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Pelvic Floor Dysfunction in Women: Tackling Barriers

Dissertation for the degree of doctor in Medical Sciences at the University of Antwerp to be defended by

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Voor Erik, Céline en Ben…

Everyone wants to live on top of the mountain, but all the happiness and growth occurs while you are climbing it.

Andy Rooney

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GENERAL INTRODUCTION

One change leaves the way open for the introduction of others.
Nicollo Machiavelli

CHAPTER 1 General introduction

1.1 Pelvic Floor Dysfunction: Definition, risk factors, impact and costs

The **pelvic floor** is a compound structure, which closes the bony pelvic outlet. The pelvic floor consists of different layers, the most cranial being the peritoneum of the pelvic viscera and the most caudal in women being the skin of the vulva and perineum (1) . The term **pelvic floor muscles** (PFM) refers to the muscular layer of the pelvic floor. The striated muscles of the pelvic floor are divided in three muscular layers. The deep layer or pelvic diaphragm, consists of the bilateral levator ani muscles formed from three muscle components: the puborectalis, the pubococcygeus, and the iliococcygeus muscles. The middle layer or urogenital diaphragm, contains the deep transverse perineal muscle and the external urethral sphincter muscle. And the most superficial perineal layer contains the superficial perineal muscle, the bulbo and ischiocavernosus muscles and the external anal sphincter. All these muscles together, combined with associated connective tissue, seal off the lower aspect of the pelvic cavity. The muscular layer is attached to the pelvic bones. Urethra, vagina, and rectum pass through the pelvic floor and are surrounded by the PFM.

The **innervation** of the pelvic floor remains controversial but the pudendal nerve is one of the major nerves that innervates the pelvic floor muscles, including the external urethral sphincter, and anal sphincter and it also participates in sensory innervation of the perineum (2). It is composed of fibers originating from the S2, S3, and S4 segments of the spinal cord. It exits the pelvis through the major isschiadic foramen, crosses the isschiadic spines, and enters the pelvis again through the minor isschiadic foramen. After running in Alcock's Canal, it splits into the inferior rectal nerve, the perineal nerve, and the genital nerve (3).

At this moment, there is still no existing international agreement on terminology of pelvic floor muscle (dys)**function**, but the contribution of the PFM is known to be important in several mechanisms, which include: the continence mechanism, support mechanisms of pelvic organs, core stability, sexual arousal and performance mechanism, and in maintaining optimal intra-abdominal pressure.

Figure 1. Female pelvic floor.

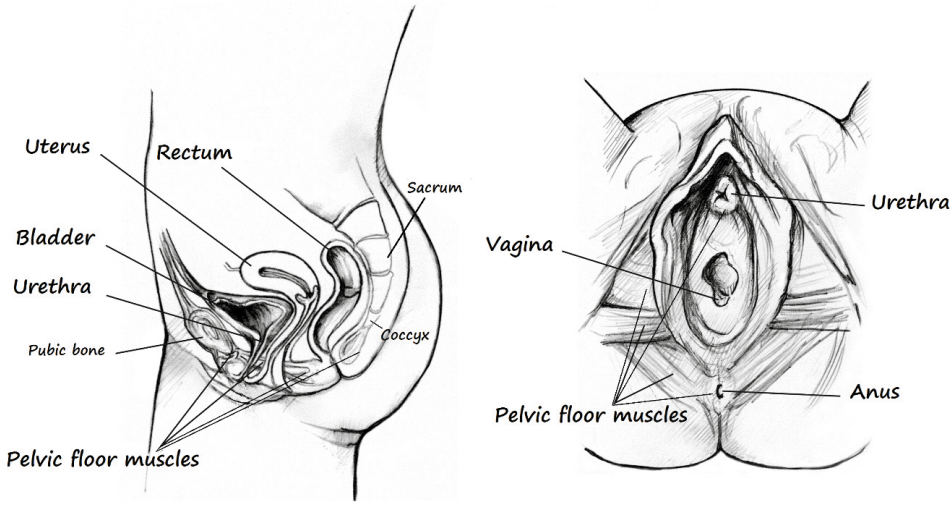
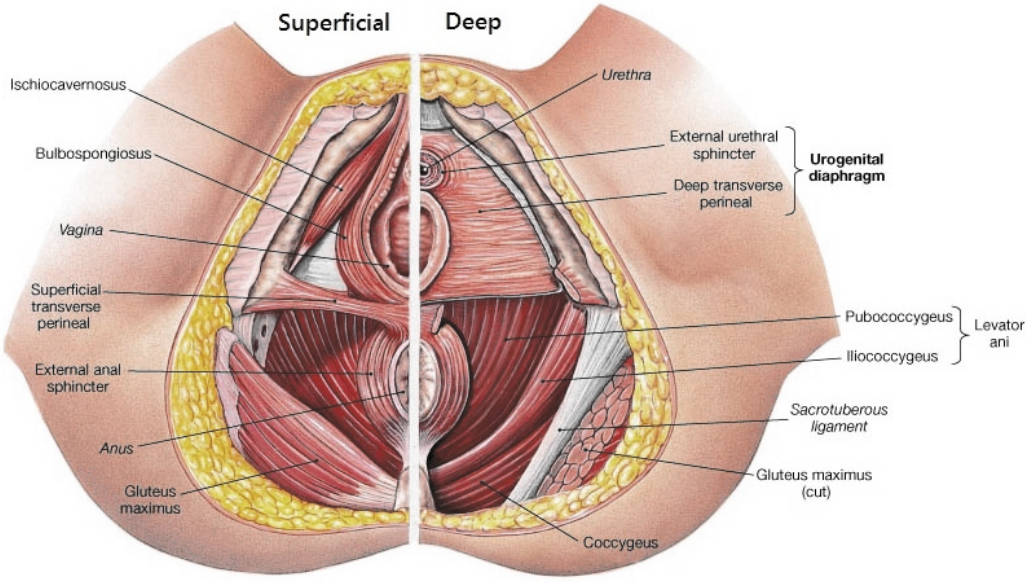


Image modified by H.Neels from NIH/NIDDK library. Parts of the bladder control system.

Figure 2. Female pelvic floor muscles



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Voluntary pelvic floor muscles **contraction** (PFMC) results in a ventral and cranial movement of the perineum and the pelvic organs caused primarily by the vaginal and rectal parts of the levator ani (4). The sphincters of the urethra, anus, and the vagina close; and, due to the detrusor-sphincter reflex, detrusor activity is inhibited.

Pelvic floor muscle **relaxation**, on the contrary, results in a reduction in the support given to the urethra, vagina, and anus. The perineum and the pelvic organs remain in the anatomical resting position. The PFM must relax in order to remove the passive continence mechanisms, thereby allowing normal micturition and normal rectal emptying.

Both terms pelvic floor training (PFT) and **pelvic floor muscle training** (PFMT) are defined as repetitive selective voluntary contraction and relaxation of the pelvic floor muscles (4).

Pelvic Floor Dysfunction (PFD) may occur when the PFM are either too weak, too tight, damaged or are incorrectly used, or there is an impairment of the sacroiliac joint, lower back, coccyx, or hip joints.

According to the **International Classification of Functioning, Disability and Health** (ICF), the causes of a non-optimal functioning pelvic floor (e.g. muscle and nerve damage after birth) can be classified as the pathophysiological component. Non-functioning PFM are the impairment component, and the symptoms of PFD (e. g. urinary incontinence, anal incontinence, pelvic organ prolapse) are disability. How these symptoms affect the woman's quality of life and participation in daily life and physical activities is an activity or participation component.

Pelvic floor dysfunction symptoms (disability component) are divided into nine groups: urinary incontinence symptoms, bladder storage symptoms, sensory symptoms, voiding and post micturition symptoms, pelvic organ prolapse (POP) symptoms, symptoms of sexual dysfunction, symptoms of anorectal dysfunction, lower urinary tract pain, and/or other pelvic pain and lower urinary tract infection (5). Whereas urinary incontinence (UI), anal incontinence (AI), fecal incontinence (FI), flatal incontinence, pelvic organ prolapse (POP), straining to defecate, constipation, feeling of incomplete (bowel) evacuation, perineal pain, and dyspareunia are only some of the possible complaints. The terms AI and FI are frequently used mixed up but AI is the broader term, because it includes the involuntary loss of feces or flatus. Definitions of these

terms according the International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Floor Dysfunction are presented in the List of Abbreviations and Definitions (5).

Etiological factors causing PFD in women are diverse and were in the past divided in either predisposing, inciting, promoting, or decompensating factors (6). The most common risk factors for PFD in general include age, parity, complicated vaginal deliveries, obesity, hysterectomy, respiratory problems and menopause. Smoking, diabetes, collagen-related disorders, white ethnicity and constipation are also associated with a higher risk on PFD (7-10). Delancey et al. later developed a more accurate Lifespan model for Pelvic Floor Disorders. They describe three phases of the pelvic floor function over a woman's life: in the first phase, women's pelvic floor function is inherent to predisposing factors (e.g., growth and development, gender, genetic); in the second phase they can get exposed to inciting factors (e.g., birth induced changes, nerve damage, radiation); and in the third phase intervening factors (e.g., age-related changes, chronic constipation, obesity, diabetes, occupations that involve heavy lifting, or conditions that elicit heavy coughing, such as chronic bronchitis) can accelerate the loss of pelvic floor function over the course of a woman's lifespan (PFD) (11).

UI and FI also have a negative **impact** on psychosocial, personal, and economic wellbeing of the affected women (12). Thus, according to the ICF classification, another health component (participation) is involved. PFD has a negative impact on the quality of life (QOL) (13) and impairs social activities. UI and AI can lead to refrainment from physical activity and sports participation (14-17).

Complaints such as UI and FI can impose a significant burden on the women who have them; but despite its high prevalence, only a minority of the women that suffer from PFD receives a routine inquiry about PFD and is advised to seek help (18). PFD is a **taboo** and women fear talking about it (19); embarrassment has proven to be the most important impediment for seeking help (14, 20).

