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ORIGINAL ARTICLE

Pelvic floor muscle function in women with pelvic floor dysfunction

A retrospective chart review, 1992–2008

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Abstract
Introduction and hypothesis The objectives of this study were to investigate the level of pelvic floor muscle (PFM) function in women with pelvic floor dysfunction (PFD) referred by gynaecologists and urologists for in-hospital pelvic floor muscle training (PFMT), and to identity associated factors for a low level of PFM function.
Methods Data of women with PFD referred to a PFMT programme were included in a retrospective chart review. Measurement of PFM function performed by digital vaginal palpation included: voluntary PFM contraction, PFM strength (Modified Oxford Grading Scale) and PFM static endurance.
Results Data of 998 women, mean age 56 (SD 13) years, with PFD (urinary incontinence, $n = 757$, anal incontinence, $n = 36$, pelvic organ prolapse, $n = 111$, other PFD, $n = 94$) were analysed. In all, 690 women (70 %) were, at baseline, unable to perform correct voluntary PFM contraction, mean PFM strength was 1.5 (SD 1.0) points, mean PFM static endurance was 16.7 (SD 16.1) seconds. Age ≥ 65 years and year of referral > 2000 were significantly ($p < 0.01$) associated with the ability to perform correct PFM contraction. Likewise, year of referral was significantly associated with high PFM strength ($p < 0.01$).
Conclusions The majority of the women were unable to perform correct voluntary PFM contraction and almost all had low PFM strength. The most important factor associated with a low level of PFM function was age.

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Introduction

Measurement at baseline of pelvic floor muscle (PFM) function [1] is essential for appropriate teaching and supervising training for women with pelvic floor dysfunction (PFD) [2] referred for pelvic floor muscle training (PFMT). Likewise, knowledge of factors leading to low PFM function is important. Without it the PFMT may lead to delayed or no effect and subsequently to unnecessary or inappropriate surgical procedures and drug treatment.

Currently, no standard measure of female PFM function is recommended [2].

According to the International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report, voluntary PFM contraction and relaxation may be assessed by visual inspection, digital palpation, electromyography (EMG), dynamometry, perineometry or ultrasound [3].

Digital vaginal palpation, which has been used for years, is a simple, inexpensive and safe method of measuring PFM function in clinical settings, although some researchers consider it unreliable, subjective and not sufficiently sensitive [4, 5]. However, a recent study showed acceptable correlation between PFM contractility, measured by surface EMG, and digital vaginal palpation [6], indicating that both methods can be used in research and clinical settings [6].

Other advantages of digital vaginal palpation include its abilities to identify if patients have voluntary PFM contraction, to perform isolated PFM contraction, to differentiate the right and left sides of the PFM and to measure strength as well as endurance and coordination [7]. In addition, digital vaginal palpation has been strongly recommended for teaching

patients the correct voluntary PFM contraction as feedback during a contraction attempt [4].

Research in women with PFD has identified several obstetric risk factors [8], but few studies have investigated the associated factors for low PFM function in women with PFD.

The objectives of this study were to investigate the level of PFM function in women with PFD referred by gynaecologists and urologists for in-hospital PFMT, and to identity associated factors for a low level of PFM function.

Materials and methods

This study is part of a large, multifaceted study focusing on women with PFD referred for PFMT [9].

Participants

This study was based on data of patients referred to a PFMT programme, at the Department of Physiotherapy and Occupational Therapy by gynaecologists and urologists at the Departments of Gynaecology/Obstetrics and Urology, Copenhagen University Hospital, Glostrup between June 1, 1992 and September 30, 2008.

Between 2000 and 2008 the criteria for referring women for a PFMT programme at the university hospital were restricted according to the rules of the Danish National Healthcare System. Symptoms were required to be "severe" or "very severe".

The following inclusion criteria were used:

1. Women with at least one of the following PFD diagnoses:
    a) Urinary incontinence (UI) according to the IUGA/ICS terminology [3]
    b) Anal incontinence (AI) [3]
    c) Pelvic organ prolapse (POP) [3]
    d) Other pelvic floor dysfunctions (OPFD): sensory and emptying, abnormalities of the lower urinary tract, defecatory dysfunction, sexual dysfunction and chronic pain syndrome [3]
2. Outpatients
3. Able to walk independently with or without aids
4. Able to read and speak Danish and/or English
5. Baseline measurement of PFM function

Exclusion criteria:

1. Undergoing treatment for cancer
2. Pregnancy

Design

This study was a retrospective chart review.

Baseline data for each patient were extracted from the referrals by the gynaecologists and urologists and the clinical notes recorded by the physiotherapists.

