in physiotherapy. Man Ther. 2000;5(4):223–6. https://doi.org/10.1054/math.2000.0372.
31. Cashin AG, McAuley JH. Clinimetrics: Physiotherapy Evidence Database (PEDro) Scale. J Physiother. 2020;66(1):59. https://doi.org/10.1016/j.jphys.2019.08.005.
32. Macedo LG, Elkins MR, Maher CG, Moseley AM, Herbert RD, Sherrington C. There was evidence of convergent and construct validity of Physiotherapy Evidence Database quality scale for physiotherapy trials. J Clin Epidemiol. 2010;63(8):920–5. https://doi.org/10.1016/j.jclinepi.2009.10.005.
33. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. Phys Ther. 2003;83(8):713–21.
34. Bø K, Frawley HC, Haylen BT, Abramov Y, Almeida FG, Berghmans B, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on

the terminology for the conservative and nonpharmacological management of female pelvic floor dysfunction. Int Urogynecol J. 2017;28(2):191–213. https://doi.org/10.1007/s00192-016-3123-4.
35. Frawley H, Shelly B, Morin M, Bernard S, Bø K, Digesu GA, et al. An International Continence Society (ICS) report on the terminology for pelvic floor muscle assessment. Neurourol Urodyn. 2021;40(5):1217–60. https://doi.org/10.1002/nau.24658.
36. Haylen BT, de Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. Int Urogynecol J. 2010;21(1):5–26. https://doi.org/10.1007/s00192-009-0976-9.
37. Hagen S, Glazener C, McClurg D, Macarthur C, Elders A, Herbison P, et al. Pelvic floor muscle training for secondary prevention of pelvic organ prolapse (PREVPROL): a multicentre randomised controlled trial. Lancet. 2017;389(10067):393–402. https://doi.org/10.1016/s0140-6736(16)32109-2.
38. Wiegersma M, Panman CM, Kollen BJ, Berger MY, Lisman-Van Leeuwen Y, Dekker JH. Effect of pelvic floor muscle training compared with watchful waiting in older women with symptomatic mild pelvic organ prolapse: randomised controlled trial in primary care. BMJ. 2014;349:g7378. https://doi.org/10.1136/bmj.g7378.
39. Panman C, Wiegersma M, Kollen BJ, Berger MY, Lisman-Van Leeuwen Y, Vermeulen KM, et al. Two-year effects and cost-effectiveness of pelvic floor muscle training in mild pelvic organ prolapse: a randomised controlled trial in primary care. BJOG. 2017;124(3):511–20. https://doi.org/10.1111/1471-0528.13992.
40. Piya-Anant M, Therasakvichya S, Leelaphatanadit C, Techatrisak K. Integrated health research program for the Thai elderly: prevalence of genital prolapse and effectiveness of pelvic floor exercise to prevent worsening of genital prolapse in elderly women. J Med Assoc Thai. 2003;86(6):509–15.
41. Ghroubi S, Kharrat O, Chaari M, Ben Ayed B, Guermazi M, Elleuch MH. Effect of conservative treatment in the management of low-degree urogenital prolapse. Ann Readapt Med Phys. 2008;51(2):96–102. https://doi.org/10.1016/j.annrmp.2007.11.002.
42. Hagen S, Stark D, Glazener C, Sinclair L, Ramsay I. A randomized controlled trial of pelvic floor muscle training for stages I and II pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2009;20(1):45–51. https://doi.org/10.1007/s00192-008-0726-4.
43. Braekken IH, Majida M, Engh ME, Bo 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 e1–7. https://doi.org/10.1016/j.ajog.2010.02.037.
44. Stupp L, Resende AP, Oliveira E, Castro RA, Girao MJ, Sartori MG. Pelvic floor muscle training for treatment of pelvic organ prolapse: an assessor-blinded randomized controlled trial. Int Urogynecol J. 2011;22(10):1233–9. https://doi.org/10.1007/s00192-011-1428-x.
45. Frawley HC, Hagen S, Sherburn M, Neumann P, Herbison P, Hay-Smith J, et al. Changes in prolapse following pelvic floor muscle training: a randomised controlled trial. Neurourol Urodyn. 2012;31(6):938–9. https://doi.org/10.1002/nau.22287.
46. 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. 2013;121(1):69–73. https://doi.org/10.1016/j.ijgo.2012.11.012.
47. Hagen S, Stark D, Glazener C, Dickson S, Barry S, Elders A, et al. Individualised pelvic floor muscle training in women with pelvic organ prolapse (POPPY): a multicentre randomised controlled trial. Lancet. 2014;383(9919):796–806. https://doi.org/10.1016/s0140-6736(13)61977-7.
48. Alves FK, Riccetto C, Adami DB, Marques J, Pereira LC, Palma P, et al. A pelvic floor muscle training program in postmenopausal women: A randomized controlled trial. Maturitas. 2015;81(2):300–5. https://doi.org/10.1016/j.maturitas.2015.03.006.
49. Due U, Brostrom S, Lose G. Lifestyle advice with or without pelvic floor muscle training for pelvic organ prolapse: a randomized controlled trial. Int Urogynecol J. 2016;27(4):555–63. https://doi.org/10.1007/s00192-015-2852-0.
50. Due U, Brostrom S, Lose G. The 12-month effects of structured lifestyle advice and pelvic floor muscle training for pelvic organ prolapse. Acta Obstet Gynecol Scand. 2016;95(7):811–9. https://doi.org/10.1111/aogs.12884.
51. Ahadi T, Taghvadoost N, Aminimoghaddam S, Forogh B, Bazazbehbahani R, Raissi GR. Efficacy of biofeedback on quality of life in stages I and II pelvic organ prolapse: A Pilot study. Eur J Obstet Gynecol Reprod Biol. 2017;215:241–6. https://doi.org/10.1016/j.ejogrb.2017.06.023.
52. McClurg D, Hagen S, Berry K, Elders A, Best C, Wane S, et al. A 10 year data-linkage follow-up study of a trial of pelvic floor muscle training for prolapse. Neurourol Urodyn. 2019;38:S368–S9. https://doi.org/10.1002/nau.24118.
53. Wu YM, McInnes N, Leong Y. Pelvic Floor Muscle Training Versus Watchful Waiting and Pelvic Floor Disorders in Postpartum Women: A Systematic Review and Meta-analysis. Female Pelvic Med Reconstr Surg. 2018;24(2):142–9. https://doi.org/10.1097/SPV.0000000000000513.
54. Bø K, Hilde G, Staer-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 e1–7. https://doi.org/10.1016/j.ajog.2014.06.049.
55. Li Y, Lei X, Jin YL, Wang J, Zhang LP. Effect of postpartum pelvic floor muscle training on pelvic organ prolapse in primiparous women. Chinese Journal of Woman and Child Health Research. 2016;27(11):1384–7.
56. Yang X, Liu Y. Analysis of the effect of pelvic floor muscle training in postpartum pelvic floor dysfunction. Journal of International Obstetrics and Gynecology. 2013;40(2):164–6.
57. Glazener CM, MacArthur C, Hagen S, Elders A, Lancashire R, Herbison GP, et al. Twelve-year follow-up of conservative management of postnatal urinary and faecal incontinence and prolapse outcomes: randomised controlled trial. BJOG. 2014;121(1):112–20. https://doi.org/10.1111/1471-0528.12473.
58. Glazener CM, Herbison GP, Wilson PD, MacArthur C, Lang GD, Gee H, et al. Conservative management of persistent postnatal urinary and faecal incontinence: randomised controlled trial. BMJ. 2001;323(7313):593–6. https://doi.org/10.1136/bmj.323.7313.593.
59. Manonai J, Harnsomboon T, Sarit-apirak S, Wattanayingcharoenchai R, Chittacharoen A, Suthutvoravut S. Effect of Colpexin Sphere on pelvic floor muscle strength and quality of life in women with pelvic organ prolapse stage I/II: a randomized controlled trial. Int Urogynecol J. 2012;23(3):307–12. https://doi.org/10.1007/s00192-011-1569-y.
60. Cheung RY, Lee JH, Lee LL, Chung TK, Chan SS. Vaginal Pessary in Women With Symptomatic Pelvic Organ Prolapse: A Randomized Controlled Trial. Obstet Gynecol. 2016;128(1):73–80. https://doi.org/10.1097/AOG.0000000000001489.
61. Panman CM, Wiegersma M, Kollen BJ, Berger MY, Lisman-van Leeuwen Y, Vermeulen KM, 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):1307–18. https://doi.org/10.1097/GME.0000000000000706.

