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CONTENTS

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Review

Original articles

Case report

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Review

Physiotherapy interventions in the treatment of pelvic floor dysfunctions after gynaecological oncology procedures: A systematic review

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ABSTRACT

Cancer is one of the leading causes of death worldwide and a large percentage of cancer in women include gynaecological neoplasms. The aim of the review was to investigate the possibilities and effectiveness of physiotherapeutic techniques in the treatment of pelvic floor dysfunction after gynaecological oncology procedures.

The review was performed in PubMed, Embase and PEDro databases. 5,561 articles were found, however only 11 met the inclusion criteria and were included in the review. To assess the risk of bias of included studies RoB-2 tool, ROBINS-1 were used. Ten studies were assessed as "low" and one study was asses as "moderate" risk.

Studies have shown that the most common physiotherapeutic method described to treat pelvic floor dysfunction are pelvic floor muscle training, followed by biofeedback, electrostimulation, and behavioural training. Extracorporeal magnetic innervation is amongst the innovative method used in the treatment of UI amongst women who have overcome gynaecological cancer. On the other hand, in the treatment of sexual disorders, a vaginal dilator and pelvic floor training are used. Overall, pelvic floor training appears to be an effective technique in the treatment of pelvic floor dysfunction after the treatment of gynaecological malignancies.

A small amount of research, a large variety of types of cancer, different methods of measuring results and small research trials make it difficult to accurately compare the results and draw appropriate conclusions.

Introduction

Cancer is one of the leading causes of death worldwide [1]. Based on the Global Burden of Disease data, in 2019, approximately 1.19 million cases of cancer were detected amongst adolescents and young adults, and 396,000 people aged 15–39 years died from cancer [2]. A large percentage of neoplasms in women include gynaecological neoplasms [3]. This group of neoplasms includes cervix and corpus uteri, ovaries, vulva and vagina neoplasms [1]. It is estimated that in 2020 the most common gynaecological neoplasms were cervix uteri (3.1 %), corpus uteri (2.2 %), and ovary (1.6 %) [4]. On the other hand, cancer uteri (3.4 %) had the highest mortality rate, followed by ovary (2.1 %) and corpus uteri (1 %) [4]. However, with the advancement of medicine, the number of cancer survivors increases [5].

Treatment of gynaecological tumors is often complex and aggressive. It can include surgery, radiotherapy, chemotherapy, hormone therapy, and a combination of these [1]. Treatment depends on the type, location and stage of the tumour [4]. In the case of endometrial cancer, one of the options is to perform hysterectomy, brachytherapy, teletherapy or chemotherapy in advanced cases [6]. Radiation therapy for cancer treatment can be performed both before and after surgery. It is used to treat the tumour itself and reduce the risk of its return [7]. The applied treatment may lead to side effects related to the pelvic floor dysfunction (PFD) [8]. The pelvic floor, which includes muscles, ligaments and fascia, is responsible for continence, micturition, defecation, sexual function, childbirth and supports the organs [9]. During a hysterectomy, the nerves or blood vessels supplying the pelvic floor may be damaged [10]. The studies also confirmed the negative effect of radiotherapy on the function of the pelvic floor muscles (PFM) [7]. Damaged muscle tissue is characterized by a worse contractile response [7], strength, endurance and neuromuscular activation [10], which contributes the PFD [7].

Data on the incidence of PFD in gynaecological cancer survivors are limited [6], and depend on the type of neoplasm, treatment performed and follow-up time [5]. The most common PFDs include urinary incontinence (UI), which is divided into stress urinary incontinence (SUI), urgent urinary incontinence (UUI), faecal incontinence (FI),

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Glossary

PFD	Pelvic Floor Dysfunctions
PFM	Pelvic Floor Muscles
PFMT	Pelvic Floor Muscles Training
UI	Urinary Incontinence

dyspareunia and pelvic organ prolapse [5]. PFD is associated with a reduction in the quality of life, poorer mental health and decreased in social functions [11,12].

Unfortunately, the area of research regarding the occurrence of PFD and the physiotherapy of PFD amongst gynaecological survivors is still poorly explored. There are few studies, in particular randomized clinical trials, assessing the effectiveness of physiotherapy in women with PFD due to gynaecological cancers. The purpose of this work is a systematic review showing the possibilities and effectiveness of physiotherapeutic techniques in the treatment of PFD after gynaecological oncology procedures.