The Ethical Committee of The Capital Region of Denmark ruled that this study was not covered by the law of the Ethics Committee (§ 6, sec. 3). The study was approved by the Register for Data Protection Agency and The Danish National Board of Health (j.no. 7-604-04-2/64/EHE, 20 February 2009).

PFM function

The measurement of PFM function was performed by digital vaginal palpation and included:

1. Voluntary PFM contraction: the result was expressed according to a specific, graduated, four-point, ordinal scale: no voluntary PFM contraction = 0; asymmetric voluntary PFM contraction = 1; voluntary PFM contraction + co-contraction of other related muscles (e.g. the gluteal, hip adductor or abdominal muscles) = 2; correct voluntary PFM contraction with upward perineum movement = 3 [10].
2. PFM strength: the result was expressed on a Modified Oxford Grading Scale (MOS) [11]: 0 = no contraction, 1 = flicker, 2 = weak, 3 = moderate, 4 = good, 5 = strong. The participants were asked to perform their maximum voluntary contraction (MVC) at PFM without co-contraction of other related muscles. The test was performed three times and the best result was used.
3. Static PFM endurance: the PFM static endurance was measured and the result expressed as the time in seconds to maintain a PFM contraction. The participants were asked to maintain the contraction of PFM for as long as possible. The cut-off time was 60 s. Static endurance was defined as the point of isometric fatigue where the muscle contraction could no longer be maintained at a certain level.

Procedure

The baseline measurement of PFM function took place initially in the PFMT programme. The instruction and test procedure were standardised in all three tests. All the tests were carried out by the same two experienced PFM physiotherapists, with 5 and 18 years' experience. All participants were asked to empty their bladder before the measurement.

Participants were tested in supine position with a hip flexed and the feet on the couch [6].

Level of PFM function

In this study PFM function is defined as:

"Unable to perform PFM contraction" = test result 0, 1 or 2 on the voluntary PFM contraction test scale.
"Able to perform PFM contraction" = test result 3 on the voluntary PFM contraction test scale.
"Low PFM strength" = test result 0, 1, 2, or 3 points on MOS.
"High PFM strength" = test result 4 or 5 points on MOS.

The participants were treated by the same two PFM physiotherapists in a systematic, controlled, intensive PFMT programme, over 12 sessions in a 3-month period (Table 1).

All participants were tested 2–3 times by digital vaginal palpation of the PFM function performed for control and feedback of correct, isolated contraction and continuous evaluation of the PFM strength. The PFMT programme, which was free of charge for all participants, has been presented elsewhere [9].

Statistics

Statistical analysis was carried out by means of IBM SPSS (Statistical Package of the Social Sciences), version 18.00 and R version 2.13.2 [12] using the package rms [13].

The results are presented as mean and standard deviation for data measured by continuous scales, and by number and percentage for data measured on short ordinal or nominal scales. A logistic regression model was fitted for each variable and results reported as odds ratios (OR). Continuous factors were initially modelled by restricted cubic splines and subsequently tested and simplified to linear or piecewise linear functions where appropriate.

For all tests, the level of significance was set to 5 %.

Table 1 Pelvic floor muscle training programme for 998 women with pelvic floor dysfunction

Introduction (theory)	60 min
Group treatment	10–14 patients/group
Frequency	1 session (60 min) per week
Duration	3 months (12 sessions)
Attendance in group treatment, sessions	≥ 8 sessions
Vaginal palpation	2–3 times
Individual instruction	2–3 times
Progressive home exercise	
Number	10 sets
Frequency	1–2 times daily

Results

Participants

Data on 998 women with PFD, mean age 56 (SD 13) years were analysed. Data were missing for 10 participants (1 %) for voluntary PFM contraction, 5 participants (0.5 %) for PFM strength and 12 participants (1 %) for PFM static endurance.

Demographic and urogynaecological baseline characteristics of the 998 participants included are presented in Table 2.

Voluntary PFM contraction

The mean voluntary PFM contraction was 2.1 (SD 0.8) and the distribution among participants was: 0, $n = 80$ participants;

Table 2 Demographic and gynaecological baseline characteristics of 998 women with pelvic floor dysfunction referred for a pelvic floor muscle training programme

Characteristics	*n* (%)
Age, years[a]	56 (13)
Nationality	
Danish	924 (93)
Turkish/Pakistani	56 (6)
Other	15 (1)
No information	3 (−)
Distance, home to hospital, km[a]	10 (8)
Referral department	
Gynaecology	874 (88)
Urology	114 (11)
Other	9 (1)
No information	1 (−1)
Diagnosis, primary	
Urinary incontinence	757 (76)
Anal incontinence	36 (4)
Pelvic organ prolapse	111 (11)
Other pelvic floor dysfunction	94 (9)
Diagnosis, secondary	
Urinary incontinence	7 (1)
Anal incontinence	9 (1)
Pelvic organ prolapse	6 (−)
Other pelvic floor dysfunction	18 (2)
None	958 (96)
Urinary incontinence type ($n = 723$)	
Stress UI	374 (52)
Urge UI	85 (12)
Mixed UI	233 (32)
Other	31 (4)

Data are shown as *n* (%) or [a] mean and ± SD

1, $n=63$ participants; 2, $n=547$ participants; 3, $n=298$ participants (Fig. 1).