62. Barber MD, Brubaker L, Burgio KL, Richter HE, Nygaard I, Weidner AC, et al. Comparison of 2 transvaginal surgical approaches and perioperative behavioral therapy for apical vaginal prolapse: the OPTIMAL randomized trial. JAMA. 2014;311(10):1023–34. https://doi.org/10.1001/jama.2014.1719.
63. Brandt C, Janse van Vuuren EC. Postoperative Physiotherapy in Women Undergoing Pelvic Floor Reconstructive Surgery: A Randomized Controlled Clinical Trial. Physiotherapy Canada. 2021;0(0):e20200053. https://doi.org/10.3138/ptc-2020-0053.
64. Duarte TB, Bø K, Brito LGO, Bueno SM, Barcelos TM, Bonacin MA, et al. Perioperative pelvic floor muscle training did not improve outcomes in women undergoing pelvic organ prolapse surgery: a randomised trial. J Physiother. 2020;66(1):27–32. https://doi.org/10.1016/j.jphys.2019.11.013.
65. Frawley HC, Phillips BA, Bø K, Galea MP. Physiotherapy as an adjunct to prolapse surgery: an assessor-blinded randomized controlled trial. Neurourol Urodyn. 2010;29(5):719–25. https://doi.org/10.1002/nau.20828.
66. Jarvis SK, Hallam TK, Lujic S, Abbott JA, Vancaillie TG. Perioperative physiotherapy improves outcomes for women undergoing incontinence and or prolapse surgery: results of a randomised controlled trial. Aust N Z J Obstet Gynaecol. 2005;45(4):300–3. https://doi.org/10.1111/j.1479-828X.2005.00415.x.
67. Jelovsek JE, Barber MD, Brubaker L, Norton P, Gantz M, Richter HE, et al. Effect of Uterosacral Ligament Suspension vs Sacrospinous Ligament Fixation With or Without Perioperative Behavioral Therapy for Pelvic Organ Vaginal Prolapse on Surgical Outcomes and Prolapse Symptoms at 5 Years in the OPTIMAL Randomized Clinical Trial. JAMA. 2018;319(15):1554–65. https://doi.org/10.1001/jama.2018.2827.
68. Mathew S, Nyhus MO, Salvesen O, Salvesen KA, Stafne SN, Volloyhaug I. The effect of preoperative pelvic floor muscle training on urinary and colorectal-anal distress in women undergoing pelvic organ prolapse surgery-a randomized controlled trial. Int Urogynecol J. 2021;32(10):2787–94. https://doi.org/10.1007/s00192-021-04684-3.
69. McClurg D, Hilton P, Dolan L, Monga A, Hagen S, Frawley H, et al. Pelvic floor muscle training as an adjunct to prolapse surgery: a randomised feasibility study. Int Urogynecol J. 2014;25(7):883–91. https://doi.org/10.1007/s00192-013-2301-x.
70. Nyhus MO, Mathew S, Salvesen O, Salvesen KA, Stafne S, Volloyhaug I. Effect of preoperative pelvic floor muscle training on pelvic floor muscle contraction and symptomatic and anatomical pelvic organ prolapse after surgery: randomized controlled trial. Ultrasound Obstet Gynecol. 2020;56(1):28–36. https://doi.org/10.1002/uog.22007.
71. Pauls RN, Crisp CC, Novicki K, Fellner AN, Kleeman SD. Pelvic floor physical therapy: impact on quality of life 6 months after vaginal reconstructive surgery. Female Pelvic Med Reconstr Surg. 2014;20(6):334–41. https://doi.org/10.1097/SPV.0000000000000090.
72. Weidner AC, Barber MD, Markland A, Rahn DD, Hsu Y, Mueller ER, et al. Perioperative Behavioral Therapy and Pelvic Muscle Strengthening Do Not Enhance Quality of Life After Pelvic Surgery: Secondary Report of a Randomized Controlled Trial. Phys Ther. 2017;97(11):1075–83. https://doi.org/10.1093/ptj/pzx077.
73. Mouritsen L, Larsen JP. Symptoms, bother and POPQ in women referred with pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2003;14(2):122–7. https://doi.org/10.1007/s00192-002-1024-1.
74. Braekken IH, Majida M, Ellstrom Engh M, Bo K. Can pelvic floor muscle training improve sexual function in women with pelvic organ prolapse? A randomized controlled trial. J Sex Med. 2015;12(2):470–80. https://doi.org/10.1111/jsm.12746.
75. Pauls RN, Crisp CC, Novicki K, Fellner AN, Kleeman SD. Impact of physical therapy on quality of life and function after vaginal reconstructive surgery. Female Pelvic Med Reconstr Surg. 2013;19(5):271–7. https://doi.org/10.1097/SPV.0b013e31829c64ea.
76. Hoogeboom TJ, Kousemaker MC, van Meeteren NL, Howe T, Bo K, Tugwell P, et al. i-CONTENT tool for assessing therapeutic quality of exercise programs employed in randomised clinical trials. Br J Sports Med. 2021;55(20):1153–60. https://doi.org/10.1136/bjsports-2019-101630.
77. Dietz HP, Chavez-Coloma L, Friedman T, Turel F. Pelvic organ prolapse in nulliparae. Aust N Z J Obstet Gynaecol. 2022. https://doi.org/10.1111/ajo.13481.
78. Woodley SJ, Lawrenson P, Boyle R, Cody JD, Morkved S, Kernohan A, et al. Pelvic floor muscle training for preventing and treating urinary and faecal incontinence in antenatal and postnatal women. Cochrane Database Syst Rev. 2020;5:CD007471. https://doi.org/10.1002/14651858.CD007471.pub4.
79. Chu X, Huang O, Zhou J. The effect of biofeedback and electrical stimulation combined with pelvic floor muscle exercises for postpartum pelvic floor rehabilitation. Progress in Obstetrics and Gynecology. 2012;21(9):679–83.
80. Zhang R, Wang Q, Zhao G. Effect on pelvic floor muscle function and quality of life by pelvic floor muscle exercise combined with lifestyle intervention in postpartum women. Chinese Journal of Health Care and Medicine. 2015;17(6):469–72.
81. Yang S, Sang W, Feng J, Zhao H, Li X, Li P, et al. The effect of rehabilitation exercises combined with direct vagina low voltage low frequency electric stimulation on pelvic nerve electrophysiology and tissue function in primiparous women: A randomised controlled trial. J Clin Nurs. 2017;26(23-24):4537–47. https://doi.org/10.1111/jocn.13790.
82. Hagen S, Elders A, Henderson L, Kilonzo M, McClurg D, Hay-Smith J, et al. Effectiveness and cost-effectiveness of biofeedback-assisted pelvic floor muscle training for female urinary incontinence: a multicentre randomised controlled trial. Neurourol Urodyn. 2019;38:S365–S6.
83. Bugge C, Adams EJ, Gopinath D, Stewart F, Dembinsky M, Sobiesuo P, et al. Pessaries (mechanical devices) for managing pelvic organ prolapse in women. Cochrane Database Syst Rev. 2020;11:CD004010. https://doi.org/10.1002/14651858.CD004010.pub4.
84. Chughtai B, Spettel S, Kurman J, De E. Ambulatory pessary trial unmasks occult stress urinary incontinence. Obstet Gynecol Int. 2012;2012:392027. https://doi.org/10.1155/2012/392027.
85. Antosh DD, Kim-Fine S, Meriwether KV, Kanter G, Dieter AA, Mamik MM, et al. Changes in Sexual Activity and Function After Pelvic Organ Prolapse Surgery: A Systematic Review. Obstet Gynecol. 2020;136(5):922–31. https://doi.org/10.1097/AOG.0000000000004125.
86. Ferreira CH, Dwyer PL, Davidson M, De Souza A, Ugarte JA, Frawley HC. Does pelvic floor muscle training improve female sexual function? A systematic review. Int Urogynecol J. 2015;26(12):1735–50. https://doi.org/10.1007/s00192-015-2749-y.
87. de Menezes FM, Driusso P, Bo K, Carvalho de Abreu DC, da Silva Lara LA, de Sa Rosa ESACJ, et al. Relationship between pelvic floor muscle strength and sexual dysfunction in postmenopausal women: a cross-sectional study. Int Urogynecol J. 2017;28(6):931–6. https://doi.org/10.1007/s00192-016-3211-5.
88. Glazener C, Breeman S, Elders A, Hemming C, Cooper K, Freeman R, et al. Clinical effectiveness and cost-effectiveness of surgical options for the management of anterior and/or posterior vaginal wall prolapse: two randomised controlled trials within a comprehensive cohort study - results from the PROSPECT Study. Health Technol Assess. 2016;20(95):1–452. https://doi.org/10.3310/hta20950.