The **economic impact** of PFD on the health care system and to the individual patient can be substantial. For incontinence care the majority of expenditures (55-70%) is attributed to routine care **costs** (including pads, diapers, laundry, and dry cleaning) (21, 22). US Women with severe incontinence pay about $900 per year out-of-pocket

for routine incontinence care (23). Over $16 billion are spent annually worldwide, an amount that continues to grow (22, 24) . As the population ages, health care utilization for PFD is predicted to grow (25, 26).

1.2 Pelvic floor dysfunction related to pregnancy and delivery

Pregnancy and delivery are two of the most important causal factors for PFD resulting in stretch and rupture of peripheral nerves, connective tissue, and the PFM (7, 11). Furthermore, the prevalence of PFD increases with increasing parity (27). Vaginal childbirth is probably the most important one and results in the combination of some or all of the following PFD conditions: UI, AI, or POP (28, 29). More than 46% of women acknowledge having some form of PFD after delivery (7). Up to 64% of pregnant women experience UI during pregnancy (30); about a third have UI after childbirth; up to 10% AI (31, 32), and about 50% of women lose some of the supporting function of the pelvic floor (33). Lifetime risk of such problems is even higher and reaches worrisome proportions in later life. It is a common indication for pelvic surgery (7).

Factors known to be associated with a greater risk of postpartum PFD include vaginal delivery (in the short term), previous UI, hereditary factors (such as pelvic anatomy, connective tissue structure, and family history of PFD), age at birth of the first child, BMI, baby's weight and head circumference, and maternal height (if <160 cm and baby >4 kg)(7, 34, 35).

1.2.1 Urinary incontinence

The prevalence of UI increases with the onset of pregnancy and decreases following delivery, although postpartum prevalence still remains higher than before pregnancy (31). Prevalence estimates during pregnancy rise to 64% ; and to 38% three months after delivery (30, 36). Presence of UI in the postpartum period is a risk factor for UI even 12 years after delivery (37).

Regarding UI, caesarean delivery could be considered a somewhat protective factor at 12 years after delivery. Women who deliver exclusively by caesarean section were less likely to have UI in comparison with women delivered vaginally (vaginal delivery 55% vs. caesarean 40%). A similar reduction is seen at 20 years after delivery in primiparous women (vaginal delivery 40.3% vs. caesarean 28.8%) (34, 38). But there

is still insufficient evidence that caesarean delivery prevents the development or exacerbation of PFD. Present data indicate that it is necessary to perform eight or nine caesarean sections in a patient group to avoid one case of UI (34).

1.2.2 Fecal incontinence

Anal incontinence, (AI) including fecal incontinence (FI) and flatus incontinence, troubles up to 16% of women during pregnancy and is an important source of embarrassment (39, 40). After delivery women may also experience involuntary loss of solid stool, liquid stool, or flatus (wind). AI is less common than UI, but is particularly distressing both psychologically and physically (19). AI has a significant impact on quality of life (41, 42). It has a negative impact on the participation component (ICF-classification) of the affected women.

The prevalence of FI after delivery is approximately 8% (43, 44). But up to 25% of parous women experience FI within the first six months postpartum (45, 46).

There is good evidence that the incidence of obstetric anal sphincter injury (OASI) is a major risk factor for AI and FI. Instrumental deliveries (using vacuum or forceps) have been showed to induce PFD, with forceps as the biggest threat to the PFM (29, 38, 47). The diagnosis of OASI is increasingly common. If endoanal ultrasound is done properly and so-called “occult” OASI are considered, the prevalence for primiparous women is 29.2% (48). Prevalence of FI can increase from 17% to 62% if there has been severe perineal trauma at classic vaginal or forceps delivery (49).

Regarding FI, the role of caesarean delivery for the prevention is a topic of debate. Research findings suggest no difference in long-term rates of FI when caesarean or classic vaginal delivery is performed (7, 46). Primary sphincter repair immediately after delivery is an important preventive measure. But the incidence of AI remains high (up to 50%) in the affected women, even after repair (50).

1.2.3 Pelvic organ prolapse

Pelvic organ prolapse (POP) after delivery is difficult to study. Significant variation exists in the prevalence and incidence of POP after delivery and how the outcomes are reported (51). Moreover many women with prolapse are asymptomatic. But operative vaginal delivery with forceps appears to double the risk of developing POP, whereas vacuum delivery would not increase the risk (52, 53).

Caesarean delivery is associated with a reduced risk of POP 12 years after delivery (vaginal delivery 29% vs. caesarean 5%)(54). In primiparous women, symptoms of POP 20 years after delivery were doubled after vaginal delivery (34).

1.2.4 Female sexual dysfunction

Female sexual dysfunction (FSD) is another serious maternal morbidity in women during pregnancy and the postpartum period (55). Dyspareunia (superficial or deep), obstructed intercourse, and vaginal laxity, are some of the symptoms associated with attempted or complete vaginal penetration (5). A high proportion of women (47%) reported sexual dysfunction symptoms six months postpartum (56). Obstetric intervention (specifically vacuum extraction and caesarean section) has shown to be associated with persisting dyspareunia in women up to 18 months postpartum (57).

1.3 Pelvic Floor Muscle Training (PFMT)

Prevention of PFD should be discussed with every pregnant woman as part of her routine antenatal care. The International Consultation on Incontinence (ICI) and the recent joint statement on PFM exercise from the Royal College of Midwives and the Chartered Society of Physiotherapy (UK) confirm that **prevention** should include pelvic floor muscle training (PFMT) during pregnancy and postpartum. In addition, they advise lifestyle modification such as avoiding smoking, maintaining normal BMI before and after pregnancy, and avoiding constipation (58, 59). Pregnant women without prior UI who perform PFMT during pregnancy (starting from around 20 weeks) were less likely to report UI during pregnancy (56% less likely) and up to 6 months postpartum (30% less likely) (58, 60).

PFMT is also recognized as the **first-line treatment** for UI and FI after delivery (58). Postnatal women with persistent UI three months after delivery and who received PFMT were less likely to report UI 12 months after delivery than women who did not receive PFMT or who received usual postnatal care without exercises for the PFM (about 40% less). The more intensive the PFMT program is, the greater the therapeutic effect. Individually learned PFMT have shown to be beneficial and show a better adherence (61, 62). As several studies have also reported a significant positive effect

of PFMT on symptom reduction after OASI and after levator ani avulsion, women should be advised to begin PFMT as soon as possible after OASIS (63-66).

Long-term effectiveness of PFMT on FI and POP require further testing (61). The possible lack of long-term benefit is probably due to the diminishing adherence on the long term. The effect of any training program will reduce with time, if the exercises are not continued (67).

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2

AIMS AND OUTLINE OF THE RESEARCH

Prevention is the daughter of intelligence.
Walter Raleigh

CHAPTER 2 Aims and outline of the research

2.1 Aims

Prevention includes a wide range of activities — known as “interventions” — aimed at reducing risks or threats to health. In this research we aim to address prevention of Pelvic Floor Dysfunction (PFD) in women.

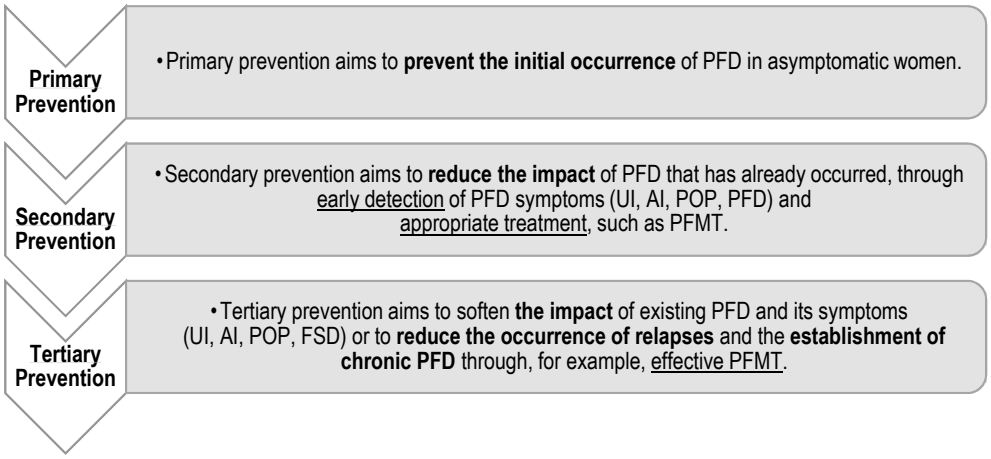
Unfortunately, **pregnancy and delivery**, two of the most beautiful and amazing challenges during the female lifecycle have been demonstrated to be part of the most important risk factors for PFD. Because preventing exposure to these hazardous challenges is of course not an option, other preventative strategies should be found.

According to the Worth Health Organization (WHO)(1), disease **prevention** covers measures not only to prevent the occurrence of disease, such as risk factor reduction, but also to arrest its progress and reduce its consequences once present. **Primary prevention** aims to prevent the initial occurrence of a disorder. **Secondary prevention** aims to reduce the impact of a disease or injury that has already occurred through early detection and appropriate treatment; and **tertiary prevention** aims to soften the impact of an ongoing disease and its effects or to reduce the occurrence of relapses and the establishment of chronic conditions through, for example, effective rehabilitation. *Figure 1 presents the prevention of PFD according to the WHO Definitions.*

Although Pelvic Floor Muscle Training (PFMT) has been proven to be effective in the prevention and treatment of PFD in women during pregnancy and after delivery (2), the lifetime prevalence of PFD remains high. This raises questions about possible obstacles or barriers to the prevention and treatment of PFD.

The aims of this research were to study some of the **possible barriers** of PFMT in the prevention of PFD and to tackle those barriers by proposing **new strategies** to improve primary, secondary, and tertiary prevention of PFD.