Materials and methods

The study protocol was prepared on the basis of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) [13]. The research protocol has been approved by PROSPERO no. CRD42021291513 Modern physiotherapy in the treatment of urinary incontinence after endometrial cancer treatment - assessment of therapeutic possibilities and needs. A systematic review and meta-analysis of the methods. The inclusion criteria for this review were randomized controlled trials, case studies, observational studies, retrospective studies, prospective studies, pilot studies, trails, publications in English or Polish, studies from January 2000 to September 2022, which include female adults, who were gynaecologic cancer survivors, studies which include physiotherapeutic pelvic floor treatment, which assess effect of physiotherapy, quality of life, sexual functioning, urodynamics or pelvic floor muscle function or other properties. The exclusion criteria were reviews, comments, letters, studies earlier than 2000, studies not in English or Polish, without physiotherapy interventions, not

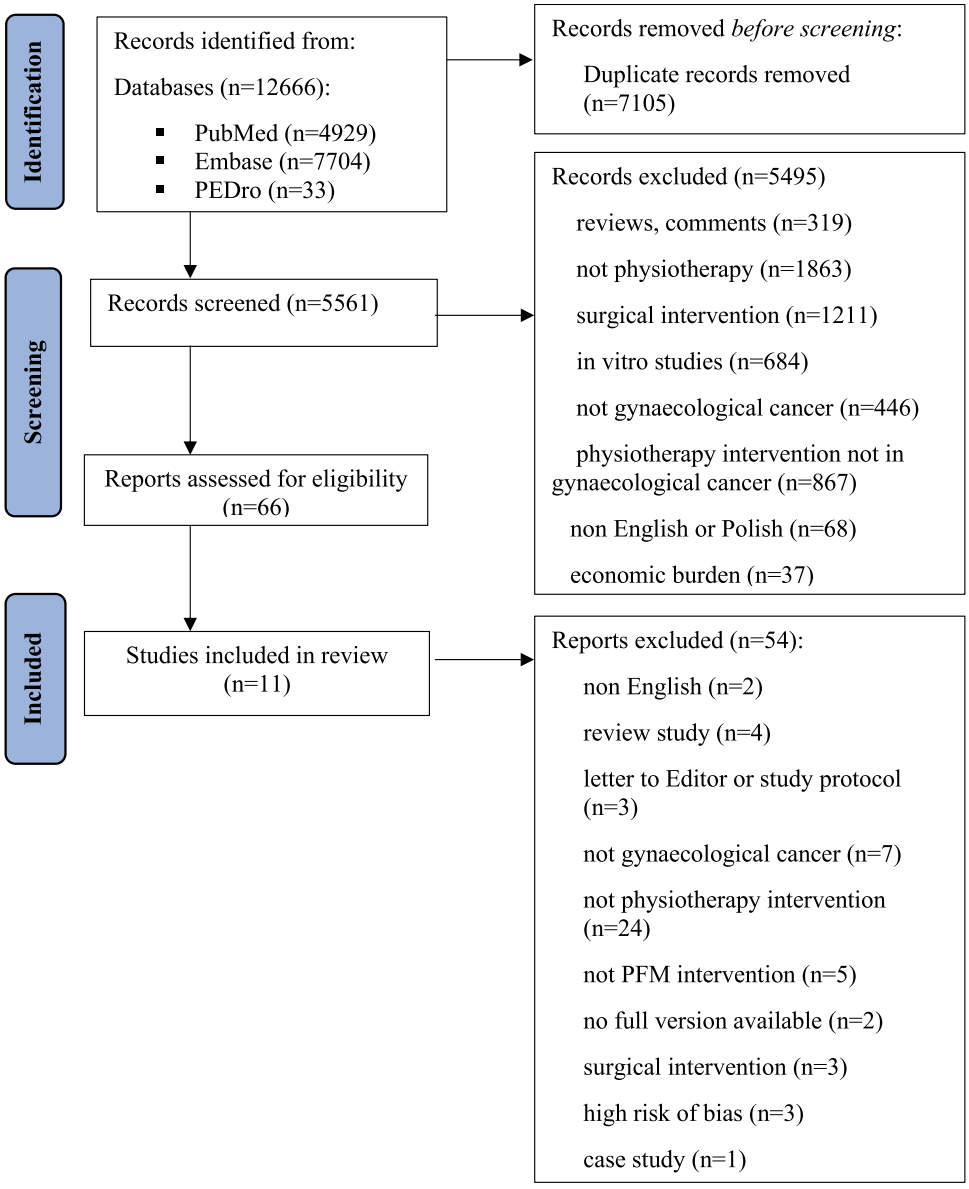

Fig. 1. PRISMA flow diagram of selection study.

Table 1
Characteristics of the type of neoplasms, dysfunctions and physiotherapeutic methods used in the treatment of pelvic floor dysfunction amongst patients who have overcome gynaecological cancer in the articles included in the review.