89. Glazener CM, Breeman S, Elders A, Hemming C, Cooper KG, Freeman RM, et al. Mesh, graft, or standard repair for women having primary transvaginal anterior or posterior compartment prolapse surgery: two parallel-group, multicentre, randomised, controlled trials (PROSPECT). Lancet. 2017;389(10067):381–92. https://doi.org/10.1016/s0140-6736(16)31596-3.
90. Reid FM, Elders A, Breeman S, Freeman RM, group Ps. How common are complications following polypropylene mesh, biological xenograft and native tissue surgery for pelvic organ prolapse? A secondary analysis from the PROSPECT trial. BJOG. 2021;128(13):2180–9. https://doi.org/10.1111/1471-0528.16897.
91. Vergeldt TF, Weemhoff M, IntHout J, Kluivers KB. Risk factors for pelvic organ prolapse and its recurrence: a systematic review. Int Urogynecol J. 2015;26(11):1559–73. https://doi.org/10.1007/s00192-015-2695-8.
92. Haskell H. Cumberlege review exposes stubborn and dangerous flaws in healthcare. BMJ. 2020;370:m3099. https://doi.org/10.1136/bmj.m3099.
93. Bø K, Hilde G. Does it work in the long term?--A systematic review on pelvic floor muscle training for female stress urinary incontinence. Neurourol Urodyn. 2013;32(3):215–23. https://doi.org/10.1002/nau.22292.
94. Herbert RD, Kasza J, Bø K. Analysis of randomised trials with long-term follow-up. BMC Med Res Methodol. 2018;18(1):48. https://doi.org/10.1186/s12874-018-0499-5.
95. Hansen BH, Kolle E, Steene-Johannessen J, Dalene KE, Ekelund U, Anderssen SA. Monitoring population levels of physical activity and sedentary time in Norway across the lifespan. Scand J Med Sci Sports. 2019;29(1):105–12. https://doi.org/10.1111/sms.13314.
96. Loyen A, Clarke-Cornwell AM, Anderssen SA, Hagstromer M, Sardinha LB, Sundquist K, et al. Sedentary Time and Physical Activity Surveillance Through Accelerometer Pooling in Four European Countries. Sports Med. 2017;47(7):1421–35. https://doi.org/10.1007/s40279-016-0658-y.
97. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451–62. https://doi.org/10.1136/bjsports-2020-102955.
98. Abhyankar P, Uny I, Semple K, Wane S, Hagen S, Wilkinson J, et al. Women's experiences of receiving care for pelvic organ prolapse: a qualitative study. BMC Womens Health. 2019;19(1):45. https://doi.org/10.1186/s12905-019-0741-2.
99. Wiegersma M, Panman C, Hesselink LC, Malmberg AGA, Berger MY, Kollen BJ, et al. Predictors of Success for Pelvic Floor Muscle Training in Pelvic Organ Prolapse. Phys Ther. 2019;99(1):109–17. https://doi.org/10.1093/ptj/pzy114.

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SPECIAL CONTRIBUTION

Impact of Lifestyle Modifications on the Prevention and Treatment of Pelvic Organ Prolapse

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Abstract

Introduction and Hypothesis This manuscript is a part of the International Urogynecology Consultation (IUC) on pelvic organ prolapse (POP) chapter three, committee three, on the impact of lifestyle modifications (i.e., weight loss, treatment of constipation, activity restriction, etc.) on the prevention and treatment of POP.

Materials and Methods An international group containing ten female pelvic medicine specialists and one university-based medical librarian performed a systematic search of the literature in Medline using the MeSH terms: pelvic organ prolapse (ID: D056887), cystocele (ID: D052858), uterine prolapse (ID: D014596), rectocele (ID: D020047), and women (ID: D014930) to identify studies addressing lifestyle modifications as prevention or treatment for POP on 10/18/21. Relevant studies were included in this review.

Results A total of 18,483 studies were identified in the initial literature search; 187 full-text articles were deemed pertinent and independently reviewed and double-screened by ten reviewers. After full-text review, information from 86 articles was included in this review.

Conclusion Women may consider various lifestyle modifications to help prevent and treat POP, even if it is challenging to quantify the efficacy of these interventions.

Keywords Pelvic organ prolapse · Lifestyle modifications · Activity level · Review article · Treatment · Prevention · Modifiable

Introduction

This narrative review was created at the behest of the International Urogynecological Association (IUGA) as part of the International Urogynecology Consultation (IUC) project. The IUC is a 4-year project tasked with producing a

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collection of 16 narrative review articles to compile the current scientific evidence regarding Pelvic Organ Prolapse (POP) to (1) guide clinical decision making, (2) inspire future research, and (3) provide best practice documents [1]. This specific manuscript reports on lifestyle modifications associated with the prevention or treatment of POP symptoms. It is included in the third chapter of the project, which focuses on the nonsurgical management of POP.

POP is defined as anatomical prolapse with descent of at least one of the vaginal walls (anterior, posterior, or apical) to or beyond the vaginal hymen with Valsalva [2] POP is a benign condition estimated to affect 50% of parous women [3], roughly 10–20% of whom will be symptomatic [4]. Women use various terms to describe POP symptoms, including vaginal bulge or lump, the sensation of a dropped bladder, pelvic heaviness, or the feeling of sitting on a ball or egg [5]. POP typically becomes symptomatic once it approximates or extends beyond the hymen.

Lifestyle modifications such as advice on physical activity and exercise (including heavy lifting, and occupation pelvic floor exercise (often called Kegels), weight management, constipation, chronic cough, and reproductive health are often included as strategies for the nonsurgical management of POP. A 2011 Cochrane Review found limited evidence to support lifestyle interventions other than pelvic floor exercises for the prevention and treatment of POP [5].

The aim of this manuscript is to discuss the impact of lifestyle changes on the prevention and treatment of POP. This chapter focuses on the impact of lifestyle interventions on preventing, developing, and resolving POP symptoms and objective physical exam findings.

Materials and Methods

The chair of this writing group was selected by the IUGA steering committee and approved by the IUGA executive committee. Writing group members were chosen from the IUGA membership through a competitive open call for volunteers. Once formed, the writing group worked collaboratively to develop the specific aims, inclusion and exclusion criteria, search terms, and writing assignments for this manuscript.

An electronic search of MEDLINE was performed from inception until 10/18/21 by a medical librarian (MB) using a combination of the following MeSH terms: pelvic organ prolapse (ID: D056887), cystocele (ID: D052858), uterine prolapse (ID: D014596), rectocele (ID: D020047), and women (ID: D014930) to identify studies addressing lifestyle modifications associated with POP. The MeSH terms were selected to ensure a broad literature search would be performed. On the basis of group discussion, the authors of this report identified 49 topics of interest to include, if available in the primary literature, these terms were presented to the IUGA membership at the annual scientific meeting in 2020. On the basis of feedback from that presentation, three additional topics (weight loss, mind–body, and postoperative limitations) were added as potential lifestyle topics of interest (all 52 topics are included in Table 1). This is not to say that all 52 terms of interest were included in this report, as the findings of this report are limited to information available in previously published studies. Rather, these topics of interest were identified as specific modifiable lifestyle factors to look for as we screened articles and reviewed the primary literature.

Study Selection

Studies were eligible for inclusion if they reported on a population of women with primary or recurrent POP or those at risk for developing these conditions. We included interventions on modifiable lifestyle activities/factors associated with preventing or reducing POP severity and symptoms. The comparators of interest included any other intervention(s), including sham or no treatment. We were interested in any associated outcomes that might be found in a structured literature search, but a priori were interested in (1) POP symptom severity, (2) objective physical exam findings for POP, (3) patient well-being, and (4) body image. We did not exclude manuscripts based on study design. We included comparative studies (such as randomized controlled trials, case–control, prospective or retrospective observational comparative studies), noncomparative single-arm studies such as case series, or review articles (such as systematic or narrative reviews or editorials). We did exclude conference abstracts without full-text manuscripts. Studies were not restricted based on published language but were excluded if we could not retrieve the full-text manuscript.

Screening and Data Extraction

Citations identified by our search were screened for eligibility by nine reviewers using Abstrackr (http://abstrackr.cebm.brown.edu/) [6]. To establish relevance and consensus, all reviewers initially screened the same random selection of 100 abstracts. The remaining abstracts were independently screened in duplicate, with discrepancies adjudicated by a third reviewer until all relevant abstracts were reviewed.