Figure 3. Prevention of PFD according to WHO Definitions



PFD= Pelvic Floor Dysfunction; UI= Urinary Incontinence; AI= Anal Incontinence; POP= Pelvic Organ Prolaps; FSD= Female Sexual Dysfunction

2.2 Outline

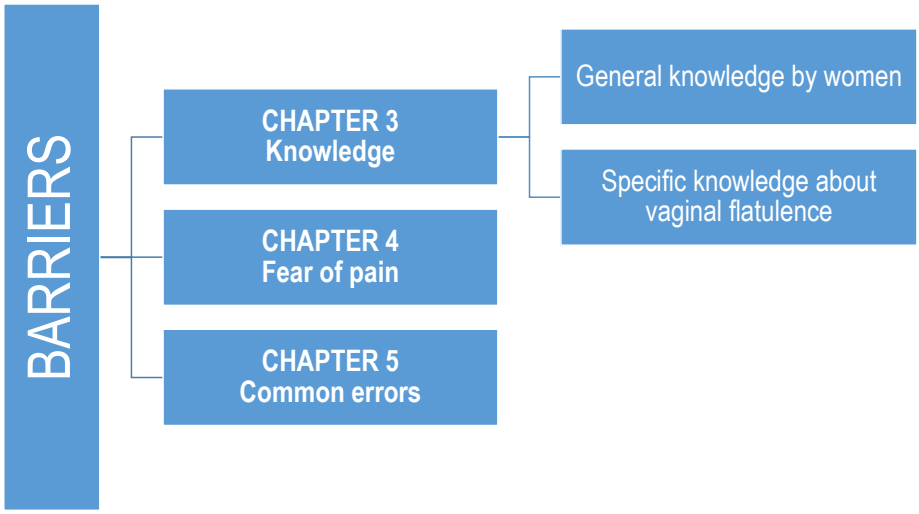
The outline of this research is based on three possible barriers to prevention of PFD in women. All research questions are focused on one of those three barriers. While chapter one and chapter two introduce the reader to this research and clarify the aims and outline, chapter three focuses on the influence of **knowledge** of PFD. Chapter four studies the effect of **fear of pain** on PFD and chapter five addresses the most **common errors** performed during PFMT.

The results of these studies are discussed in chapter six; new strategies to tackle the barriers are proposed and future perspectives and research questions are presented.

A more detailed outline, including the research questions of this research, is given below.

2.3 Barriers to prevention of PFD in women

Figure 4. Outline of the research: Barriers to the prevention of PFD in women



2.3.1 Knowledge

2.3.1.1 General knowledge by women

Insufficient knowledge and misperceptions about PFD have proven to be some of the largest barriers to seeking care (3). Current guidelines in perinatal care emphasize that women need to know the real risks and possible outcomes of pregnancy and delivery before embarking on this—mostly—very natural process, which can be associated with medium- to long-term pelvic floor damage (4).

No significant research has previously been performed to define the general knowledge that women have about the pelvic floor muscles and their function. Therefore, the following research questions were studied in chapter 3:

- What is the current knowledge women have about the pelvic floor muscles and their function?
- What is the difference in knowledge women have about the pelvic floor muscles and their function, compared by age groups?
- Are women interested in knowing more about the pelvic floor muscles and their function?

2.3.1.2 Specific knowledge about vaginal flatulence

In the medical literature, vaginal flatulence is often not included in the variety of symptoms that are described with PFD. Little is known about vaginal flatulence, but from anecdotal reports from urogynaecologists and physiotherapists, it is a consistent and underreported problem for postpartum women. Therefore, chapter 3 gives a systematic literature review of vaginal flatulence.

2.3.1 Fear of pain after delivery

Perineal pain is defined by the International Continence Society as the complaint of pain felt between the posterior fourchette (posterior lip of the introitus) and the anus (3, 4). Recent research found a high prevalence of perineal pain postpartum, ranging from 74% to 90% (59, 60). Other research found that early onset (during the first month postpartum) of PFMT is recommended after vaginal deliveries (57). To the best of our knowledge, the influence of perineal pain on the onset of PFMT has not been previously studied. Therefore, the following research questions were studied

in chapter 4:

- Are pelvic floor muscle contractions (PFMC) provoking perineal pain in women shortly after delivery and nine weeks later?
- What is the influence of pain on PFMC in women shortly after delivery and nine weeks later?

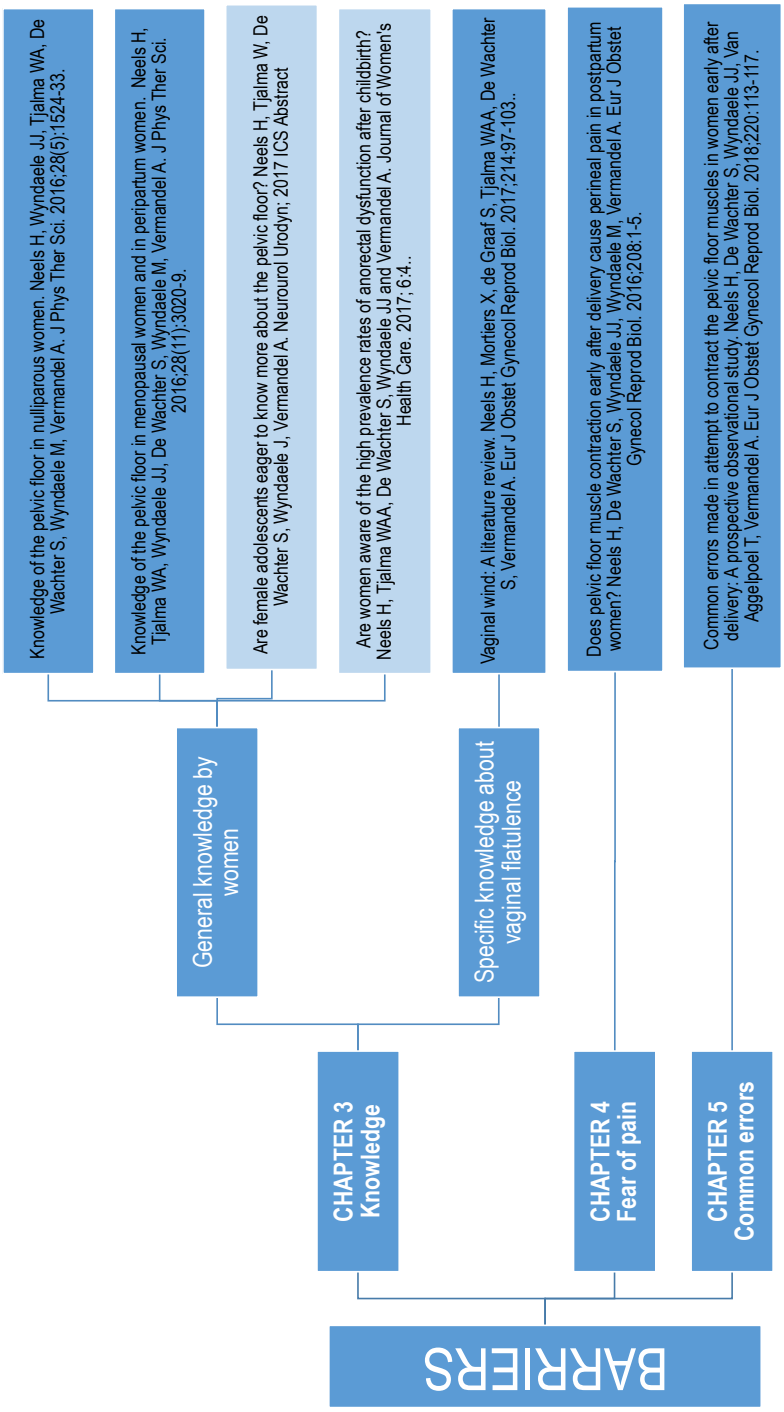
2.3.2 Common errors performed during a pelvic floor muscle contraction after delivery

Prevention of PFD should include PFMT, and all women should be advised to perform PFMT postpartum to prevent or treat PFD. This has been recommended by the International Consultation on Incontinence (4, 5). Boyle et al. concluded that the beneficial effect of PFMT augmented with increasing intensity of an individually guided exercise program (2). Mathé et al. recently concluded that rehabilitation should be carried out by a physiotherapist specialised in perineology (6). Instead of focusing on the caregiver, other research found that 33% of all postpartum women assessed were not able to perform a correct pelvic floor muscle contraction (PFMC)(7). **COMMOV** is

an acronym for the "**C**"ontractions of "**O**"ther "**M**"uscles and other "**MOV**"ements that can take place during PFMT. For example, the contraction of other muscles might involve the m. rectus abdominus, the gluteal muscles, and the adductors and other movements could include pelvic tilt, breath holding, and straining. These so called COMMOV could be an "obstacle" or "impediment" to the performance of a correct PFMC, which is the basic exercise in PFMT. Therefore, the following research questions were studied in chapter 5:

- What is the prevalence of COMMOV performed in addition to or instead of the PFMC immediately after childbirth?
- Does the performance of COMMOV influence the performance of a correct isolated PFMC?
- Is verbal feedback effective in unlearning COMMOV?

Figure 5. Output of the research: Barriers to the prevention of PFD in women



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3

KNOWLEDGE

Knowledge of the pelvic floor in nulliparous women.

Knowledge of the pelvic floor in menopausal women and in peripartum women.

Are women aware of the high prevalence rates of anorectal dysfunction after childbirth?

Are female adolescents eager to know more about the pelvic floor?

Vaginal wind: A literature review.