Study	Cancer	SF	UI	QoL	PFM function	PFMT	BF	VD	Home exercises	Other technics and evaluations carried out
Li [16]	cervical	+		+		+			+	A home-based, nurse-led health program
Li [17]	cervical				+					UR, ES, bladder training
Rutledge [18]	uterine, ovarian, cervical		+			+				Behavioural therapy
Yang [19]	cervical, endometrial	+			+	+	+		+	Bladder and bowel function, core exercises
Sacomori [20]	cervical				+	+				
Sun [21]	uterine, cervical		+							ExMI
Bernard [22]	endometrial		+			+	+			
Araya-Castro [23]	cervical	+				+		+		VS
Cyr [24]	endometrial, cervical	+		+		+	+	+	+	Manual therapy
Charatsi [25]	endometrial, cervical	+		+				+		VS
Cyr [26]	endometrial, cervical	+		+	+	+	+	+	+	Manual therapy

SF – sexual function; UI – urinary incontinence; QoL – quality of life; PFM – pelvic floor muscles; VS – vaginal stenosis; UR – urinary retention; PFMT – pelvic floor muscle training; BF – biofeedback; VD – vaginal dilator; ExMi - extracorporeal magnetic innervation; ES – electrostimulation.

gynaecologic cancer survivors, in vitro studies, not only gynaecological cancer were results cannot be divided, males, case reports, letters, reviews.

The search was carried out on 3 platforms: PubMed, Embase, PEDro.

Our search strategy on PubMed was as follows: (pelvic neoplasm OR gynaecologic cancer OR hysterectomy OR ovarian cancer OR endometrial cancer OR fallopian tube cancer OR cervical cancer OR vaginal cancer OR cancer of the vulva) AND (incontinence or physiotherapy or electrotherapy or rehabilitation or pelvic floor training or pelvic floor disorders or biofeedback or conservative treatment or pelvic muscles functions) Filters: Full text, English, Polish, Female, from 2000 – 2022

Our search strategy on Embase was as follows: ('pelvis tumor'/exp OR 'pelvis tumor' OR 'female genital tract tumor'/exp OR 'female genital tract tumor' OR 'hysterectomy'/exp OR hysterectomy OR 'ovary cancer'/exp OR 'ovary cancer' OR 'endometrium cancer'/exp OR 'endometrium cancer' OR 'fallopian tube cancer'/exp OR 'fallopian tube cancer' OR 'uterine cervix cancer'/exp OR 'uterine cervix cancer' OR 'vagina cancer'/exp OR 'vagina cancer' OR 'vulva cancer'/exp OR 'vulva cancer') AND ('incontinence'/exp OR incontinence OR 'physiotherapy'/exp OR physiotherapy OR 'electrotherapy'/exp OR electrotherapy OR 'rehabilitation'/exp OR rehabilitation OR 'pelvic floor muscle training'/exp OR 'pelvic floor muscle training' OR 'pelvic floor disorder'/exp OR 'pelvic floor disorder' OR 'biofeedback'/exp OR biofeedback OR 'conservative treatment'/exp OR 'conservative treatment' OR 'pelvis floor muscle'/exp OR 'pelvis floor muscle') AND [2000–2022]/py AND [article]/lim AND ([*english*]/lim OR [polish]/lim) AND [female]/lim

Our search strategy on PEDro was as follows: each of following phrase were searched singly using simple search: pelvic neoplasm, gynaecologic cancer, hysterectomy, ovarian cancer, endometrial cancer, fallopian tube cancer, cervical cancer, vaginal cancer, cancer of the vulva

Each reviewer followed the same strategies, but they worked independently. Records were downloaded to Excel file, where duplicates were removed using Excel tool. Each record was initially evaluated by title and abstract against inclusion and exclusion criteria. If the record contained any exclusion criteria phrases it was rejected. Then the full version of the article was evaluated in terms of the study group, materials and methods, developing and presenting results. Inclusion and exclusion criteria were used all the time. Two authors performed each step independently. After selecting titles, abstracts and full texts, the authors compared their results. When there was disagreement, the authors discussed together following the inclusion and exclusion criteria and had to reach a consensus.

Randomized control trials was assessed by risk of bias tool – RoB-2. This tool allow for analyse the entire study, starting with randomization, variations from intervention, loosing data, measure and presentation of results. Each of the researcher independently answer the question which assess the quality of mention above parts. After assessing each domain, the program calculates the risk of the entire study [14]. On the other hand, a tool that assesses, amongst others, observation and retrospective tests, all those that are not randomized is ROBINS-I. Very like in the case of Rob-2, researchers answer questions formulated in such a way that the risk can be assessed. Again, the questions are grouped in domains: confounding, loosing data, study group, results. After answering the questions, the researcher assesses each domain, and then the assessment of the entire study [15]. Both tools can be found via the Cochrane platform.