Full-text articles relevant to this topic were reviewed using the appropriate Specialist Unit for Review Evidence (SURE) checklist based on study design to help evaluate the information provided by each study and to aid reviewers in deciding which studies to include in this report [7]. See Fig. 1 for the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram of the article selection process. Concurrent with this evaluation

Table 1 Lifestyle terms of interest identified prior to literature search

Lifestyle terms of interest*
1) Obesity
2) Weight loss
3) Abdominoplasty
4) Abdominal pressure
5) Intra-abdominal pressure management
6) Pelvic floor muscles
7) Pelvic floor muscle training—at home
8) Levator ani muscles
9) Biofeedback
10) Kegel's exercises
11) Levator tone/strength/Oxford scale
12) Pelvic floor relaxation/laxity
13) Exercise—running jumping, heavy lifting
14) Pilates/yoga
15) Meditation/mindfulness
16) Mind body therapy (central desensitization)
17) Strength and resistance training
18) High intensity training (HIT), high intensity interval training (HIIT)
19) Pregnancy
20) Vaginal birth—use of instruments
21) Traditional birthing practices, abdominal pressure
22) Cesarean section
23) Diet
24) Fiber, water intake
25) Constipation, toilet posture
26) Bowel regimen/management
27) Splinting
28) Spinal curvature
29) Body mechanics
30) Posture
31) Heavy lifting in daily activities
32) Lifting mechanics
33) House work, heavy lifting, deep squatting
34) Occupational lifting, squatting
35) Role of female in family—autonomy in health decisions, heavy house work
36) Adaptive assistive devices
37) Supportive garments
38) Abdominal binding
39) Medical conditions associated with prolapse (constipation, obesity, lung disease, etc.)
40) Chronic coughing
41) Smoking
42) Smoking cessation
43) Dietary modification
44) Breathing
45) Knowledge and awareness of reproductive health
46) Access to contraception, control of birth spacing
47) Traditional treatments—herbal remedies, etc.
48) Observation/expectant management
49) Patient education
50) Postoperative restrictions
51) Psychological aspects
52) Body image

*If an above topic is not covered in this review, we either did not find any data to report, or have referenced the appropriate IUGA chapter where it is discussed

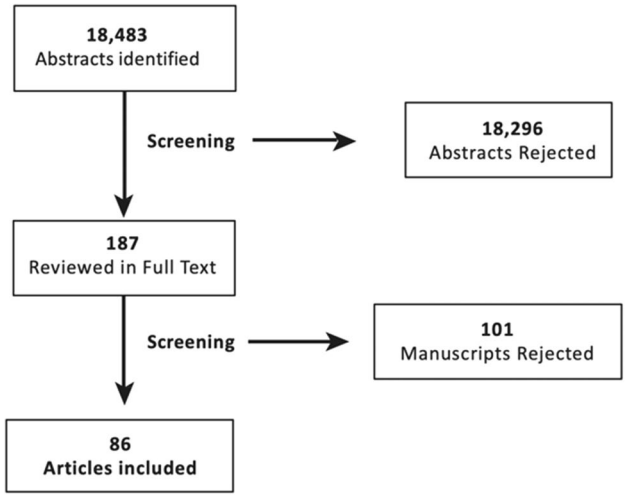

Fig. 1 PRISMA diagram of the article selection process

process, evidence mapping was done. Topics identified in the abstract and results sections were entered into a spreadsheet to track and identify lifestyle interventions pertinent to this project. Subsequently, interventions of interest were not determined by expert consensus of our group but instead based on what was identified in the published literature. Studies were grouped by interventions and assigned to group members for full-text review and data extraction.

The IUC peer-review process involved four rounds of review, starting with a review by the co-chairs, then the steering committee members, then IUGA general membership (through an online process), and finally, the IUGA board members, before being submitted to the International Urogynecology Journal for formal peer-review.

Results

Of the 18,483 studies identified by the initial literature search, 187 full-text articles were deemed pertinent and independently reviewed and double-screened by ten reviewers. After full-text review, information from 86 articles was included in this review (see Fig. 1).

Effect of Physical Activity and Exercise on POP

Overall, we identified 38 articles that reported on lifestyle factors associated with activity, including three systematic reviews, three narrative reviews, nine case–control, six cohort, fifteen cross-sectional studies, and two case series [8–45] that addressed physical activity, physical tasks, position changes, high and low impact exercise, lifting, and occupational activities.

Physical Activity and Exercise

Sixteen articles reported on physical activity or exercise [8, 11–13, 16, 17, 19, 20, 25, 29, 31–33, 37, 40, 41], including one systematic review, two narrative reviews, three case control, four cohort, and six cross-sectional studies. Many studies, including the systematic review, do not support an association between any type of exercise or activity and POP [12, 13, 19, 25, 31, 32, 40, 41], while others demonstrate a link between moderate to vigorous exercise and anatomic prolapse [8, 11, 33]. When lifting weights > 15 kg were included as part of the exercise routine, one study found a higher rate of prolapse symptoms compared to the general population [17], while three others did not find increased POP in women lifting up to 99 kg [16, 20, 29]. Three studies in nulliparous populations did not show differences in prolapse symptoms or exam findings between strenuous and nonstrenuous exercise [13, 25, 29]. Though studies are inconsistent, the higher prevalence of POP in female runners, Olympic powerlifters, and nulliparous military paratroopers compared to the general population suggests that particularly strenuous and repetitive activity may facilitate the development or worsening of POP [11, 17, 32, 37].

Twelve articles, including three systematic reviews, one narrative review, two case control, three cohort, and three cross-sectional studies, examined lifting and strenuous physical work [10, 12, 15, 18, 24, 28, 30, 35, 38, 40–42]. The data are heterogeneous due to substantial differences in cultures and lifestyles of populations in developing countries [10, 15, 24, 42] compared to developed nations [12, 18, 30, 35, 38, 40, 41]. Though some studies found no link between heavy lifting or strenuous physical work and POP [15, 18, 24, 41], many found positive associations between POP and chronic repetitive physically demanding work such as carrying heavy objects > 2 h per day, > 20 heavy lifts per week, or working in standing position > 50% of the time [10, 12, 28, 40, 42]. In two other studies, heavy physical work (not defined) and lifting > 10 kg were independent risk factors for symptomatic POP [30, 38].

Occupation

Ten studies address the role of occupation on POP, including one systematic review, one narrative review, three case control, two cohort, and three cross-sectional studies [10, 14, 15, 19, 21, 27, 31, 40, 41, 44]. These studies suggest that homemakers, manual laborers, and factory workers are significantly more likely to report symptoms or have more POP on exam than teachers, doctors, lawyers, and other job categories that do not entail heavy lifting or manual labor activities [14, 15, 44]. However, the systematic review found that occupation was not associated with primary POP among five included studies [41].

One short-term (6 week) prospective cohort study ($n = 177$) reported women who commenced physically strenuous occupations within 12 months postpartum were three times more likely (OR 3.0 [95% CI 1.2 to 7.3]) to report POP symptoms compared to women without a strenuous workload during this time [40]. Physically strenuous occupations were based on participant self-report of physically demanding work, spending > 50% of their time walking or standing, and experiencing heavy lifting at work > 10 times a day. Further study is needed to draw conclusions regarding occupation and POP, as many studies used subjective questionnaire data, did not solicit specific occupations, or did not clearly define or characterize strenuous occupational tasks.

Physical Activity, Exercise, and Occupation Summary

In general, conflicting and inconsistent observational data preclude definitive conclusions about the role of physical activity on pelvic organ prolapse. The inconsistency of data can be attributed to the information available in the primary literature. Notably, there were no RCTs, and 12 studies had cross-sectional designs or relied on subjective questionnaire data for assessments [10, 13, 15–20, 24, 37, 38, 44]. In addition, included studies often had wide variations in population characteristics, non-standardized definitions, substantial variability in assessments and outcomes, and poor control of confounders.

Effect of Body Weight on POP

Forty-one articles describe the impact of obesity, body mass index (BMI), and/or weight loss on POP. These include 14 non-randomized comparative studies [46–59] ten cross-sectional studies [19, 22, 23, 26, 30, 58, 60–63], eight systematic reviews [5, 41, 64–69], four case–control studies [9, 12, 27, 70], one randomized control trial [71], and four narrative reviews [35, 72–74]. For standardization, in this section, we will use the World Health Organization classification to categorize body mass index (BMI) as underweight ≤ 18.4, normal weight 18.5–24.9, overweight 25–29.9, and obese ≥ 30 [40], combining obesity classes I, II, and III.

Body Mass Index

Obesity is often considered a modifiable risk factor for the development or progression of POP, but the evidence is conflicting. The prevailing theory is that increasing BMI results in higher abdominal pressure causing weakness of the vaginal support structures with resultant POP [35, 72–74]. Thirteen studies [12, 22, 26, 30, 41, 46, 47, 51, 59, 60, 62, 63, 65], including one case control, two systematic reviews, four non-randomized comparative studies, and six cross-sectional studies, support the theory that women who are overweight or obese (hereafter reported as BMI ≥ 25) are more likely to have symptomatic prolapse. Four studies [23, 61, 69, 70], including one case–control, two cross-sectional studies, and one systematic review, demonstrate no association between a BMI ≥ 25 and the development or progression of POP. Overall, studies describing an association between obesity and POP are limited by study design [65]. The systematic review by Giri et al. reports women with a BMI ≥ 25 have a risk ratio of 1.36 (95% CI 1.20–1.53) of reporting symptomatic POP compared to women in the normal weight category [65], and women with BMI ≥ 25 were more likely to have progression of POP compared to women with a normal BMI. The effect size varies slightly with the compartment of prolapse considered, with odds ratios of 1.39 in the anterior, 1.38 in the posterior, and 1.31 in the apical compartments identified women with a BMI ≥ 25, and 1.57 in the anterior, 1.75 in the posterior, and 1.40 in the apical compartments of those with a BMI ≥ 30 [19, 51]. In the first year postpartum, increased BMI was associated with an increased odds of developing POP (OR 1.41, [95% CI 1.01–1.97, $p = 0.45$]) [49].