If you can't explain it simply, you don't understand it well enough.
Albert Einstein

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Original Article

Knowledge of the pelvic floor in nulliparous women

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Abstract. [Purpose] Proper pelvic floor function is important to avoid serious dysfunctions including incontinence, prolapse, and sexual problems. The current study evaluated the knowledge of young nulliparous women about their pelvic floor and identified what additional information they wanted. [Subjects and Methods] In this cross-sectional survey, a validated, 36 item questionnaire was distributed to 212 nulliparous women. The questionnaire addressed demography, pelvic floor muscles, pelvic floor dysfunction, and possible information sources. Descriptive statistics were generated for all variables. Stability and validity testing were performed using Kappa statistics and intra class correlation coefficients to define agreement for each question. The study was approved by the ethics Committee (B300201318334). [Results] Using a VAS scale (0 to 10), the women rated their knowledge about the pelvic floor as a mean of 2.4 (SD 2.01). A total of 93% of the women were insufficiently informed and requested more information; 25% had concerns about developing urinary incontinence, and 14% about fecal incontinence. Many of the women were unaware what pelvic floor training meant. [Conclusion] There was a significant lack of knowledge about pelvic floor function among nulliparous women. The majority of nulliparous women expressed a need for education, which might offer a way to reduce dysfunction.

Key words: Knowledge, Nulliparity, Pelvic floor disorders

(This article was submitted Dec. 14, 2015, and was accepted Feb. 2, 2016)

INTRODUCTION

The pelvic floor (PF) is a well-defined muscular structure that plays a role in several important urological, gynecological, gastroenterological, and pulmonary functions[1–5]. Pelvic floor dysfunction (PFD) can lead to mild or even devastating consequences such as urinary incontinence (UI), fecal incontinence (FI), pelvic organ prolapse (POP) and sexual problems[6]. The major known risk factors that contribute to PFD are pregnancy and childbirth, obesity, chronic obstructive pulmonary disease, and menopause[1, 7–10].

While pelvic floor training (PFT) is very effective to treat deficient pelvic floor muscles (PFM), clinicians should focus on the prevention of PFD[11–13]. Research has suggested that knowledge about PF may be lacking in adult women[9]; therefore, we designed this study to assess women's knowledge. Improvement in knowledge is necessary to influence care-seeking behavior[14] and can improve compliance with PFT treatment recommendations[15]. One study demonstrated that women who attended information sessions were more likely to execute routine pelvic floor muscle exercises[16], which is known to be both

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the first line for the prevention of and treatment for PFD[13].

The primary objective of this research was to evaluate the knowledge of pelvic floor function in young nulliparous women.

SUBJECTS AND METHODS

A descriptive cross-sectional design was used for this study. The study was conducted in a population of young nulliparous (NP) women. Inclusion criteria were women with Dutch proficiency, aged between 18 and 27 years of age, who had never been pregnant. Purposive sampling was performed[17]: participants were recruited from students of non-medical oriented bachelor educations and their friends. Data were recorded anonymously and written informed consent was obtained.

To develop our own questionnaire (Appendix 1), several physicians worked intensively on item generation, reduction, and sampling to redundancy[18], according to 'the Delphi process'[17], during five brainstorming sessions, which were inspired by individual interviews with patients.

The questionnaire consisted of 36 questions: 5 on demographic characteristics, 6 on PF structure and function, 12 on PFD and risk factors, 3 on sexual (dys)function, 4 on PFT, 5 on education and gathering of information, and 1 on concerns about PF. A rendering of a female body was included in order to evaluate the participants' topographical knowledge.

The questions were phrased in a socially and culturally sensitive manner, and complex terminology was avoided. Succinct and unbiased response formats, "open" (free text) as well as "closed" (structured)[18], were used (depending on the information we intended to gather). In addition, indecisive response options (e.g., "I don't know" and "other") were included to enhance the response rates[18, 19]. Five questions were open ended, in order to gather information and thoughts; these answers were divided into categories to report the information. Validity testing was performed through expert opinion from four involved experts (two urologists, one pelvic floor therapist, and one gynecologist), and three independent experts (a gynecologist, a gastroenterologist and a general practitioner) tested the questionnaire for content validity.

Face validity[18] was assessed in a pilot study with 18 independent volunteers, in order to evaluate whether respondents interpreted questions in a consistent manner[20], to judge the appropriateness of each included question, and to record the time required to complete the questionnaire. Test-retest reliabilit and stability testing were performed within a span of 2–4 days to avoid having the subjects learn the answers. Criterion and construct validity were not assessed because no other scales exist with which this questionnaire could be compared.

Descriptive statistics were generated. Stability and validity testing were performed by using Kappa statistics and intra class correlation coefficients to define agreement for each question. SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA) was used. Approval was granted by the local Ethics Committee (B300201318334).

RESULTS

Test–retest reliability: Fifteen participants completed the questionnaire two times. A total of 89% of the questions had a $k>0.80$, indicating perfect agreement, and 9% had a k value between 0.61 and 0.80, indicating substantial agreement. Only 2% of the questions had a $k<0.40$, indicating slight or fair agreement. For the items scored on a visual analogue scale, there was a high agreement (ICC=0.92) between test-retest answers.

The content-validity and face-validity of the questionnaire were assessed by the experts and untrained volunteers. They indicated that the questions were well interpreted, measured what they were intended to, and that the content assessed all fundamental aspects of PFM and PFD. All of the women included returned the questionnaire, for an actual response rate of 100%. The time required to complete the questionnaire ranged from 10 to 20 minutes.

Demographic characteristics of participants: A total of 212 NP women (mean age 21.6; range 18–27 years old) were included. The highest achieved degree of education was Elementary School in two (1%), High School in 106 (50%), and bachelor's or master's degree in 104 (49%). All women were of European nationality, 211 women were of Caucasian race, and one of black race. All had a gravidity and parity status of zero.

Pelvic floor structure and function: Almost all of the NP women (193 [93%]) knew that the PF contains muscles and almost all the women (187 [92%]) located the PF correctly on the figure of the female body. Seventeen (8%) located the PF in the abdomen or at the caput femoris.

Approximately 73% (155) of the participants knew at least one function of the PF, and 43% (91) knew more than one function. The closure function (115 [56%]) and the support function (91 [44%]) were the most widely known functions. Only 20 women (10%) knew about the role of the PF in sexual function.

Almost all participants (190 [90%]) were aware that PFM can be consciously contracted, and most (116 [57%]) answered that they make an inward lifting and/or a pinching movement to contract. Seventy-five NP women (37%) answered that the PFM also involves an outward pushing movement. A great proportion of the women (121 [58%]) did not know how many openings there are in the female PF. Only 13% (28) of the women correctly answered "three" and were able to name them.

The answers to the questions regarding the most important causes of PFD are shown in Table 1. The results of the questions about the knowledge of the pelvic floor, sexual (dys)function, pelvic floor therapy, and education are shown in Table 2. Only a few participants (6 women [3%]) had done PFT before. On a VAS scale from 0 to 10 (0: no knowledge; 10 expert in the domain), the women rated their general knowledge about the PF as a mean of 2.4 (SD 2.01; min 0; max 9.3). The results

on the educational levels of the participants and their interest in additional information are presented in Table 2. Most of the participants (168 [81%]) had never received information about the PF. The participants who had been educated about the PF were informed between the ages of 18 to 20, either at school or from relatives. A quarter of the women (50 [25%]) expressed a concern about urinary incontinence, and 28 (14%) about fecal incontinence.

Table 3 presents the results of the most expected consequences of pregnancy and delivery. Dividing those consequences into three categories—urinary, fecal and sexual—we found that only 9% (19) of the women expected consequences in all three categories. The majority of the participants (153 [89%]) knew that vaginal delivery, prolonged labor, and forceps delivery could be risk factors for PFD. Most of the participants (148 [86%]) thought that a perineal rupture could cause a more severe lesion of the PFM than an episiotomy. Most of the women answered that "the vagina" tears during a perineal tear. For the majority of the participants (158 [75%]) "pelvic organ prolapse" or "sagging in the little pelvis" was unknown. The participants were not aware which organs could descend into the pelvis.

DISCUSSION

The high prevalence rates of PFD in women are an important medical and socio-economical problem[21]. Women are reluctant to seek help even when they have PFD[21]. The present study evaluated the knowledge of nulliparous women about the PFM and their role in PFD, the possible treatment options, and the women's interest in specific education on the topic.

Pregnancy and childbirth have been shown to be important risk factors for PFD in women[1, 10]. Three quarters of young NP women are well aware of at least one of these risk factors and answered that during the 6 months postpartum (PP), these problems would become less frequent than during the immediate PP period, which is realistic. Nevertheless, one out of three participants has no idea (or even a too negative idea) about the prognosis of PFD after childbirth, which is a large proportion. Other researchers have examined this aspect of knowledge about PFD in great deal[22, 23]. In this study, our questionnaire posed the question whether an episiotomy or perineal rupture would cause more damage and results in worse outcomes to the PFM. It appeared that 86% of the participants believed that a rupture has a more negative outcome compared to an episiotomy, which is clearly in contrast to the most recent research evidence[22–24].

Some of the questions were unanswered by a large proportion of the women, e.g. questions about the forceps/spoons, the vacuum delivery, or even prolapse. We suspect these data were missing because the women did not understand the question, as they have no first-hand knowledge of these topics.

Mellville et al. found an interesting relationship between knowledge and behavior; women who believe that the cause of their UI is out of their control (e.g. part of being female, due to childbirth) may believe that nothing can be done to treat it[15]. They did not, however, investigate the influence of prevention. Hermansen et al. showed that 76% of women who experienced UI after delivery were convinced that they had become incontinent due to weakened PFM and because they had not performed sufficient PFM exercises[25]. One may assume that knowledge about PFM and PFD could positively affect care-seeking behavior. Our study shows that young NP women lack such knowledge. Therefore, education about PFM and PFD could be of major importance in NP women, before they become pregnant and deliver.