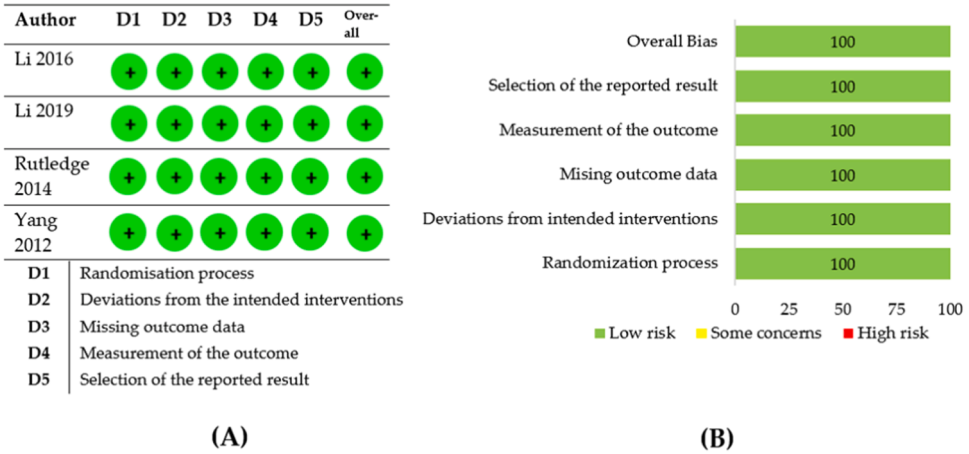

Fig. 2. Risk-of-bias analysis (ROB-2) and summary plot of the overall risk of bias. (A) RoB-2 analysis. (B) Summary plot of the overall risk of bias.

Table 2
ROBINS-I analysis.

Author	Type of study	Bias due to confunding	Bias in selection of participants into the study	Bias due to Missing data	Bias in measurement of outcomes	Bias in selection of the reporter result	Overall
Sacomori [20]	Pilot study	Low	Low	Low	Low	Low	Low
Sun [21]	Pilot study	Low	Low	Low	Low	Low	Low
Bernard [22]	A single-case experimental	Low	Moderate	Low	Low	Low	Low
Araya-Castro [23]	Interventional study with no control group	Low	Low	Serious	Moderate	Low	Moderate
Cyr [24]	A multicentre prospective international study	Low	Moderate	Low	Low	Low	Low
Charatsi [25]	Observational Study	Low	Low	Moderate	Low	Low	Low
Cyr [26]	A multicentre prospective international study	Low	Moderate	Low	Low	Low	Low

Table 3
Prevalence of urinary incontinence, faecal incontinence and dyspareunia following gynaecological cancer procedures due to the type of cancer.

Type of cancer	Prevalence		
	UI [%]	FI [%]	Dyspareunia [%]
Cervical	4–76 [5]	2–34 [5]	12–58 [5]
Endometrial	2–53 [5]	11–24 [5]	23–39 [5]
Uterine	54 [27]	11–24 [5]	7–39 [5]
Ovarian	15–42 [5]	7 [28]	62 [29]

Results

Characteristics of the studies

Based on the phrases above, a total of 12,666 publications were searched. After removing the duplicates, 5561 works remained. After an analysis of the titles and abstracts, 5495 publications were rejected. There were 66 papers left to full reading. Ultimately 11 works met the inclusion criteria. A detailed analysis of the various stages of the review is presented in the PRISMA diagram (Fig. 1).

Ten of included studies described physiotherapy amongst women after cervical cancer, 5 studies focused on physiotherapy after endometrial cancer, 2 studies described physiotherapy after treatment of uterine cancer, and 1 focused on physiotherapy after ovarian cancer treatment. The areas which were most often assessed were sexual function, incontinence, and pelvic floor muscle function. The most common therapy used and evaluated was pelvic floor muscle exercise. The characteristics of the included works are presented in Table 1.

Quality of trials was assessed by two reviewers independently. Using the RoB-2 tool, the quality of 4 works was assessed. All of them were assessed as low risk. The 7 remaining studies were not randomized clinical studies and the ROBINS-I tool was used to assess their risk of bias. Six of them were assessed as low risk, while one was assessed as moderate risk. All works were included in the final analysis. The results are presented in Fig. 2 and Table 2.