Weight Loss

Ten studies evaluate the effect of weight loss on POP, again with mixed results. Eight studies demonstrate symptomatic improvement [48, 52, 53, 55, 58, 66, 67, 71], but two studies demonstrate no change [56, 68]. Several studies have evaluated the effect of weight loss after bariatric surgery suggesting symptomatic improvement based on validated questionnaires, but no significant association of improved anatomic POP stage has been demonstrated [48, 51–53, 56, 58, 66–68, 71]. The only randomized controlled trial on behavioral weight loss and Pelvic Organ Prolapse Quantification system (POP-Q) measurements showed that a 6-month weight loss program resulted in a statistically, but perhaps not clinically relevant (< 0.25 cm change), improvement in the genital hiatus, perineal body, and posterior vaginal wall measurements. However, prolapse symptoms improved with weight loss based on prolapse questionnaires [71].

Weight and Postoperative Development of POP

Four studies evaluate the impact of BMI on developing POP after gynecologic surgery [27, 50, 54, 57]. A case–control study by Lukanovic et al. suggests BMI is not an independent risk factor for the development of POP after hysterectomy [27]. The effect of weight gain on the risk of recurrent prolapse is also unclear. One non-randomized comparative study by Metcalfe et al. showed no association between BMI and recurrent prolapse after an apical repair (including native tissue and mesh-augmented repairs) [54]. However, two non-randomized comparative studies focused chiefly

on native tissue repairs, including uterosacral ligament suspension and isolated anterior colporrhaphy, suggest women with BMI ≥ 25 may be at higher risk of developing recurrent anterior compartment prolapse [50, 57].

Body Weight Summary

In summary, roughly 25 studies report an association between weight and POP, while eight do not. The vast majority of the data are from cross sectional and non-randomized comparative studies providing low-quality evidence. Although results are mixed, obesity may increase the risk of POP; weight loss may provide symptomatic, if not anatomic, improvement in POP. Increased BMI may be a risk factor for recurrent POP after native tissue surgical repair of POP.

Effect of Medical Conditions and Treatment on POP

Along with lifestyle and weight loss, correcting certain medical conditions is often suggested as a means of reducing or even improving the symptoms of POP. Generally, advice centers around correcting diseases that increase intra-abdominal pressure as the increases in intra-abdominal pressure are thought to aggravate the processes that cause or worsen POP. However, as with most suggestions in this area, there is little evidence to support these recommendations.

Constipation

Our literature review identified ten articles evaluating an association between constipation and POP; three case–control studies, four cross-sectional studies, and three narrative reviews/editorials [9, 34, 35, 75–81]. Two studies demonstrated a positive association between subjective POP (self-reported POP symptoms) and constipation [34, 78]. Of five studies evaluating the impact of constipation on anatomic POP, three studies demonstrated a significant positive association between constipation and overall prolapse [75–77]. An additional study found a significant association between constipation and posterior prolapse but not anterior or apical prolapse [78]. It has been postulated that constipation is a risk factor for POP because repeated straining during defecation causes downward pressure on the pelvic organs and soft tissue resulting in tissue laxity and prolapse.

However, not all studies demonstrate an association. A retrospective analysis of two prospective cohorts did not demonstrate an association between bowel function and the severity of posterior vaginal prolapse [80]. A case–control study assessing constipation as a risk factor for post-hysterectomy POP did not demonstrate an increased risk [9]. Significant heterogeneity was identified between studies regarding how constipation was defined, including self-reported duration [9, 34, 35], type (frequency, straining, manual evacuation) [77, 81], with or without the use of a standardized classification system [75, 78], or validated questionnaires [76].

Although the literature suggests a potential positive association between constipation and POP, robust evidence is lacking. The current evidence does not allow further comment on the causative role of constipation on anatomic distortion and development of POP.

Pulmonary Disease

Pulmonary factors (smoking, coughing, asthma, or Chronic Obstructive Pulmonary Disease [COPD]) affecting POP were evaluated in six studies, two cross-sectional, two case–control, one cohort, and one narrative review [9, 14, 18, 23, 26, 35]. Findings were mixed; two smaller studies did not show an effect of smoking on POP [14, 23], while two larger studies found a statistically significant impact on POP symptoms incurred by asthma, smoking, and coughing [18, 26]. The other case–control study demonstrated that chronic pulmonary disease (but not current smoking) increased the risk of surgery for POP following a hysterectomy (OR 22) [9]. Results highlighted in a narrative review suggest that smoking and COPD are risk factors for POP [35]. Overall, larger epidemiological studies suggest smoking, coughing, and asthma may increase POP symptoms.

Effect of Medical Disease on POP Summary

While often suggested as a casual factor in the development of POP, the literature is mixed on whether medical conditions that increase intra-abdominal pressure, such as constipation and COPD, negatively impact or worsen POP. The evidence suggests these conditions have a negative impact on POP but the evidence is not clear. The data on smoking is also conflicting, further confounded by the association between smoking and chronic cough. We did not identify any literature on the impact of improving these conditions as a treatment or prevention strategy for POP.

Hormones

In this literature review, ten articles reported on estrogen treatment for POP, including one systematic review, three RCTs, one cross-sectional study, one case–control study, and four narrative reviews [82–91]. The routes, types, and doses of estrogen vary between articles, making conclusions difficult.

Hormonal Therapy for Prevention and Treatment of POP

Simply stated, the effect of vaginal estrogen on POP remains unclear [82–84]. Research studies have found that prophylactic

estrogen does not seem to prevent or treat POP [85–89]. A large cross-sectional study in the United States including 5387 postmenopausal women found no relationship between POP taking hormone replacement therapy [86]. One randomized placebo-controlled study found prolapse symptoms were not improved by vaginal estrogen [88]. Vaginal estrogen may improve the quality of the epithelium but does not seem to repair structural pelvic floor defects [89]. A large Finnish study including 13,316 women found that POP was more common in women using estrogen and progestogen (OR 1.52) [90]. One randomized, double-blinded, placebo-controlled study compared women taking estrogen, tamoxifen, raloxifene, and placebo, with worse POP as measured by POP-Q in the agonist–antagonist groups compared to estrogen or placebo [91]. They found that 75% of patients in the raloxifene group and 60% of the tamoxifen group had increased POP compared with 18% of the patients in the placebo group and 22% in the estrogen group ($p=0.015$). Given limited and conflicting findings among existing studies, additional studies are needed to clarify the utility of hormone therapy for POP.

Hormone Summary

Hormone therapy appears to improve vaginal epithelial tissues but not the structures that support the pelvic viscera. However, no conclusion can be drawn on the clinical role of HRT and or topical estrogen therapy in women with POP due to the lack of scientific data. Additional studies are needed to clarify the utility of hormone therapy for POP.

Miscellaneous

Several factors were evaluated in single studies, limiting any firm conclusions about their roles in POP. Specifically, wearing a sash around the waist (presumably increasing abdominal pressure), low coffee consumption, mentally strenuous work, alcohol use, poor health status, normal vitamin D levels (≥ 30 ng/mL), and poor nutrition were all associated with an increased risk of POP [15, 22, 23, 26, 34, 42].

Effect of Modifiable Obstetric Risk Factors on POP

Obstetric risk factors such as parity, delivery mode, use of instruments, and postnatal care do not strictly fall under lifestyle factors. Since obstetric risks are covered in IUC chapter 1.3 [92], we direct readers to that chapter for additional details.

Effect of Pelvic Floor Muscle Training Versus Lifestyle Modification Advice on POP

Pelvic floor muscle training (PFMT) is the subject of IUC chapter 3 [93]. Pelvic floor muscle exercises are certainly a modifiable lifestyle intervention, please see that manuscript for current synopsis of the evidence.

Discussion

This review provides an overview of modifiable and non-modifiable lifestyle factors that may contribute to the progression or regression of POP symptoms based on data from a comprehensive search of published studies. On the basis of the currently available data, there is limited evidence to support any lifestyle modifications for the treatment or prevention of POP.

Women seeking care for POP symptoms are often provided with advice regarding multiple lifestyle modifications, so evaluations of composite information from various single studies may be more pragmatic and informative. Many of the lifestyle strategies recommended by clinicians and discussed in this review promote an overall healthy lifestyle, but cannot be conclusively said to impact POP risk based on existing data.

Additional work is needed to determine best practices for educating women on activities that may decrease POP risk. On the basis of the findings of this review, it appears that obesity may increase the risk of POP while weight loss may provide symptomatic improvement, and there appears to be a potential positive association between constipation and POP. There is insufficient evidence to recommend for or against other modifiable lifestyle choices such as type of physical activity, exercise, occupation, or treatment of medical conditions that increase intra-abdominal pressure, such as constipation, smoking, and COPD. On the basis of this limited information, women may choose to avoid repeatedly lifting heavy weights but this consideration needs to be balanced against the known benefits of weightlifting, including cardiac, bone, and mental acuity.