PFM strength

The mean value PFM strength was 1.5 (SD 1.0) and the distribution among participants was: 0, $n=124$ participants; 1, $n=442$ participants; 2, $n=264$ participants; 3, $n=129$ participants; 4, $n=30$ participants; 5, $n=4$ participants (Fig. 2).

PFM static endurance

The mean static endurance was 16.7 seconds (SD 16.1) and participants were distributed as follows: 0–10 s, $n=393$ (40 %) participants; 11–20 s, $n=336$ (34 %) participants; 21–30 s, $n=152$ (16 %) participants; 31–40 s, $n=28$ (3 %) participants; 41–50 s, $n=14$ (1 %) participants; 51–60 s, $n=63$ (6 %) participants.

Associated factors

Table 3 shows that the probability of being able to perform the correct PFM contraction decreases significantly with age above 65 (OR: 0.92 [0.87–0.97] per 1 year increase), but not for age less than 65 ($p=0.18$). Moreover, the probability of being able to perform correct PFM increased significantly for referrals from 2000 onwards (OR: 1.38 [1.20–1.59] per 1-year increase; defined as the year written on the referral form), but not for referrals before 2000 ($p=0.16$). All other factors were not significant.

Table 4 shows that there was a small, but statistically significant, positive trend in terms of year of referral with respect to high PFM strength (OR 1.00 (1.00–1.01) per 1-year increase, e.g. comparing 2000 with 1999, $p<0.01$) between participants with low and high PFM strength regarding year of referral. This corresponds to OR=1.07 (1.02–1.12) from 1992 to 2008 (16-year increase).

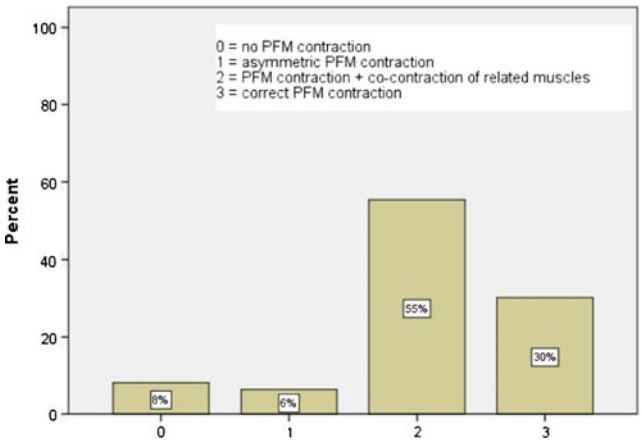

Fig. 1 Results of the test of voluntary PFM contraction

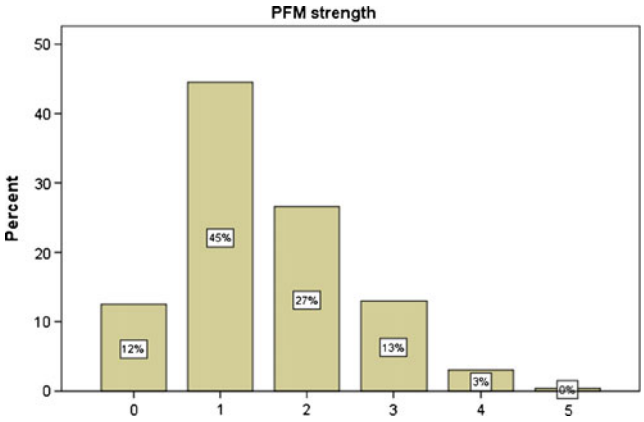

Fig. 2 Results of the PFM strength test expressed on a modified Oxford grading scale

Discussion

This study showed that 70 % of the women with PFD were unable to perform correct voluntary PFM contraction and that 97 % of them showed low PFM strength. Age and year of referral were the only significant factors; nationality, diagnosis and urinary incontinence type did not appear to be associated with the ability to perform the correct PFM function. Year of referral was significantly associated with high PFM strength.