Pelvic floor disorders in women with gynaecological neoplasms

Data indicating the presence of PFD in women treated with gynaecological cancers show that the occurrence of dysfunctions such as UI, FI and dyspareunia are frequent. Moreover, these dysfunctions also occur before treatment and their frequency depends on the type of tumour [5]. The most common dysfunction faced by women before the treatment of gynaecological neoplasms is UI, which occurs amongst 15–42 % of patients [5]. Pelvic organ prolapse, which is observed amongst 41 % of women, is also a common problem for patients with gynaecological neoplasms [12]. Data on the occurrence of other PFD before treatment are limited. More accurate data on the incidence of PFD are available for post-treatment patients. The incidence of PFD after cancer treatment varies depending on the type of cancer. However, the most common problems amongst gynaecological cancer survivors are UI, followed by dyspareunia and FI. Detailed data on the occurrence of PDF depending on the cancer treated is presented in Table 3. The above problems lead to a significant reduction in the quality of life [13].

Physiotherapy intervention

Patients who have undergone surgeries due to neoplasm of the gynaecological area are at risk of UI due to damage to the pelvic floor structures. The procedure disturbs the statics of the organs, damaging the fascia, ligaments, muscles, and the supporting apparatus [17]. The most commonly used method in the treatment of PFD was pelvic floor muscle training (PFMT), which increases the effectiveness of PFM contraction and its strength. It is a generally accepted technique [19]. PFMT increases the number of motor neurons, improving PFM function [16]. PFMT focused on proper coordination, contraction, endurance, and relaxation [26]. PFMT started in a lying position, then sitting, followed by standing [26]. Researches propose from two to six sets of PFMT per day [16,18-20,22,23,26]. Women performed 8 to 10 long 10 s of maximal PFM contractions [17-20,23,26], followed by 5 s [18], and the best 10 s break. Women also performed rapid maximal contraction [19,20,23,26], and voluntary precontraction of PFM before activities that increased intraabdominal pressure [20,23]. It is important to avoid contraction of gluteal, adductor and abdominal muscles during PFMT [18]. PFMT can be performed by using the modern technology with a dynamometer that connects wirelessly to the mobile app and enables real-time biofeedback [22]. Devices with biofeedback teach PFM exercises [19], promote PFM relaxation, as well as proper contraction [24], and can reminds and monitors a progress [22].

One of the complications amongst patients after gynaecological cancer surgery may be urinary retention. Nerve damage during surgery can affect the proper functioning and sensation of the bladder [17]. Researchers showed that applied low-frequency electrostimulation, even in a short period lasting 3 days, the urinary retention was 10.41 % lower than in applying only bladder training [17]. Non-invasive treatment which stimulated PFM and sacral roots to improved UI was extracorporeal magnetic innervation (ExMI). A statistically significant improvement appeared after 8 ExMI sessions, and the effect continued after 24.2 months of follow-up. In 1 h of the test pad, the average weight was 27.2 g, while after the therapy the weight dropped to 12.1 g ($p<0.05$) [21].

Another dysfunction faced by gynaecological cancer survivors is sexual dysfunction. Vaginal dilators (VD) are often used in the treatment

Table 4
Characteristics of included studies on physiotherapeutic methods used in the treatment of pelvic floor disorders in women after treatment of gynaecological neoplasms.