While not a lifestyle modification and thus outside the scope of this chapter, IUC chapter 1.3 addresses the role of obstetric trauma on development of POP [92]. Increasing parity is positively associated with development of POP and Cesarean section negatively associated with its development. On the basis of these findings and the paucity of data supporting other modifiable risk factors, we should encourage patients to discuss birthing plans with their providers and families including this perspective.

This review also addresses the goal of identifying areas of insufficient or conflicting evidence. Future research will hopefully elucidate the complicated interplay between modifiable risk factors that seem at odds, such as strenuous exercise and weight gain. Such understanding would help guide additional treatment options for the progression and regression of POP. As is common with review articles, standardization of measurements would be very helpful. The utilization of validated questionnaires to ascertain and track

POP symptoms over time, and where possible, performance of a POP-Q exam, would be helpful to track anatomic findings and allow direct comparisons between studies. At the very least, when resources do not permit a physical exam (POP-Q) or standardized questionnaire, asking "do you feel or see a bulge" would be recommended. For a full discussion of POP specific quality of life questionnaires, we direct readers to IUGA chapter 1.4 [94].

Our study is similar to a prior Cochrane Review on the conservative prevention and management of vaginal prolapse, which did not clearly identify any lifestyle changes associated with POP [5]. In contrast to that Cochrane Review, we did not restrict study types to RCTs but rather included all relevant study types. Including all available studies, regardless of their design, allowed us to evaluate the current state of evidence for this specific question.

This study does have limitations. The most notable is that there is minimal and conflicting published data available to guide prevention or treatment of lifestyle modifications. Lifestyle topics of interest were determined a priori, such that we were looking for any published interventions or outcomes of interest listed in Table 1. If a topic of interest listed in Table 1 is not included in this review, it means that we specifically looked for that intervention but did not find any data, or have referenced the appropriate IUC chapter where that topic is discussed. Perhaps part of the reason for lack of published data is that studies that do not find significant associations are less likely to be published, and so any review of published literature is subject to inherent publication bias. Many of the completed studies present conflicting evidence. In addition, publications use heterogeneous terminology for prolapse severity and symptoms, and for treatment response. As is common in most reviews, standardized reporting would significantly improve the consolidation and interpretation of data from various studies.

In conclusion, there is insufficient data to provide recommendations on lifestyle modifications that may prevent or treat POP.

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Declarations

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References

1. Digesu A, Swift S. The International Urogynaecology Consultation: the new IUGA educational project. Int Urogynecol J. 2021;32:2309–10. https://doi.org/10.1007/s00192-021-04947-z.
2. Collins SA, O'Shea M, Dykes N, et al. International Urogynecological Consultation: clinical definition of pelvic organ prolapse. Int Urogynecol J. 2021;32:2011–9. https://doi.org/10.1007/s00192-021-04875-y.
3. Beck RP, McCormick S, Nordstrom L. A 25-year experience with 519 anterior colporrhaphy procedures. Obstet Gynecol. 1991;78:1011–8.
4. Brown HW, Hegde A, Huebner M, et al. International urogynecology consultation chapter 1 committee 2: Epidemiology of pelvic organ prolapse: prevalence, incidence, natural history, and service needs. Int Urogynecol J. 2022;33:173–87. https://doi.org/10.1007/s00192-021-05018-z.
5. Hagen S, Stark D. Conservative prevention and management of pelvic organ prolapse in women. Cochrane Database Syst Rev. 2011;CD003882. https://doi.org/10.1002/14651858.CD003882.pub4.
6. Wallace BC, Trikalinos TA, Lau J, et al. Semi-automated screening of biomedical citations for systematic reviews. BMC Bioinformatics. 2010;11:55. https://doi.org/10.1186/1471-2105-11-55.
7. Cardiff University Specialist Unit for Review Evidence. http://www.cardiff.ac.uk/specialist-unit-for-review-evidence/resources/critical-appraisal-checklists. Accessed 19 Oct 2021.
8. Ali-Ross NS, Smith ARB, Hosker G. The effect of physical activity on pelvic organ prolapse. BJOG. 2009;116:824–8. https://doi.org/10.1111/j.1471-0528.2009.02112.x.
9. Blandon RE, Bharucha AE, Melton LJ, et al. Risk factors for pelvic floor repair after hysterectomy. Obstet Gynecol. 2009;113:601–8. https://doi.org/10.1097/AOG.0b013e3181998998.
10. Belayneh T, Gebeyehu A, Adefris M, et al. Pelvic organ prolapse in Northwest Ethiopia: a population-based study. Int Urogynecol J. 2020;31:1873–81. https://doi.org/10.1007/s00192-019-04196-1.
11. Bø K, Nygaard IE. Is physical activity good or bad for the female pelvic floor? A narrative review. Sports Med. 2020;50:471–84. https://doi.org/10.1007/s40279-019-01243-1.
12. Braekken IH, Majida M, Ellström Engh M, et al. Pelvic floor function is independently associated with pelvic organ prolapse. BJOG. 2009;116:1706–14. https://doi.org/10.1111/j.1471-0528.2009.02379.x.
13. Carvalho C, da Silva Serrão PRM, Beleza ACS, Driusso P. Pelvic floor dysfunctions in female cheerleaders: a cross-sectional study. Int Urogynecol J. 2020;31:999–1006. https://doi.org/10.1007/s00192-019-04074-w.
14. Chiaffarino F, Chatenoud L, Dindelli M, et al. Reproductive factors, family history, occupation and risk of urogenital prolapse. Eur J Obstet Gynecol Reprod Biol. 1999;82:63–7. https://doi.org/10.1016/s0301-2115(98)00175-4.
15. Devkota HR, Sijali TR, Harris C, et al. Bio-mechanical risk factors for uterine prolapse among women living in the hills of west Nepal: a case-control study. Womens Health (Lond). 2020;16:1745506519895175. https://doi.org/10.1177/1745506519895175.
16. Forner LB, Beckman EM, Smith MD. Symptoms of pelvic organ prolapse in women who lift heavy weights for exercise: a cross-sectional survey. Int Urogynecol J. 2020;31:1551–8. https://doi.org/10.1007/s00192-019-04163-w.
17. Forner LB, Beckman EM, Smith MD. Do women runners report more pelvic floor symptoms than women in CrossFit®? A cross-sectional survey. Int Urogynecol J. 2021;32:295–302. https://doi.org/10.1007/s00192-020-04531-x.
18. Gillor M, Saens P, Dietz HP. Demographic risk factors for pelvic organ prolapse: Do smoking, asthma, heavy lifting or family history matter? Eur J Obstet Gynecol Reprod Biol. 2021;261:25–8. https://doi.org/10.1016/j.ejogrb.2021.04.006.