Several studies have shown that more than 30 % of women with UI cannot contract their PFM at their first consultation, even after thorough individual instruction [10, 14]. In the present study this rate was 70 %, which was surprising because we expected the women to have previously received PFMT. According to Adekanmi et al. it is presumed that 50 % of women with UI have not received PFMT when they are referred for secondary healthcare [15]. Unfortunately, in our study the number of participants who had received PFMT previously was not systematically registered.

In a study by Talasz et al. [16] in geriatric women with UI, more than 87 % of the women were unable to perform any voluntary or involuntary PFM contraction. In contrast, Henderson et al. [17] reported in a study among women with or without PFD that 85–87 % of the women performed correct PFM contraction at the first attempt. However, the authors defined "correct PFM contraction" without reporting the possible co-contraction of related muscles and the evaluation of PFM function was performed by trained nurses and not by an experienced PFM physiotherapist.

In another study Talasz et al. [18] measured PFM strength as an aspect of PFM function. The PFM strength was measured by digital vaginal palpation and rated on MOS, showing that 44.9 % of the participants were unable to perform normal

Table 3 Associated factors for 988 women with pelvic floor dysfunction who were able and unable to perform correct voluntary pelvic floor muscle contraction. Unadjusted odds ratios for the probability of being able to perform correct voluntary pelvic floor muscle contraction

Factors	Able to perform correct voluntary PFM contraction, $n=298$ n (%)	Unable to perform correct voluntary PFM contraction, $n=690$ n (%)	OR (95 % CI)	P value
Age, years[a], per 1-year increase	55 (12)	56 (13)	Age <65: 1.01 (1.00–1.02)	0.18
			Age ≥ 65: 0.92 (0.87–0.97)	<0.01
Year of referral[a], per 1 calendar year increase	2002.20 (4.25)	2000.11 (3.92)	Year <2000: 0.94 (0.86–1.02)	0.16
			Year ≥ 2000: 1.38 (1.20–1.59)	<0.01
Nationality				
Danish	282 (95)	634 (92)	Ref	Ref
Turkish/Pakistani	12 (4)	42 (6)	0.64 (0.33–1.24)	0.19
Other	4 (1)	11 (2)	0.82 (0.26–2.59)	
No information	–	3 (–)		
Diagnosis, primary				
Urinary incontinence	222 (75)	529 (77)	Ref	Ref
Anal incontinence	12 (4)	24 (3)	1.19 (0.59–2.42)	0.63
Pelvic organ prolapse	36 (12)	74 (11)	1.16 (0.76–1.78)	0.50
Other pelvic floor dysfunction	28 (9)	62 (9)	1.08 (0.67–1.73)	0.76
No information		1 (–)	n.e	n.e
Diagnosis, secondary				
Urinary incontinence	2 (1)	5 (1)	None vs. any:[b]	0.53
Anal incontinence	–	9 (1)	None:1.26	
Pelvic organ prolapse	2 (1)	4 (–)	(0.61–2.63)	
Other pelvic floor dysfunction	6 (2)	11 (2)	Any: ref	
None	288 (96)	661 (96)		
Urinary incontinence type				
Stress UI	108 (36)	260 (38)	Ref	Ref
Urge UI	24 (8)	59 (8)	0.98 (0.58–1.66)	0.94
Mixed UI	72 (24)	160 (23)	1.08 (0.76–1.55)	0.66
Other	13 (5)	18 (3)193 (28)	1.74 (0.82–3.67)	0.15
No information	81 (27)		1.01 (0.72–1.42)	0.95

Data are shown as n (%) for categorical variables and mean and ± SD for continuous variables

n.e. = not estimatable

*Significant at p <5 %

[a] Age and year of referral are continuous variables and thus the reported OR are per 1-unit increase, e.g. comparing a 70-year-old with a 69-year-old for age. Both variables have a piecewise linear association with the outcome on the log-odds scale consisting of two separate domains

[b] There are too few data for separate analyses and thus we tested no secondary diagnosis vs any secondary diagnosis

voluntary PFM contraction. In that study normal voluntary PFM contraction was defined as PFM strength ≥ 3 points on MOS whereas our definition was strong for PFM strength rated > 3 points on MOS. Furthermore, the sample was not comparable regarding diagnosis and age.

Madill et al. [19] reported the effect of PFM rehabilitation on PFM function and morphology in older women. The level of PFM strength at baseline was measured by digital vaginal palpation with a mean value of 2.7 (SD 0.7) on MOS, which compares with our low level of 1.5 (SD 1.0). Similarly higher levels of PFM function in the sample have been seen in several reliable studies of MOS in women with UI [2, 5]. As far as the authors know, no studies have been published including samples with the level of PFM function below 2 points measured on MOS.