Author, year	Main Objective	Participants	Intervention	Outcomes
Li, 2016 [16]	To investigate the effect of a home-based, nurse-led health program (NLHP-HB) on quality of life and family function for postoperative patients with early-stage cervical cancer.	226 patients Con.:107 Exp.:119	Con.: patients received conventional nursing care, including drug and health education, nutrition nursing. Exp.: NLHP-HB program: PFMT 10 × 3–5times per day, time of contraction:10 s, time of relaxation:10 s, yoga exercises, informal social support system, home online follow-up monitoring Assessment: 7 days post-surgery and 6 months after NLHP-HB program in both groups, FACT-Cx; FSFI; FACES-II	NLHP-HB program improves QoL ($p<0.01$), sexual function ($p<0.01$) and family function ($p<0.01$) amongst postoperative patients with early stage cervical cancer.
Li, 2019 [17]	To evaluate the clinical significance of low-frequency ES in preventing UR after RH	91 patients Con.:43 Exp.:48	Con.: from the 11th day since the operation bladder function training for 3 days Exp.: from the 11th day since the operation bladder function training and ES for 3 days, for 15 to 30 min, twice a day: GrA: frequency - 35 Hz, pulse width - 200 μs; GrB: frequency - 1 Hz, pulse width - 270 μs Assessment: 14 days after the operation, PFM strength, B ultrasound	Low-frequency ES is more effective than conventional therapy in prevention UR after RH. The incidence of UR in GrB was lower than in GrA (9.09% vs 11.54 %; $p<0.01$).
Rutledge, 2014 [18]	To evaluate PFMT for UI amongst gynaecologic cancer survivors.	40 patients Mean age: 57 (range:37–79) Con.: age= 57.5 ± 7.5 Exp.: age= 57.9 ± 6.6	Con.: usual care, no PFMT and behavioural training Exp.: PFMT 3 times daily for 12 weeks, 10 contraction for 5 s, and behavioural training, education and feedback of the PFM contraction Assessment: baseline and 12 weeks post intervention, ISI, QUID, UDI-6, IIQ-7, PGI-I, PFM function	PFMT and behavioural therapy significantly improved cancer survivor's UI, 80 % of treated patients reported that their UI is "much better" or "very much better" vs 40 % of control group ($p = 0.02$).
Yang, 2012 [19]	To investigate the effects of a PFMT with core exercise on pelvic floor function and QoL in gynaecological cancers survivors.	34 patients Con.: 17 (age= 52.5 ± 2.9) Exp.: 17 (age= 52.3 ± 5.2)	Con.: information about PFMT, lifestyle advice Exp.: supervised 45 min exercise session and 30 min counselling session per week for 4 weeks: BF PFMT per 20 min, 40 contractions of PFM for 10 s, then 20 s relaxation, core exercises for 20 min. counselling session: lifestyle advise, PFM evaluation, reeducation of home-based PFMT. At home: PFMT 6 sets daily, 10max contractions for 10 s, 4 s relaxation, 1 min break, 10 fast contractions for 20–30 s. Assessment: baseline and after 4 weeks, Australian Pelvic Floor Questionnaire, perineometer, Sacral and transcranial MS, QLQ-C30, QLQ-CX 24.	PFMT and core exercises program improved PFM function and strength ($p = 0.036$), as well as improved sexual functioning ($p = 0.048$) and QoL.
Sacomori, 2020 [20]	To evaluate the influence of PFMT education on PFM function in women before and after 1 month of pelvic radiation.	49 patients, 28 returned to follow-up	Intervention: 1 session of 30 min teaching PFMT before radiation therapy. At home: 2 times per day of 8 max contractions of 6 s with 10 s rest, 8 max one-second contractions, voluntary precontraction of the PFM before activities that increased intra-abdominal pressure Assessment: baseline and after 1 month, vaginal bidigital evaluation grading with the modified Oxford Scale, ICIQ-SF, PFM EMG	There was no significant change from baseline to post-radiation therapy in muscle strength ($p = 0.052$), EMG records ($p = 0.586$) and incontinence ($p = 0.794$). Nevertheless teaching PFMT may be a protective factor for improve PFM functions and preventing UI, and FI.
Sun, 2015 [21]	To assess the efficiency of ExMI therapy for women with urinary tract dysfunction following RH for uterine cervical cancer	32 patients Median age=61 (range 52–80)	Intervention: twice-weekly ExMI session for 12 weeks =24 session. Magnetic field pulsed: 3 s on and 6 s off for 10 min, 2 min rest, then second treatment for 10 min (3 s on and 6 s off), Patients with SUI or UUI: 50 Hz (first 10 min session) and 10 Hz (second 10 min session). Patients with MUI: 10 Hz (first treatment) and 50 Hz (second treatment). Assessment: UDI-6, IIQ-7, 1 h pad test	ExMI treatment improves symptoms of UI ($p<0.001$). The 1 h pad test weight decreased from 27.2 g to 12.1 g ($p<0.05$).
Bernard, 2021 [22]	To assess the effects of an in-home rehabilitation program, including the use of a mobile technology, to reduce UI severity in endometrial cancer survivors.	8 patients; Range age: 39–76 years old	Intervention: daily home-based PFMT using mobile app, bladder training regimen and counselling on lifestyle habits for 12 weeks, weekly follow-up telephone from physiotherapist. Assessment: 1-h pad test, 3-day bladder dairy, ICIQ-UI SF, ultrasound, intravaginal dynamometry	A home-base PFMT using mobile technology reduce UI ($p<0.05$). The strength and efficiency of the PFM quick contractions improved to a lesser extent ($p<0.05$).