19. Hendrix SL, Clark A, Nygaard I, et al. Pelvic organ prolapse in the Women's Health Initiative: gravity and gravidity. Am J Obstet Gynecol. 2002;186:1160–6. https://doi.org/10.1067/mob.2002.123819.
20. High R, Thai K, Virani H, et al. Prevalence of pelvic floor disorders in female crossfit athletes. Female Pelvic Med Reconstr Surg. 2020;26:498–502. https://doi.org/10.1097/SPV.0000000000000776.
21. Jørgensen S, Hein HO, Gyntelberg F. Heavy lifting at work and risk of genital prolapse and herniated lumbar disc in assistant nurses. Occup Med (Lond). 1994;44:47–9. https://doi.org/10.1093/occmed/44.1.47.
22. Kato J, Nagata C, Miwa K, et al. Pelvic organ prolapse and Japanese lifestyle: prevalence and risk factors in Japan. Int Urogynecol J. 2022;33:47–51. https://doi.org/10.1007/s00192-021-04672-7.
23. Kim CM, Jeon MJ, Chung DJ, et al. Risk factors for pelvic organ prolapse. Int J Gynaecol Obstet. 2007;98:248–51. https://doi.org/10.1016/j.ijgo.2007.02.019.
24. Koyuncu A, Kadota JL, Mnyippembe A, et al. Heavy load carrying and symptoms of pelvic organ prolapse among women in Tanzania and Nepal: an exploratory study. Int J Environ Res Public Health. 2021;18:1279. https://doi.org/10.3390/ijerph18031279.
25. Larsen WI, Yavorek TA. Pelvic organ prolapse and urinary incontinence in nulliparous women at the United States Military Academy. Int Urogynecol J Pelvic Floor Dysfunct. 2006;17:208–10. https://doi.org/10.1007/s00192-005-1366-6.
26. Li Z, Xu T, Li Z, et al. An epidemiologic study of pelvic organ prolapse in postmenopausal women: a population-based sample in China. Climacteric. 2019;22:79–84. https://doi.org/10.1080/13697137.2018.1520824.
27. Lukanovic A, Drazic K. Risk factors for vaginal prolapse after hysterectomy. Int J Gynaecol Obstet. 2010;110:27–30. https://doi.org/10.1016/j.ijgo.2010.01.025.
28. Majumdar A, Saleh S, Hill M, Hill SR. The impact of strenuous physical activity on the development of pelvic organ prolapse. J Obstet Gynaecol. 2013;33:115–9. https://doi.org/10.3109/01443615.2012.721408.
29. Middlekauff ML, Egger MJ, Nygaard IE, Shaw JM. The impact of acute and chronic strenuous exercise on pelvic floor muscle strength and support in nulliparous healthy women. Am J Obstet Gynecol. 2016;215:316.e1-7. https://doi.org/10.1016/j.ajog.2016.02.031.
30. Miedel A, Tegerstedt G, Mæhle-Schmidt M, et al. Nonobstetric risk factors for symptomatic pelvic organ prolapse. Obstet Gynecol. 2009;113:1089–97. https://doi.org/10.1097/AOG.0b013e3181a11a85.
31. Nygaard IE, Shaw JM. Physical activity and the pelvic floor. Am J Obstet Gynecol. 2016;214:164–71. https://doi.org/10.1016/j.ajog.2015.08.067.
32. Nygaard IE, Shaw JM, Bardsley T, Egger MJ. Lifetime physical activity and pelvic organ prolapse in middle-aged women. Am J Obstet Gynecol. 2014;210:477.e1-12. https://doi.org/10.1016/j.ajog.2014.01.035.
33. Nygaard IE, Wolpern A, Bardsley T, et al. Early postpartum physical activity and pelvic floor support and symptoms 1 year postpartum. Am J Obstet Gynecol. 2021;224:193.e1-193.e19. https://doi.org/10.1016/j.ajog.2020.08.033.
34. Rortveit G, Brown JS, Thom DH, et al. Symptomatic pelvic organ prolapse: prevalence and risk factors in a population-based, racially diverse cohort. Obstet Gynecol. 2007;109:1396–403. https://doi.org/10.1097/01.AOG.0000263469.68106.90.
35. Schaffer JI, Wai CY, Boreham MK. Etiology of pelvic organ prolapse. Clin Obstet Gynecol. 2005;48:639–47. https://doi.org/10.1097/01.grf.0000170428.45819.4e.
36. Simpson S, Deeble M, Thompson J, et al. Should women with incontinence and prolapse do abdominal curls? Int Urogynecol J. 2016;27:1507–12. https://doi.org/10.1007/s00192-016-3005-9.
37. Skaug KL, Engh ME, Frawley H, Bø K. Prevalence of pelvic floor dysfunction, bother and risk factors and knowledge of the pelvic floor muscles in Norwegian male and female powerlifters and olympic weightlifters. J Strength Cond Res. 2020. https://doi.org/10.1519/JSC.0000000000003919.
38. Slieker-ten Hove MCP, Pool-Goudzwaard AL, Eijkemans MJC, et al. Symptomatic pelvic organ prolapse and possible risk factors in a general population. Am J Obstet Gynecol. 2009;200:184.e1-7. https://doi.org/10.1016/j.ajog.2008.08.070.
39. Smibert J. Does lifting cause prolapse? Aust N Z J Obstet Gynaecol. 1971;11:180–2. https://doi.org/10.1111/j.1479-828x.1971.tb00474.x.
40. Tennfjord MK, Engh ME, Bø K. The influence of early exercise postpartum on pelvic floor muscle function and prevalence of pelvic floor dysfunction 12 months postpartum. Phys Ther. 2020;100:1681–9. https://doi.org/10.1093/ptj/pzaa084.
41. Vergeldt TFM, Weemhoff M, IntHout J, Kluivers KB. Risk factors for pelvic organ prolapse and its recurrence: a systematic review. Int Urogynecol J. 2015;26:1559–73. https://doi.org/10.1007/s00192-015-2695-8.
42. Walker GJA, Gunasekera P. Pelvic organ prolapse and incontinence in developing countries: review of prevalence and risk factors. Int Urogynecol J. 2011;22:127–35. https://doi.org/10.1007/s00192-010-1215-0.
43. Walton LM, Raigangar V, Abraham MS, et al. Effects of an 8-week pelvic core stability and nutrition community programme on maternal health outcomes. Physiother Res Int. 2019;24: e1780. https://doi.org/10.1002/pri.1780.
44. Woodman PJ, Swift SE, O'Boyle AL, et al. Prevalence of severe pelvic organ prolapse in relation to job description and socioeconomic status: a multicenter cross-sectional study. Int Urogynecol J Pelvic Floor Dysfunct. 2006;17:340–5. https://doi.org/10.1007/s00192-005-0009-2.
45. Yamasato KS, Oyama IA, Kaneshiro B. Intraabdominal pressure with pelvic floor dysfunction: do postoperative restrictions make sense? J Reprod Med. 2014;59:409–13.
46. Awwad J, Sayegh R, Yeretzian J, Deeb ME. Prevalence, risk factors, and predictors of pelvic organ prolapse: a community-based study. Menopause. 2012;19:1235–41. https://doi.org/10.1097/gme.0b013e31826d2d94.
47. Aytan H, Ertunç D, Tok EC, et al. Prevalence of pelvic organ prolapse and related factors in a general female population. Turk J Obstet Gynecol. 2014;11:176–80. https://doi.org/10.4274/tjod.90582.
48. Chen CCG, Gatmaitan P, Koepp S, et al. Obesity is associated with increased prevalence and severity of pelvic floor disorders in women considering bariatric surgery. Surg Obes Relat Dis. 2009;5:411–5. https://doi.org/10.1016/j.soard.2008.10.006.
49. Chen Y, Johnson B, Li F, et al. The effect of body mass index on pelvic floor support 1 year postpartum. Reprod Sci. 2016;23:234–8. https://doi.org/10.1177/1933719115602769.
50. Kawasaki A, Corey EG, Laskey RA, et al. Obesity as a risk for the recurrence of anterior vaginal wall prolapse after anterior colporrhaphy. J Reprod Med. 2013;58:195–9.
51. Kudish BI, Iglesia CB, Sokol RJ, et al. Effect of weight change on natural history of pelvic organ prolapse. Obstet Gynecol. 2009;113:81–8. https://doi.org/10.1097/AOG.0b013e318190a0dd.
52. Leshem A, Groutz A, Amir H, et al. Surgically induced weight loss results in a rapid and consistent improvement of female pelvic floor symptoms. Scand J Urol. 2018;52:219–24. https://doi.org/10.1080/21681805.2018.1447600.