In this study it was seen that the ability to perform correct PFM contraction decreased with age for patients older than 65 years. In a study aiming to determine the PFM function in hospitalised elderly women with UI, Talasz et al. [20] reported that patient age correlated negatively with PFM function ($p <$ 0.001). However, the authors did not report on which measurements this result was based; thus, the study does not reveal

Table 4 Associated factors for 993 women with pelvic floor dysfunction referred for a pelvic floor muscle training programme, between weak and strong pelvic floor muscle strength. Unadjusted odds ratios for probability of high pelvic floor muscle strength

Factors	Low PFM strength (< 4 on MOS), *n* = 959 *n* (%)	High PFM strength (≥ 4 on MOS), *n* = 34 *n* (%)	OR (95 % CI)	*P* value
Age, years[a]	56 (13)	54 (13)	0.99 (0.96–1.02)	0.46
Year of referral[a] per 1-year increase	2000.64 (4.11)	2002.91 (4.59)	1.00 (1.00–1.01)	<0.01*
Nationality				
Danish	888 ((93)	31 (91)	Ref	Ref
Turkish/Pakistani	54 (6)	2 (6)	1.06 (0.25–4.55)	0.94
Other	14 (1)	1 (3)	2.05 (0.26–16.06)	0.50
No information	3 (−)	.	n.e	n.e
Diagnosis, primary				
Urinary incontinence	727 (76)	28 (82)	Ref	Ref
Anal incontinence	36 (4)	0	n.e	n.e.
Pelvic organ prolapse	108 (11)	3 (9)	0.72 (0.22–2.41)	0.60
Other pelvic floor dysfunction	87 (9)	3 (9)	0.90 (0.27–3.01)	0.86
No information	1 (−)	0	n.e.	n.e.
Diagnosis, secondary				
Urinary incontinence	7 (1)		n.e	n.e
Anal incontinence	9 (1)			
Pelvic organ prolapse	6 (−)			
Other pelvic floor dysfunction	17 (2)			
No information	920 (96)	34 (100)		
Urinary incontinence				
Stress UI	361 (38)	11 (32)	Ref	Ref
Urge UI	79 (8)	5 (15)	2.08 (0.70–6.15)	0.19
Mixed UI	222 (23)	10 (29)	1.48 (0.62–3.54)	0.38
Other	28 (3)	3 (9)	3.52 (0.93–13.34)	0.06
No information	269 (28)	5 (15)	0.61 (0.21–1.78)	0.36

Data are shown as *n* (%) for categorical variables and mean and ± SD for continuous variables

n.e. = not estimatable

*Significant at $p < 5$ %

[a] Age and year of referral are continuous variables and thus the reported OR are per 1-unit increase, e.g. comparing a 70-year-old with a 69-year-old for age. Both variables have a linear association with the outcome on the log-odds scale

whether or not age was associated with ability to perform the correct PFM contraction.

As our study showed that the ability to perform correct PFM contraction decreased with age it was a pity that those measurements were not reported by the above-mentioned studies. We shall recommend this in future studies to confirm this correlation.

The ability to perform correct PFM contraction was seen to increase for referring women after 2000. We do not have any explanation for this correlation.

Several limitations have to be considered. The first limitation is the different definition of the term "PFM function". Some authors measure maximum PFM strength as PFM function, while others measure PFM strength and endurance [2, 19] and Brækken et al. [21] measure PFM strength, endurance and vaginal resting pressure. A second limitation is the different methods of measurement, which makes it difficult to compare studies. A third limitation may be the reliability of the three PFM measurements. Ferreira et al. [5] evaluated the inter-rater reliability of the MOS; they did not support the use of MOS as a reliable and valid method for measuring and differentiating PFM strength. However, in that study the women were younger (mean age 23.7 years) and had no gynaecological complaints or diseases.

As far as the authors know, no validity or reliability studies of these three PFM measurements in women with PFD have been published. These measurements need further study to develop a tool that can be used by researchers [5].

Finally, it appears that registration of some demographic and gynaecological data (i.e. body mass index, duration of

education, smoking, co-morbidities and past gynaecological history) was not systematically performed in this study, which could have influenced the results.

The main strengths of this study were the large sample size, systematic measurement, standardised test procedure and the fact that all measurements were performed by the same two physiotherapists.

Conclusion

The results showed that the majority of women with PFD referred to in-hospital PFMT by gynaecologists and urologists were unable to perform the correct voluntary PFM contraction and almost all women showed low PFM strength regardless of age, nationality, diagnosis and type of urinary incontinence.

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