(*continued on next page*)

Table 4 (*continued*)

Author, year	Main Objective	Participants	Intervention	Outcomes
Araya-Castro, 2020 [23]	To assess the effectiveness of the combination of VD and PFME on vaginal stenosis, sexual health and QoL amongst women undergoing RT for CC.	648 women, analysed 28 women	Two 30 min session: 1st: pre-rehabilitation – PFME verbal and written instructions 1 month before RT, PFME practice at home at least twice per day; 2nd: rehabilitation with VD and PFME instructions; at home VD at least 3times/week for 5–10 min. Follow-up: three months after the 2nd session Assessment: EORTC QLQ-C30, EORTC QLQ CX24, VD size, PFM strength	An educational intervention with VD and PFME was effective in preventing vaginal stenosis ($p = 0.027$). Most of women (81.8 %) were sexually active after 3 months of using VD.
Cyr, 2020 [24]	To assess the feasibility, acceptability and effects of multimodal PFPT in gynaecological cancer survivors with dyspareunia.	31 EC and CC survivors (age= 55.9 ± 10.8)	Twelve weekly, individual multimodal PFPT of 60 min with certified PT in women's health. Session with PT consisted of education, manual therapy, PFME with BF. At home breathing exercises, PFME 4x/week, and use of a VD 3x/week. Assessment: MPQ, FSFI, NRS for pain intensity	Multimodal PFPT improves pain, sexual function amongst women with dyspareunia after gynaecological cancer ($p \leq 0.044$).
Charatsi, 2022 [25]	To investigate the efficacy of VD for the treatment of radiation-induced VS and the effect of a VD on sexual QoL.	53 EC and CC survivors (mean age at diagnosis=58 years)	Twelve month using VD twice per week after completing RT or chemotherapy. Assessment: SVQ	VD significantly reduces VS after 12 month of using ($p<0.001$).
Cyr, 2022 [26]	To investigate the changes in PFM function after multimodal PFPT in gynaecological cancer survivors suffering from dyspareunia.	31 EC and CC survivors; 28 participants completed	Twelve weekly, individual multimodal PFPT of 60 min with certified PT in women's health. Session with PT consisted of education, manual therapy, PFME with BF. At home breathing exercises, PFME 4x/week, and use of a VD 3x/week. Assessment: MPQ, FSFI, NRS for pain intensity, USG	Significant changes from rest to maximal contraction significantly improved ($p<0.0001$). Women also presented with a significant decrease in tone ($p = 0.006$).

BF- biofeedback; CC – cervical cancer; EC – endometrial cancer; ES- electrical stimulation; EMG – electromyography; EORTC QLQ-C30 - European Organization for Research and Treatment of Cancer Quality of Life Group Quality of Life Questionnaire Core-30 version 3.0; EORTC QLQ CX24 - European Organization for Research and Treatment of Cancer Quality of Life Group Quality-of-Life questionnaire cervical cancer module; FACT-Cx-Functional Assessment of Cancer Therapy for Cervical Cancer; FSFI- Female Sexual Function Index; FACES-II- The Adaptability and Cohesion Scale, Second Edition; ICIQ – international consultation on incontinence questionnaire; ICIQ-UI SF – International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form; ISI- Incontinence Severity Index; IIQ-7 - Incontinence Impact Questionnaire; MS- magnetic stimulation; MPQ - The McGill Pain Questionnaire; MUI – mixed urinary incontinence; NLHP-HB - home-based, nurse-led health promotion; NRS - A numerical rating scale; PT – physical therapist; PGI-I - Patient Global Impression of Improvement; PFM – pelvic floor muscle; PFPT - pelvic floor physical therapy; PFMT – Pelvic floor muscle training; PFME - pelvic floor muscle exercises; RH – radical hysterectomy; RT – radiation therapy; SUI – stress urinary incontinence; SVQ - sexual function vaginal changes questionnaire; UI – urinary incontinence; UR – urinary retention; UUI – urge urinary incontinence; UDI-6 - Urinary Distress Inventory; QUID - Questionnaire for Urinary Incontinence Diagnosis; USG – Ultrasound imaging; QoL – quality of life; VD – vaginal dilator; VS – vaginal stenosis.

of vaginal stenosis, and many studies have confirmed their effectiveness [23,25,26]. The vast majority of women in the Araya-Castro et al. [23] study retained dilator size or improved one size 4 months after surgery [23]. However, Charatsi et al. [25] noticed that only participants starting dilator use less than 3 months after surgery showed a significant decrease in vaginal stenosis after 12 months [25]. For relaxation PFM Cyr et al. [26] used manual therapy, applied externally and vaginally. Stretching techniques, massage and trigger points therapy were used [26]. To improve sexual function PFMT were also performed [16,19] often combined with dilator [23,24,26].

The characteristics of the included studies is presented in Table 4.