53. Leshem A, Shimonov M, Amir H, et al. Effects of bariatric surgery on female pelvic floor disorders. Urology. 2017;105:42–7. https://doi.org/10.1016/j.urology.2017.03.003.
54. Metcalfe ND, Shandley LM, Young MR, et al. Pelvic organ prolapse recurrence after apical prolapse repair: does obesity matter? Int Urogynecol J. 2022;33:275–84. https://doi.org/10.1007/s00192-021-04806-x.
55. Myers DL, Sung VW, Richter HE, et al. Prolapse symptoms in overweight and obese women before and after weight loss. Female Pelvic Med Reconstr Surg. 2012;18:55–9. https://doi.org/10.1097/SPV.0b013e3182471f9.
56. Olivera CK, Herron DM, Kini SU, et al. Long-term quality of life and pelvic floor dysfunction after bariatric surgery. Am J Obstet Gynecol. 2012;207:431.e1-4. https://doi.org/10.1016/j.ajog.2012.06.041.
57. Rappa C, Saccone G. Recurrence of vaginal prolapse after total vaginal hysterectomy with concurrent vaginal uterosacral ligament suspension: comparison between normal-weight and overweight women. Am J Obstet Gynecol. 2016;215:601.e1-601.e4. https://doi.org/10.1016/j.ajog.2016.06.022.
58. Wasserberg N, Petrone P, Haney M, et al. Effect of surgically induced weight loss on pelvic floor disorders in morbidly obese women. Ann Surg. 2009;249:72–6. https://doi.org/10.1097/SLA.0b013e31818c7082.
59. Whitcomb EL, Lukacz ES, Lawrence JM, et al. Prevalence and degree of bother from pelvic floor disorders in obese women. Int Urogynecol J Pelvic Floor Dysfunct. 2009;20:289–94. https://doi.org/10.1007/s00192-008-0765-x.
60. Isık H, Aynıoglu O, Sahbaz A, et al. Are hypertension and diabetes mellitus risk factors for pelvic organ prolapse? Eur J Obstet Gynecol Reprod Biol. 2016;197:59–62. https://doi.org/10.1016/j.ejogrb.2015.11.035.
61. Kim BH, Lee SB, Na ED, Kim HC. Correlation between obesity and pelvic organ prolapse in Korean women. Obstet Gynecol Sci. 2020;63:719–25. https://doi.org/10.5468/ogs.19075.
62. Risk factors for genital prolapse in non-hysterectomized women around menopause. Results from a large cross-sectional study in menopausal clinics in Italy. Progetto Menopausa Italia Study Group. Eur J Obstet Gynecol Reprod Biol. 2000;93:135–140.
63. Young N, Atan IK, Rojas RG, Dietz HP. Obesity: how much does it matter for female pelvic organ prolapse? Int Urogynecol J. 2018;29:1129–34. https://doi.org/10.1007/s00192-017-3455-8.
64. Gedefaw G, Demis A. Burden of pelvic organ prolapse in Ethiopia: a systematic review and meta-analysis. BMC Womens Health. 2020;20:166. https://doi.org/10.1186/s12905-020-01039-w.
65. Giri A, Hartmann KE, Hellwege JN, et al. Obesity and pelvic organ prolapse: a systematic review and meta-analysis of observational studies. Am J Obstet Gynecol. 2017;217:11-26.e3. https://doi.org/10.1016/j.ajog.2017.01.039.
66. Greer WJ, Richter HE, Bartolucci AA, Burgio KL. Obesity and pelvic floor disorders: a systematic review. Obstet Gynecol. 2008;112:341–9. https://doi.org/10.1097/AOG.0b013e31817cfdde.
67. Lian W, Zheng Y, Huang H, et al. Effects of bariatric surgery on pelvic floor disorders in obese women: a meta-analysis. Arch Gynecol Obstet. 2017;296:181–9. https://doi.org/10.1007/s00404-017-4415-8.
68. Montenegro M, Slongo H, Juliato CRT, et al. The impact of bariatric surgery on pelvic floor dysfunction: a systematic review. J Minim Invasive Gynecol. 2019;26:816–25. https://doi.org/10.1016/j.jmig.2019.01.013.
69. Zenebe CB, Chanie WF, Aregawi AB, et al. The effect of women's body mass index on pelvic organ prolapse: a systematic review and meta analysis. Reprod Health. 2021;18:45. https://doi.org/10.1186/s12978-021-01104-z.
70. Swift SE, Pound T, Dias JK. Case-control study of etiologic factors in the development of severe pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2001;12:187–92. https://doi.org/10.1007/s001920170062.
71. Gozukara YM, Akalan G, Tok EC, et al. The improvement in pelvic floor symptoms with weight loss in obese women does not correlate with the changes in pelvic anatomy. Int Urogynecol J. 2014;25:1219–25. https://doi.org/10.1007/s00192-014-2368-z.
72. Lee UJ, Kerkhof MH, van Leijsen SA, Heesakkers JP. Obesity and pelvic organ prolapse. Curr Opin Urol. 2017;27:428–34. https://doi.org/10.1097/MOU.0000000000000428.
73. Pomian A, Lisik W, Kosieradzki M, Barcz E. Obesity and pelvic floor disorders: a review of the literature. Med Sci Monit. 2016;22:1880–6. https://doi.org/10.12659/msm.896331.
74. Ramalingam K, Monga A. Obesity and pelvic floor dysfunction. Best Pract Res Clin Obstet Gynaecol. 2015;29:541–7. https://doi.org/10.1016/j.bpobgyn.2015.02.002.
75. Amselem C, Puigdollers A, Azpiroz F, et al. Constipation: a potential cause of pelvic floor damage? Neurogastroenterol Motil. 2010;22(150–153): e48. https://doi.org/10.1111/j.1365-2982.2009.01409.x.
76. Arya LA, Novi JM, Shaunik A, et al. Pelvic organ prolapse, constipation, and dietary fiber intake in women: a case-control study. Am J Obstet Gynecol. 2005;192:1687–91. https://doi.org/10.1016/j.ajog.2004.11.032.
77. Spence-Jones C, Kamm MA, Henry MM, Hudson CN. Bowel dysfunction: a pathogenic factor in uterovaginal prolapse and urinary stress incontinence. Br J Obstet Gynaecol. 1994;101:147–52. https://doi.org/10.1111/j.1471-0528.1994.tb13081.x.
78. Soligo M, Salvatore S, Emmanuel AV, et al. Patterns of constipation in urogynecology: clinical importance and pathophysiologic insights. Am J Obstet Gynecol. 2006;195:50–5. https://doi.org/10.1016/j.ajog.2005.12.046.
79. American College of Obstetricians and Gynecologists and the American Urogynecologic Society, INTERIM UPDATE: This Practice Bulletin is updated as highlighted to reflect the US Food and Drug Administration order to stop the sale of transvaginal synthetic mesh products for the repair of pelvic organ prolapse. Pelvic organ prolapse. Female Pelvic Med Reconstr Surg. 2019;25:397–408. https://doi.org/10.1097/SPV.0000000000000794.
80. Weber AM, Walters MD, Ballard LA, et al. Posterior vaginal prolapse and bowel function. Am J Obstet Gynecol. 1998;179:1446–1449; discussion 1449–1450. https://doi.org/10.1016/s0002-9378(98)70008-0.
81. Weber AM, Richter HE. Pelvic organ prolapse. Obstet Gynecol. 2005;106:615–34. https://doi.org/10.1097/01.AOG.0000175832.13266.bb.
82. Verghese TS, Middleton L, Cheed V, et al. Randomised controlled trial to investigate the effectiveness of local oestrogen treatment in postmenopausal women undergoing pelvic organ prolapse surgery (LOTUS): a pilot study to assess feasibility of a large multicentre trial. BMJ Open. 2020;10: e025141. https://doi.org/10.1136/bmjopen-2018-025141.
83. Ragni E, Lousquy R, Costa P, et al. Risk factors and prevention of genitourinary prolapse. Prog Urol. 2009;19:932–8. https://doi.org/10.1016/j.purol.2009.09.021.
84. Tinelli A, Malvasi A, Rahimi S, et al. Age-related pelvic floor modifications and prolapse risk factors in postmenopausal women. Menopause. 2010;17:204–12. https://doi.org/10.1097/gme.0b013e3181b0c2ae.
85. Cardenas-Trowers O, Meyer I, Markland AD, et al. A review of phytoestrogens and their association with pelvic floor conditions. Female Pelvic Med Reconstr Surg. 2018;24:193–202. https://doi.org/10.1097/SPV.0000000000000559.
86. Cardenas-Trowers OO, Borgstrom M, Addis I. Associations between type and route of hormone use on urinary incontinence

and pelvic organ prolapse in premenopausal and postmenopausal women. Female Pelvic Med Reconstr Surg. 2018;24:100–4. https://doi.org/10.1097/SPV.0000000000000493.
87. Tzur T, Yohai D, Weintraub AY. The role of local estrogen therapy in the management of pelvic floor disorders. Climacteric. 2016;19:162–71. https://doi.org/10.3109/13697137.2015.1132199.
88. Marschalek M-L, Bodner K, Kimberger O, et al. Does preoperative locally applied estrogen treatment facilitate prolapse-associated symptoms in postmenopausal women with symptomatic pelvic organ prolapse? A randomised controlled double-masked, placebo-controlled, multicentre study. BJOG. 2021;128:2200–8. https://doi.org/10.1111/1471-0528.16894.
89. Rahn DD, Ward RM, Sanses TV, et al. Vaginal estrogen use in postmenopausal women with pelvic floor disorders: systematic review and practice guidelines. Int Urogynecol J. 2015;26:3–13. https://doi.org/10.1007/s00192-014-2554-z.
90. Rahkola-Soisalo P, Savolainen-Peltonen H, Gissler M, et al. Postmenopausal hormone therapy is accompanied by elevated risk for uterine prolapse. Menopause. 2019;26:140–4. https://doi.org/10.1097/GME.0000000000001173.
91. Vardy MD, Lindsay R, Scotti RJ, et al. Short-term urogenital effects of raloxifene, tamoxifen, and estrogen. Am J Obstet Gynecol. 2003;189:81–8. https://doi.org/10.1067/mob.2003.374.
92. Deprest JA, Cartwright R, Dietz HP, et al. International Urogynecological Consultation (IUC): pathophysiology of pelvic organ prolapse (POP). Int Urogynecol J. 2022;33:1699–710.
93. Bø K, Anglès-Acedo S, Batra A, et al. International urogynecology consultation chapter 3 committee 2; conservative treatment of patient with pelvic organ prolapse: Pelvic floor muscle training. Int Urogynecol J. 2022;33:2633–67. https://doi.org/10.1007/s00192-022-05324-0.
94. Robinson D, Prodigalidad LT, Chan S, et al. International Urogynaecology Consultation chapter 1 committee 4: patients' perception of disease burden of pelvic organ prolapse. Int Urogynecol J. 2022;33:189–210. https://doi.org/10.1007/s00192-021-04997-3.

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