Our results show that most NP women expect that pregnancy and delivery will have a negative impact on women's sexuality. A great proportion of the women thought that UI and dyspareunia were normal. Most women acknowledged the role of the PFM in the sexual function. Previous research has revealed that women of all ages are not likely to discuss intimate problems such as sexual dysfunction or UI during intercourse[26]. The overall prevalence of dyspareunia and other sexual disorders varies between 4% and 42%[27–29], depending on the source and on the applied definition. The prevalence of sexual dysfunction in women below 30 years was found to be elevated compared to women between 30 and 40 years[30]. Approximately 60% of our participants believed occasional dyspareunia was normal, which is a very high number and indicates that correct health-related information is needed[31]. Nevertheless, we should be careful in our conclusions; the number of

Table 1. Reply to the question "most important causes of pelvic floor dysfunction" N (%)

Vaginal delivery	119 (57.2%)
Pregnancy	104 (50%)
Surgery on urinary tract, uterus or abdominal organs	98 (47.1%)
Obesity	88 (42.3%)
Pushing during voiding	72 (34.8%)
Heredity	57 (27.4%)
Constipation	31 (14.9%)
Abuse of alcohol	16 (7.7%)
Caesarean	11 (5.3%)
Smoking	6 (2.9%)

Number of participants=208 (4 missing).

Table 2. Reply to the questions about pelvic floor, sexual (dys)function, pelvic floor therapy and education

Item/question	N (m)	Results		
		n "I don't know" (%)	n "Yes" (%)	n "No" (%)
Knowledge of Pelvic Floor				
Is conscious control of PFM possible?	212 (0)	20 (9.4%)	190 (89.6%)	2 (0.9%)
Occasional leakage of urine?	211 (1)	28 (13.3%)	69 (32.7%)	114 (54.0%)
Urine leakage during sports?	210 (2)	45 (21.4%)	70 (33.3%)	95 (45.2%)
Precautionary use of a pad?	210 (2)	22 (10.5%)	121 (57.6%)	67 (31.9%)
PFM weakness after delivery?	212 (0)	34 (16%)	169 (79.7%)	9 (4.2%)
Pain after delivery?				
Immediately pp	212 (0)	56 (26.4%)	149 (70.3%)	7 (3.3%)
1 month pp	211 (1)	92 (43.6%)	71 (33.6%)	48 (22.7%)
6 months pp	211 (1)	80 (37.9%)	5 (2.4)	126 (59.7%)
UI after delivery?				
Immediately pp	212 (0)	44 (20.8%)	154 (72.6%)	14 (6.6%)
1 month pp	211 (1)	72 (34.1%)	73 (34.6%)	66 (31.3%)
6 months pp	211 (1)	69 (32.7%)	28 (13.3%)	114 (54.0%)
FI after delivery?				
Immediately pp	212 (0)	51 (24.1%)	76 (35.8%)	85 (40.1%)
1 month pp	212 (0)	52 (24.5%)	4 (1.9%)	156 (73.6%)
6 months pp	212 (0)	45 (21.2%)	2 (0.9%)	165 (77.8%)
Dyspareunia after delivery normal?				
1 month pp	210 (2)	61 (29.0%)	128 (61.0%)	21 (10.0%)
6 months pp	211 (1)	62 (29.4%)	23 (10.9%)	125 (59.2%)
Knowledge about the sexual (dys)function of PFM				
Do the PFM play a role in orgasm?	210 (2)	57 (27.1%)	135 (64.3%)	18 (8.6%)
UI during sexual intercourse?	211 (1)	69 (32.7%)	27 (12.8%)	115 (54.5%)
Occasional dyspareunia?	211 (1)	35 (16.6%)	120 (56.9%)	56 (26.5%)
Continuous dyspareunia?	211 (1)	30 (14.2%)	13 (6.2%)	168 (79.6%)
Knowledge about pelvic floor therapy				
Is prenatal physiotherapy useful?	211 (1)	35 (16.6%)	166 (78.7%)	10 (4.7%)
Is postnatal physiotherapy useful?	211 (1)	17 (8.1%)	188 (89.1%)	6 (2.8%)
Do you know what PFT means?	207 (5)	0	15 (7.2%)	192 (92.8%)
Ever followed PFT?	208 (4)	0	6 (2.9%)	202 (97.1%)
Education and gathering of information about the topic				
Ever received information?	208 (4)	0	40 (19.2%)	168 (80.8%)
Ever searched for information?	205 (7)	0	8 (3.9%)	197 (96.1%)
Sufficiently informed?	205 (7)	0	15 (7.3%)	190 (92.7%)
Interested in more information?	206 (6)	0	191 (92.7%)	15 (7.3%)

N: number of participants, m: missing items, n: number of answers, PFM: pelvic floor muscles, pp: postpartum, UI: urinary incontinence, FI: fecal incontinence, PFT: pelvic floor training

Table 3. Reply to the question "consequences of pregnancy/delivery" N (%)

Urinary incontinence	147 (80.2%)
Pain in the pelvic floor	109 (59.3%)
Pain during intercourse	94 (51.1%)
Gapping vagina	84 (45.9%)
Diminished orgasm during intercourse	39 (21.4%)
Stool problems	26 (14.3%)
Flatulence	18 (9.9%)

Number of participants=183 (29).

questions on sexual dysfunction could have been be too sparse in this survey to create a clear sight on the actual perceptions about this topic in young nulliparous women. In addition, we did not query for cultural and social influences.

Almost all of the women expressed the need for more information, and simultaneously acknowledged that they had not actively searched for information on their own. This might be explained, on one hand, by the small number of PFD that one could expect in such population, and on the other hand, as a sign of the existing taboo about discussing these concerns, which was mentioned above. To the best of our knowledge, no similar research has been performed in a large group of young NP women. However, previous research has revealed that 64% of pregnant women actively consulted at least one source of information about PFD[16], and that information given by a doctor has a profound influence on knowledge and anxiety; women who received information about PFD from their doctor had better knowledge and less anxiety about PFD[32]. In addition, it has been shown that information given verbally has a more profound influence than written information[32]. Education about PFM and PFT was shown to enhance women's knowledge about this topic for longer periods[2, 31, 33–35]. Unfortunately, no comparable information is available in NP women. Surprisingly, the NP women in our study expressed high thrust in pre and post-natal physiotherapy, and at the same time stated that they had very little knowledge about it.

Only a small percentage of the NP women expressed anxiety or fear about pelvic floor dysfunction. This might be a consequence of the lack of knowledge. Previous studies have shown that anxiety can lead to exacerbating complaints and make women more vulnerable to the experience of PFD[36]. The low levels of anxiety among NP women may be reassuring, unless that such fear becomes more serious during actual pregnancy and delivery.

The strengths of our study are the large number of participants, high response rate, and use of an extended, psychometrically validated survey, with open and closed answers, as well as indecisive response options.

We should acknowledge that the results gathered by this study only deliver observational information about the knowledge of these women. For approximately ten questions, a correct answer reflected good knowledge, but for the remaining questions, no clear right or wrong answer existed. We did not collect prospective data about these women. We have reviewed the current literature about possible preventive measures, but with these results, we cannot yet validate the proposed ways of prevention. Therefore, we believe that future research on this topic is necessary to study the best ways to educate NP women, and to determine whether educational campaigns have the intended impact on preventing PFD in women of all ages.

We believe that better general education on this topic is mandatory, preferably given earlier in life (during school), or before women are exposed to PFD risk factors such as pregnancy and delivery (pre-pregnancy education). The main purpose should be to make information easily available and accessible to all.

One shortcoming of this study may be that the participants were almost all highly-educated and medium-educated young women of Belgian ethnicity. Although recent research has revealed that general education is not correlated with good health literacy and disease understanding[37], more research in women with different demographic characteristics would help determine how generalizable our findings are.

This survey in nulliparous women showed poor knowledge and considerable concerns about PF-related function/dysfunction. The vast majority of the women surveyed expressed the need for more information. We believe that women should be better educated in order to promote the implementation of pelvic floor muscle exercises to prevent dysfunctions. Future research should be conducted to assess the most effective ways to deliver education and promote these preventive measures.

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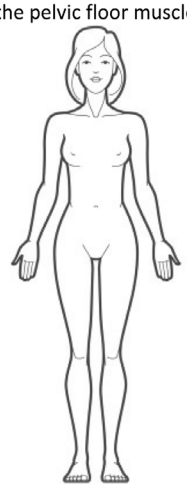
Appendix 1. Questionnaire

Remark for researchers and physicians: The survey's translation provided in English is for information only and has not been tested. Literal translation of the original Dutch version may not convey the meanings intended. To obtain the original psychometrically validated questionnaire please contact the authors.

Dear Madam,
The purpose of this study is to improve the prevention and the treatment of pelvic floor disorders. Through the questionnaire below, we try to explore the current knowledge of women (who have never been pregnant before) about the pelvis and pelvic floor muscles. Therefore we would like you to respond spontaneously to these questions without searching for the correct answers in books or on the Internet.
This survey is completely anonymous and was approved by the Ethics Committee(B300201318334). Completion takes about 20 minutes of your time.
We thank you for your cooperation.

Occasionally we will ask you some open answer questions. Please fill in the thoughts that first come into your mind.

1) How old are you? … years
2) Mark your highest degree of education:
   ☐ Elementary School ☐ High School ☐ University/ College
3) What is your current occupation (profession)?……
4) Nationality: Mark to which group you belong:
   ☐ Belgian ☐ Moroccan ☐ Polish
   ☐ Dutch ☐ Turkish ☐ Others: …
5) Origin: Indicate your native origin:
   ☐ Belgian ☐ Moroccan ☐ Polish
   ☐ Dutch ☐ Turkish ☐ Others:….
6) What is included in the pelvic floor? Multiple answers are possible.
   ☐ Muscles ☐ Tendons and ligaments ☐ Abdominal organs: Uterus, bladder, bowel, kidneys
   ☐ Skin and fat ☐ Arteries and nerves
   ☐ Bone and joints ☐ Other: ……
7) Where can you localize the pelvic floor muscles? Please mark on this graph.



8) What do the pelvic floor muscles do? ☐ I don't know

.....

.....

Why do we need them? ☐ I don't know

.....

.....