Discussion

The aim of this review was to assess the needs, possibilities and effectiveness of physiotherapeutic methods used in the treatment of PFD in gynaecological cancers survivors. Cancer treatments leads to PFM disorders [30], which provoke PFD [31]. Earlier researches confirm that physiotherapy is effective and widely used in the population both of women, and men with PFD [31,32]. In this review, we have shown that the most frequently physiotherapeutic method described as the treatment of PFD amongst women after treatment of gynaecological neoplasms was PFMT [16,18-20,22-24,26]. However, according 6 th International Consultation on Incontinence, women after irradiation of the pelvis and radical pelvic surgery was classified as a group of "complicated" UI and amongst them recommended is specialised management [33]. There are no strictly defined standards for PFD treatment in gynaecological cancer survivors [34] Physiotherapy management recommendation for PFD in general population are supported by a lot of evidence and includes a conjunction of many methods as exercise, and often a combination of electrophysical agents, biofeedback [33,35,36], which obtain better treatment results [37]. Unfortunately, amongst gynaecological cancer survivors, methods e.g. electrostimulation, magnetic stimulation, whole-body vibration training and biofeedback are not often combined. Moreover, there are not many studies, especially those that describe treatments other than PFMT. In contrast to the situation of women after treatment of gynaecological cancer, electrostimulation is commonly used to reduce UI amongst men after prostatectomy due to prostate cancer [32]. In the literature, there are many studies evaluating the effect of electrostimulation after prostatectomy on PFD, and even the effect of specific frequencies on the reduction of UI symptoms [32]. Whereas, due to studies indicating the risks associated with the use of electrostimulation [38], it is not recommended amongst gynaecological cancer survivors [33], even up to 5 years after treatment [38]. It is believed, that electrostimulation can stimulate cell replication and DNA synthesis, thus the growth of cancer and its spread [38]. On the other hand, in-vitro and in-vivo study on a mouse model showed that electrostimulation has no effect on proliferation of cervical cancer cells [39]. Although, hysterectomy gets rid of tumour [40] and there is a small risk of developing cancer of other pelvic organs [41], so it could also be used in women after surgeries due to gynaecological tumours. It remains to ask why women after gynaecological cancer surgery are deprived of therapeutic possibilities, which in studies show high effectiveness, and amongst men after prostate cancer,

electrostimulation methods are described in detail. Perhaps this should be the first line of research to thoroughly assess the safety of these electrophysical agents. So as not to be afraid of using modern physiotherapy techniques amongst gynaecological cancer survivors that effectively reduce the symptoms of PFD, and thus significantly improve the quality of life. Nevertheless, PFD treatment is not a priority for women who have survived gynaecological cancers shortly after cancer treatment [34]. There is not much researches on physiotherapy to treat PDF after gynaecological cancer surgery. Current evidence shows that PFDs are a very common problem for gynaecological cancer survivors, while physiotherapy options are limited in this group.

Limitation of the study

This study has several limitations. First, there is a lack of research in the literature, in particular RCT studies focusing on the physiotherapy of PFD following cancer-related gynaecological surgery. Only works in English and Polish were taken into account. The amount of work included in the review was very small. Researchers also pay attention to limitations in their works. The patients were operated on with various techniques, unfortunately the differences between the treatment methods and the effectiveness of physiotherapy were not divided in the analysis. Moreover, the stages of the tumors varied. There were no preoperative PFM assessment [19], an insufficient research group [18], a short follow-up [19,23], a short physiotherapeutic intervention [18,19], and too few measurement points [16]. The patients included in the study by Li et. were in early-stage cervical cancer survivors, they were young and more anxious, which could have influenced the final result of the study [16]. Also, the lack of blindness of the researchers could have distorted the assessment [18]. There was a large number of PFMT protocols in the research, some of the therapies were carried out by physiotherapists, some of the patients practiced at home. Additional methods of therapy were often used, which makes it difficult to conclude which therapy is more effective. Various methods of measuring results were also used, which makes it difficult to compare studies with each other. This review showed that more research is needed to evaluate physiotherapeutic approaches in cancer survivors.

Conclusions

The presented physiotherapeutic methods demonstrate effectiveness in the treatment of pelvic floor dysfunction, especially urinary incontinence and dyspareunia. The studies emphasized the reduction of pelvic floor dysfunction and increase the quality of life. However, on the basis of the current research results, it is not possible to draw precisely conclusions which methods, duration and intensity of physiotherapy interventions are the most effective. More randomized controlled trials and larger-population trials and research of single physiotherapy treatments are needed.

Ethics approval and consent to participate

Not applicable.

CRediT authorship contribution statement

Sabina Tim: Investigation, Writing – original draft, Visualization, Formal analysis. **Agnieszka I. Mazur-Bialy:** Conceptualization, Methodology, Investigation, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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