9) Is a healthy woman able to control (contract and relax) the pelvic floor muscles whenever she wants?
☐ Yes ☐ No ☐ I don't know

10) Which movement do the pelvic floor muscles make? Please mark, multiple answers are possible.
☐ Pinching movement ☐ Outward pushing movement
☐ Inwards lifting movement ☐ No conscious control possible

11) How many openings do women have in the pelvic floor? ☐ I don't know

.....

Which are they? ☐ I don't know

.....

.....

12) Which are the possible causes of bad functioning of the pelvic floor muscles? Please mark the three most common causes.
☐ Pregnancy ☐ Surgery of to the urinary tract, uterus or abdomen ☐ Caesarean delivery
☐ Heredity ☐ Constipation (blockage of the bowels)
☐ Vaginal delivery
☐ Straining during peeing ☐ Drinking Alcohol ☐ Others: …
☐ Overweight (obesity) ☐ Smoking

13) Does a healthy person occasionally loses urine?
☐ Yes ☐ No ☐ I don't know

14) Does a healthy person loses urine during exercise or effort, such as intensive sports?
☐ Yes ☐ No ☐ I don't know

15) Do you find it normal if women daily use a precautionary pad to control urine leakage?
☐ Yes ☐ No ☐ I don't know

16) Are the pelvic floor muscles not as strong as before, after childbirth?
☐ Yes ☐ No ☐ I don't know

If yes, mark which consequences after childbirth are normal, multiple answers are possible:
☐ Gapping vagina ☐ Pain in the pelvic floor
☐ (Involuntary) loss of urine ☐ Pain during intercourse
☐ Stool problems (blockage, diarrhea, etc.) ☐ Diminished orgasm during intercourse
☐ Flatulence

17) Does a healthy woman experiences pain in the pelvic floor?

Immediately after delivery	☐ Yes	☐ No	☐ I don't know
1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

18) Does a healthy woman occasionally loses urine?

Immediately after delivery	☐ Yes	☐ No	☐ I don't know
1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

19) Does a healthy woman occasionally loses stool?

Immediately after delivery	☐ Yes	☐ No	☐ I don't know
1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

20) Does an average women experiences pain during intercourse?

1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

21) **Circle per line** which way of delivery may have the most negative consequences for the pelvic floor muscles:

- Caesarean Section OR vaginal delivery
- Fast vaginal delivery OR vaginal delivery that takes longer
- Vaginal delivery with episiotomy (cut) OR vaginal delivery with rupture (tear)
- Vaginal delivery with spoons / forceps OR vaginal delivery with vacuum

22) What can be cut or tear during vaginal delivery? ☐ I don't know

.....

.....

23) What does the term "prolapse/sagging in the small basin" means for you? ☐ I don't know

.....

.....

What can prolapse/sag/descend in the small basin? ☐ don't know

.....

.....

24) Do pelvic floor muscles play a role in getting a sexual orgasm?
☐ Yes ☐ No ☐ I don't know

25) Does a healthy woman frequently experiences pain during sexual intercourse?
☐ Yes ☐ No ☐ I don't know

26) Does a healthy woman leaks a little bit urine during sexual intercourse?
☐ Yes ☐ No ☐ I don't know

27) Do you think that prenatal physiotherapy (during pregnancy, before delivery) is useful?
☐ Yes ☐ No ☐ I don't know

28) Do you think that postnatal physiotherapy (after delivery) is useful?
☐ Yes ☐ No ☐ I don't know

29) Do you know the therapy that is given to women with pelvic floor problems? Yes / No

30) Did you ever receive pelvic floor therapy? Yes / No
If yes, why? .....

31) How much do you know about the pelvic floor muscles on a scale from zero to ten, whereas zero is absolutely nothing and ten is expert in the domain? Mark your knowledge with a cross on the horizontal line.
0 ---------- 10

32) Did you ever receive information about the pelvic floor muscles? Yes / No
If yes: When? .....

For which reason? .....

From who/what? - multiple answers or possible -

- ☐ Gynecologist
- ☐ Nurse
- ☐ General practitioner
- ☐ Friends/family
- ☐ Midwife
- ☐ Information Evening
- ☐ Physiotherapist
- ☐ School
- ☐ Others: .....

33) Did you ever search for information about this topic on your own initiative? Yes / No
If yes: Through which source? - multiple answers are possible -

- ☐ Books
- ☐ Internet
- ☐ Gynecologist
- ☐ Physiotherapist
- ☐ Friends/family
- ☐ General practitioner
- ☐ Others: .....

34) Do you find yourself good enough informed about the pelvic floor muscles? Yes / No
35) Do you want more information about the pelvic floor muscles? Yes / No

36) Which is your biggest anxiety or fear about the pelvic floor? ☐ I don't know ☐ None
.....

.....

Thanks for your cooperation!

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Original Article

Knowledge of the pelvic floor in menopausal women and in peripartum women

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Abstract. [Purpose] Pelvic floor dysfunction is an important health-care issue, with pregnancy, childbirth, and menopause as the most important risk factors. Insufficient knowledge about pelvic floor dysfunction is the largest barrier to seeking care. The aim of this study was to investigate the level of knowledge and information on pelvic floor dysfunction in peripartum and menopausal women. [Subjects and Methods] The present study was a cross-sectional survey. A valid and reliable questionnaire of 48 items was distributed to 402 women who were pregnant or had recently given birth and to 165 postmenopausal women. All answers were analyzed and interpreted. The study was approved by an ethics committee (B300201318334). [Results] On a VAS scale of 0 to 10, the mean ratings of the peripartum and postmenopausal women concerning their knowledge were 4.38 (SD 2.71) and 4.92 (SD 2.72). Peripartum women held significantly more pessimistic perceptions about the occurrence of postpartum pelvic floor dysfunction. The results showed that 75% of the peripartum women and 68% of the postmenopausal women felt insufficiently informed or want to get better informed. [Conclusion] The results reveal sparse knowledge about the pelvic floor among women of all ages and that a major proportion of them would be interested in more information. Amelioration of common knowledge could improve help-seeking behavior in women.
Key words: Pelvic floor dysfunction, Women, Knowledge

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INTRODUCTION

Pelvic floor dysfunction (PFD) is present in a wide range of clinical conditions, such as urinary incontinence (UI), anal and fecal incontinence (FI), pelvic organ prolapse (POP), pelvic pain syndromes, sexual dysfunction, and defecation problems[1)]. PFD occurs when the pelvic floor muscles (PFMs) are either too weak or too tight or are incorrectly used. Because of its high prevalence, its invalidating effects on quality of life and its impact on health-related economics, PFD is considered an important health-care issue[2)].

The major known risk factors associated with PFD include pregnancy and childbirth, obesity, menopause, and chronic obstructive pulmonary disease[3)]. Most frequently, vaginal partus and prolonged labor are related to PFD[1, 4)]. Several published guidelines recommend pelvic floor muscle training (PFMT) as a first-line treatment but also as a prevention strategy for PFD[5, 6)]. This type of treatment has become more widely available in many parts of the world, yet the prevalence rates of PDF-related symptoms remain high in adult women, e.g. up to 46% for UI[7, 8)]. Therefore, one can only assume that preven-

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tion and treatment of PFD are not handled as well in women as they could be.

Previous research suggested that insufficient knowledge and misperceptions about PFD are the largest barriers to seeking care[9–11]. Moreover knowledge has been shown to improve compliance with treatment and can induce behavioral changes[12].

Previously, we observed an important lack of knowledge about PFMs and PFD in young nulliparous women[13]. In this survey, we explored whether the knowledge of women about PFMs and PFD differ with age, pregnancy, parity, and menopause. We also aimed to evaluate whether women are satisfied with the information they received on this subject.

SUBJECTS AND METHODS

A written cross-sectional survey was conducted amongst a large group of European women who agreed to participate. Two different groups were included. One group consisted of women in the peripartum (PP) period (from the second half of gestation till the first three months after delivery); the other group consisted of postmenopausal (PMP) women over 50 years of age. Purposive chunk sampling was performed[14]: PP women were recruited during the "Baby Boom fair" in Antwerp (the largest fair for future and young parents), during baby swimming classes, and during stock sales of maternity wear and baby clothes. PMP women were recruited during a lecture organized by "Actual Thinking", a regional association of pluralistic women.

Exclusion criteria were health-care training and lack of Dutch proficiency. Participants filled in the questionnaire immediately after receiving it and returned it immediately after filling it in.

The Human Research Ethics Committee of the University Hospital of Antwerp (Belgium) approved the study (B300201318334); data were recorded anonymously, and written informed consent was obtained from all the participants.

A literature search could not identify existing psychometrically tested questionnaires that could answer the research questions of the current study. Therefore, a new questionnaire was developed, through item generation, reduction, and "sampling to redundancy", according to "the Delphi process"[14, 15]. The questionnaire was based on that developed for nulliparous women[13], though 5 questions were added to collect data about gravidity, parity, and menopause. The questionnaire consisted of 48 questions: 5 on demographic characteristics, 5 on gravidity and parity, 1 on menopause, 6 on PF structure and function, 12 on PFD and risk factors, 3 on sexual (dys)function, 4 on PFT, 5 on education and gathering of information about this topic, and 1 on worries about PF. A female body figure was included to evaluate topographical knowledge (Appendix 1).

The design, wording, form, and order of questions can affect the type of responses obtained; thus careful design was used to minimize bias in the results[16]. Questions were phrased in a socially and culturally sensitive manner, avoiding complex terminology. Succinct and unbiased response formats, "open" (free) and "closed" (structured) text[15], were used (depending on the information we intended to gather). Indecisive response options (e.g., "I don't know" and "other") were included in order to enhance the response rates[15, 17].

Validity was examined by collecting expert opinions from 4 involved experts (2 urologists, 1 pelvic floor therapist, and 1 gynecologist), and 3 independent experts (a gynecologist, a gastroenterologist, and a general practitioner). The questionnaire was evaluated for face and content validity. A pilot study was performed among the target population (22 volunteers) to evaluate whether respondents interpreted questions in a consistent manner[18], to judge the appropriateness of each included question, and to record the time required to complete the questionnaire.

Descriptive statistics were generated in IBM SPSS Statistics 20.0 for Windows (IBM Corp., Armonk, NY, USA). Stability and validity testing were performed by using Kappa statistics and intraclass correlation coefficients (ICC) to define agreement for each question. The χ^2 test was used to analyze the differences between groups, and the Kruskal Wallis test was used for scale parameters. To account for multiple testing, the significance level was set at 0.001.

RESULTS

Test-retest reliability: Sixteen participants completed the questionnaire a second time after 2–4 days. The k value was over 0.80 for 86% of the questions, indicating perfect agreement, and 14% of the questions had a k value between 0.61 and 0.80, indicating substantial agreement. For the one item about knowledge (a visual analogue scale), there was high agreement (ICC single measures 0.92, average measures 0.96) between test-retest answers. Asessement of content and face validity indicated that the questions were well interpreted and gave an accurate measurement of the concept and that the content assessed all fundamental aspects of PFMs and PFD. All women returned the questionnaire, giving a response rate of 100%. The time required to complete the questionnaire ranged from 10 to 20 minutes.

Demographic characteristics and gravidity-parity: A total of 402 PP women (mean age 29.8; 19 to 43 years old) and a total of 156 PMP women (mean age 65.3; 50 to 86 years old) were included (Figs. 1 and 2). The highest achieved degree of education was bachelor's or master's degree in 270 (67%) PP women and 95 (62%) PMP women, high school in 126 (31%) PP women and 55 (36%) PMP women and elementary school in 5 (1%) PP women and 3 (2%) PMP women. The educational degree in the two groups did not differ significantly (p=0.461). All PMP women were of European nationality, as were the majority (99%) of the PP women. Most PP women were Caucasian (385, 96%); 7 (2%) were Asian, and 3 (0.7%) were black. Most PMP women were Caucasian (151, 99%); one PMP woman was black. The majority of the PP women (295 women, 73%) were on average 23 weeks (SD 8.0 weeks) pregnant, and 221 of them were pregnant for the first time (nulliparous

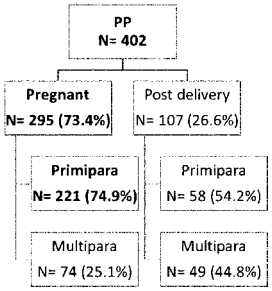

Fig. 1. PP women distributed by current status of pregnancy/post delivery and their number of deliveries (PP, peripartum; N, number of participants)

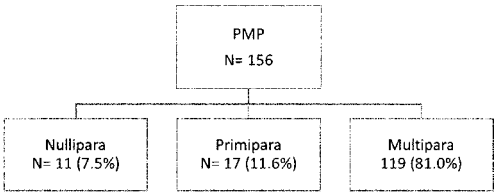

Fig. 2. PMP women distributed by their number of deliveries (PMP, postmenopausal; N, number of participants)

pregnant women). All PMP women declared that they were in the postmenopausal period. Gravidity and parity (G-P) differed significantly ($p<0.001$) between PP and PMP women. PP women had been pregnant once on average (mean 1.05 ± 1.88), and the mean parity was 0.67 (± 0.88); PMP women had a mean gravidity of 2.8 (± 1.60) and mean parity of 2.54 (± 1.29). In PMP women, a significantly higher number of episiotomies (PP women 0.16 ± 0.44; PMP women 1.17 ± 1.24; $p<0.001$) and instrumental vaginal deliveries (PP women 0.010 ± 0.099; PMP women 0.099 ± 0.55; $p=0.001$) were performed.

Pelvic floor structure and function: Differences in knowledge between women based on difference in parity (or experience) and difference in age shown in Table 1. Most PP women (351, 88%) and most PMP women (140, 93%) knew that the PF contains muscles. One-third of PP and PMP women answered that the PF also includes bones, joints, and tendons and ligaments. Furthermore, 75 (51%) PMP women also thought the PF includes arteries and nerves, which was significantly more ($p<0.001$) than the number of PP women (125, 31%). The majority of all participants (370, 92%, PP women; 142, 91%, PMP women) located the PF correctly on the figure of the female body. On the other hand, 30 (8%) PP women and 9 (9%) PMP women located the PF in the abdomen (above the os ileum) or at the caput femoris.

The closure function (181 PP women, 45%; 64 PMP women, 41%) and support function (193 PP women, 48%; 90 PMP women, 58%) were known best. No significant differences between groups were found. Eight (2%) PP and 13 (8%) PMP women knew about the sexual function ($p=0.005$), and 33% (n=133) of PP women and 19% (n=30) of PMP women answered that they did not know what the PFMs do or why we need them ($p=0.003$).

Almost all participants were aware that PFMs could be consciously contracted (380 PP women, 94%; 143 PMP women, 97%). A significant larger proportion (73%, n=114) of PMP women were aware of the squeezing and lifting movement that the PFMs normally makes during an analytic contraction, whereas to 241 (60%) PP women ($p<0.001$) were aware of this.

A great portion of the women (246 PP women, 61%; 61 PMP women, 43%) did not know how many normal anatomical openings there are in the female PF. Only 72 (18%) PP women and 46 (33%) PMP women answered "three" and were able to name them correctly. No significant differences between PP and PMP groups were found, although Table 1 does indicate that nulliparous pregnant women knew significantly less.

Knowledge of PFD: The answers for the questions about the causes of PFD are shown in Table 1. PMP women answered significantly more frequently that obesity and constipation can cause PFD. The results for the questions about the occurrence of PFD are also shown in Table 1. Significant differences between groups were found for the answers for the following questions: "Is it normal that the pelvic floor muscles are not as strong after childbirth as before?" (more PP women answered "yes"), "Is it normal that a healthy woman experiences pain in the pelvic floor after childbirth?" (more PP women answered "yes"), "Is it normal that a healthy woman occasionally loses urine after childbirth?" (more PP women answered "yes"), "Is it normal that an average women experiences pain during intercourse after childbirth?" (more PP women answered "yes" at one month postpartum, and more PMP women answered "I don't know" at 6 months postpartum). A significant greater percentage of PP women answered that UI and pain in the pelvic floor are consequences to expect of a vaginal delivery (Table 1).

Most participants in both groups (203 PP women, 71%; 69 PMP women, 87%) thought that a perineal rupture causes more damage to the PFMs than an episiotomy. Most of them answered that it is "the vagina" that tears during a perineal tear. Furthermore, 90% (n=250) of PP women answered that a vaginal delivery causes more damage to the PFMs than a caesarean, which was a significantly greater portion compared with the proportion of PMP women (77%, n=52; $p<0.001$). A significant difference between groups was found for the knowledge of POP: for 296 (74%) PP women and 76 (49%) PMP women ($p<0.001$) had no knowledge of POP. Finally, 19% (n=76) of PP women and 36% (n=55) of PMP women were able

Table 1. Differences in knowledge between women based on the difference in parity (or experience) and difference in age

Item/ question	Group	N	
Knowledge of PFD			
Number of openings in PF=3**			
	NulliP P	221	Correct, 28 (13%); UK, 151 (68%)
	MultiP PP	181	Correct, 44 (24%); UK, 95 (53%)
	PMP	140	Correct, 46 (33%); UK, 0 (0%)
Causes of PFD: vaginal delivery**			
	NulliP P	221	116 (53%)
	MultiP PP	181	138 (76%)
	PMP	146	80 (55%)
Causes of PFD: constipation**			
	NulliP P	221	15 (7%)
	MultiP PP	181	20 (11%)
	PMP	145	36 (25%)
Fear: for UI (yes answers) / no fear for PFD at all**			
	NulliP P	221	51 (23%)/131 (59%)
	MultiP PP	181	81 (45%)/68 (38%)
	PMP	156	89 (57%)/44 (28%)
Occasional UI normal? (yes answers)			
	NulliP P	221	27 (12%)
	MultiP PP	181	17 (9%)
	PMP	150	25 (17%)
SUI normal? (Yes answers)			
	NulliP P	221	43 (20%)
	MultiP PP	181	29 (16%)
	PMP	151	36 (24%)
Precautionary pad normal? (yes answers)			
	NulliP P	220	94 (43%)
	MultiP PP	181	71 (39%)
	PMP	149	70 (47%)
Diminished force of PFMs after delivery? (yes answers)**			
	NulliP P	219	182 (83%)
	MultiP PP	178	162 (91%)
	PMP	152	110 (72%)
Consequences of pregnancy and delivery: UI**			
	NulliP P	221	162 (73%)
	MultiP PP	181	144 (80%)
	PMP	156	60 (39%)
Consequences of pregnancy and delivery: stool problems**			
	NulliP P	221	35 (16%)
	MultiP PP	180	76 (42%)
	PMP	156	33 (21%)
Consequences of pregnancy and delivery: flatulence**			
	NulliP P	221	16 (7%)
	MultiP PP	181	27 (15%)
	PMP	156	5 (3%)
Consequences of pregnancy and delivery: perineal pain**			
	NulliP P	221	104 (47%)
	MultiP PP	180	85 (47%)
	PMP	156	38 (24%)
Complaints of pain/ UI/ FI/ dyspareunia after delivery: immediately PP/1 month PP/6 months PP			

NulliP P and MultiP PP give similar answers, while PMP expect significantly (**p<0.001) less complaints immediately PP and 1 month PP; at 6 months PP, no significant differences between groups were found (for questions 23–26, see Appendix 1).

to describe which organs could descend in the pelvis.

Sexual (dys)function: No significant differences were found between groups (Table 1). A greater percentage of PMP women answered “yes” while a greater percentage of PP women did not know whether UI during sexual intercourse is normal.

Pelvic floor therapy: No significant difference was found between PP and PMP women in terms of the percentage of women that had ever received pelvic floor therapy (PFT), both being 24%, although results in Table 1 show that PFT was mostly received after the first pregnancy. Nulliparous pregnant women received significantly less PFT. Only those women in the two groups who had received PFT answered that they were aware of the current treatment strategies.

Education and gathering of information: On a VAS scale of 0 to 10 (0, no knowledge; 10, very high knowledge), the mean ratings of the PP and PMP women for their general knowledge about the PF were 4.38 (SD 2.71) and 4.92 (SD 2.72) respectively. The Kruskall-Wallis test revealed a significant difference of p<0.001. Half of the PP women (n=201, 51%) and 61 (43%) of the PMP women never received information about the PF. Table 1 shows a significant difference in received information between nulliparous women who were pregnant for the first time and parous women. There was no significant difference between the proportion of currently pregnant multiparous or post-delivery women who had been informed and the PMP women who had experienced their peripartum period years previously.

Only 14/195 PP women had received PFM information before pregnancy, such as during yoga or Pilates classes, back school, or sporting activities. IN the informed PP women, 93% (n=181) of the informed PP women received the information during their pregnancy or after their delivery. In contrast, 27/80 informed PMP women (34%) received information during their peripartum period. This means that the majority of this group (n=53, 66%, received information about PF in their PMP period and thus at a higher age. A large number of women were interested in more information on the topic (75% of PP women and 68% of PMP women). No significant difference was found between the PP and PMP groups.

Table 1. Continued.

Item/ question	Group	N	
Knowledge about sexual (dys)function related to the PFMs			
Do the PFMs play a role in orgasm?			
	NulliP P	221	117 (53%)
	MultiP PP	181	111 (61%)
	PMP	141	78 (55%)
UI during sexual intercourse normal?			
	NulliP P	221	12 (5%)
	MultiP PP	181	9 (5%)
	PMP	145	19 (13%)
Occasional dyspareunia normal?			
	NulliP P	221	66 (30%)
	MultiP PP	181	52 (29%)
	PMP	146	49 (34%)
Continuous dyspareunia normal?			
	NulliP P	221	4 (2%)
	MultiP PP	180	6 (3%)
	PMP	146	4 (3%)
Knowledge about pelvic floor therapy			
Do you know what PFT means? (no answers)**			
	NulliP P	221	192 (87%)
	MultiP PP	180	123 (68%)
	PMP	135	100 (74%)
Ever received PFT? (yes answers)**			
	NulliP P	221	22 (10%)
	MultiP PP	180	76 (42%)
	PMP	146	35 (24%)
Prenatal physiotherapy useful? (yes answers)			
	NulliP P	221	184 (83%)
	MultiP PP	180	137 (76%)
	PMP	147	124 (84%)

Table 1. Continued.

Item/ question	Group	N	
Postnatal physiotherapy useful? (yes answers)			
	NulliP P	221	196 (89%)
	MultiP PP	181	168 (93%)
	PMP	147	134 (91%)
Education and gathering of information about the topic			
Estimation of knowledge (0–10)**			
	NulliP P	220	3.71 (SD 2.59)
	MultiP PP	181	5.21 (SD 2.62)
	PMP	147	4.92 (SD 2.72)
Ever received information? (yes answers)**			
	NulliP P	219	62 (28%)
	MultiP PP	179	133 (74%)
	PMP	141	80 (57%)
Ever searched for information? (yes answers)			
	NulliP P	221	55 (25%)
	MultiP PP	181	51 (28%)
	PMP	128	46 (36%)
Sufficiently informed? (no answers)**			
	NulliP P	221	178 (81%)
	MultiP PP	180	94 (52%)
	PMP	137	77 (56%)
Interested in more information? (yes answers)**			
	NulliP P	221	195 (88%)
	MultiP PP	180	107 (59%)
	PMP	138	94 (68%)

NulliP P: group of nulliparous pregnant women; MultiP PP: group of multiparous pregnant women and postnatal women (until 3 months post delivery); PMP women: postmenopausal women; UK: unknown (answered with "I don't know"); UI: urinary incontinence; SUI: stress urinary incontinence; PFMs: pelvic floor muscles; PFT: pelvic floor therapy. ** The difference between groups for this item is significant ($p<0.001$)

Worries about PF: The majority (n=89, 57%) of the PMP women expressed a concern about urinary incontinence; this was significantly higher than in the PP group (n=132, 33%). No significant difference was found for fear of fecal incontinence (7 PP women, 12%; 16 PMP women, 10%; p=0.484) or fear of prolaps (26 PP women, 7%; 16 PMP women, 10%; p=0.128).

DISCUSSION

The results of this extended survey show moderate actual knowledge about PFMs and PFD in PP and PMP women. The questionnaire was not constructed to rate the degree of knowledge. The answers could not always be considered wright or wrong. On the contrary, the questions were constructed to reveal better comprehension of the current knowledge and ideas of women about this topic.

To the best of our knowledge, all previous studies have focused on the knowledge of PFMT and not on the general knowledge women have about PFMs and PFD[19, 20]. Mandimika et al. recently investigated the knowledge of UI and POP among a population of community-dwelling woman[10]. Similar to our results, they found a global lack of knowledge about UI and POP among community-dwelling women, with more pronounced knowledge gaps among nonwhite women. Our present study investigated the knowledge of a broad range of all PFD symptoms and compared the results in different phases of life (age groups).

Previously, we observed an important lack of knowledge in young nulliparous women about the PFMs and PFD[13]. Young women who had never been exposed to PFD risk factors such as pregnancy and delivery rated their actual knowledge about these topics as 2.4 ± 2.01/10. The results of the present study reveal slightly better actual knowledge with PP and PMP

women scoring their own knowledge significantly higher (4.4 ± 2.71/10 for PP women and 4.9 ± 2.72/10 for PMP women). Thus we can conclude that the actual knowledge of women about the PFMs and PFD differ with age, pregnancy, parity, and menopause. But it is certainly remarkable that the level of knowledge did not differ significantly between PP and PMP women for most of the questions and that it still remains poor (less than 5/10).

PP and PMP women showed the same trend in acceptance of PFD symptoms after delivery: most women agree that certain PFD symptoms could be considered normal immediately after childbirth but should improve or disappear after 3 to 6 months. Nevertheless, significant differences were found for these questions between the two groups. More PP women accepted PFD complaints. Their illness perceptions about PFD after childbirth were more pessimistic, and this was in agreement with the results found in nulliparous women. In our opinion, it is important to use education about this topic to prevent young women from accepting PFD symptoms and to empower help-seeking behavior.

A significant difference between groups existed with respect to parity. Parity and gravidity were significantly higher in the PMP group compared with the PP group. But the general knowledge about PFMs and PFD did not differ between these groups. This led us to the conclusion that higher numbers of pregnancies and deliveries do not seem to improve knowledge about the PF.

It is remarkable that only half of the PP and PMP women ever received information about the PF and that a majority of them would welcome more information. When information was provided, it was mostly during pregnancy or around delivery in the PP group; most PMP women got information in the postmenopausal period, which is rather late.

The participating PMP women were significantly better aware of PFD risk factors such as obesity and constipation. Similar results were found for POP: PMP women were better aware of this PFD symptom. Better knowledge of these symptoms and contributing factors, at a younger age, could affect help-seeking behavior[10, 19] and positively influence prevention of PFD.

Also, PMP women were significantly more occupied with and in fear of PFD. This may be related to the higher prevalence of PFD in their age group. Information and education about complaints, syndromes, and pathologies has been shown to affect cognition and perceptions[20, 21] of patients about their complaints. Furthermore previous research has also suggested education as a means of avoiding catastrophizing behavior of patients[22].

Information about the PF was received rather late in life, so timely prevention was not possible. This shows that there is work to be done to better inform all women. One can only encourage the trend that we observed that more women these days are already getting informed about this topic during their childbearing years. Nevertheless the results of this study confirm the need to reach more women with good information, and the authors suggest information should be offered repeatedly to ensure it is not forgotten. Improved knowledge about such things as bladder behavior, PFM exercises, and stool habits would likely make a great difference. Further work is needed to determine how such education should be provided and who should provide it.

A shortcoming of the present study may be that the participants were young women of Belgian ethnicity with mid to high levels of education. Previous research revealed better knowledge about urologic topics in white women compared with other races[10, 23]. More research in women with different demographic characteristics could help define how general our findings are.

In 2013, Buurman et al. performed a qualitative research about women's perceptions about PFD and their help-seeking behavior. Several women explicitly mentioned embarrassment as an impediment for seeking help[21]. In general, PF problems are still a taboo for most women. The low number of women in our study that took active steps to get help or information confirms these statements. Our results clearly reveal that the majority of women of all ages are aware of the problem, feel badly informed, and are interested in more information. This is a strong argument further work on improving and intensifying PF education. Future research must investigate how women would like to be informed and which campaigns would be the most effective, with the best compliance.

To conclude, there is sparse knowledge about the pelvic floor among women of all ages. Most postmenopausal women get informed during the postmenopausal period, which is very late. A major proportion of women would be interested in more information. Improving common knowledge about PFMs and PFD could improve help-seeking behavior in women but could also have a role in the prevention of PFD.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Appendix 1. Questionnaire

Remark for researchers and physicians: The survey's translation provided in English is for information only and has not been tested. Literal translation of the original Dutch version may not convey the meanings intended. To obtain the original psychometrically validated questionnaire please contact the authors.

Dear Madam,
The purpose of this study is to improve the prevention and the treatment of pelvic floor disorders. Through the questionnaire below, we try to explore the current knowledge of women (who have never been pregnant before) about the pelvis and pelvic floor muscles. Therefore we would like you to respond spontaneously to these questions without searching for the correct answers in books or on the Internet.
This survey is completely anonymous and was approved by the Ethics Committee(B300201318334). Completion takes about 20 minutes of your time.
We thank you for your cooperation.

Occasionally we will ask you some open answer questions. Please fill in the thoughts that first come into your mind.

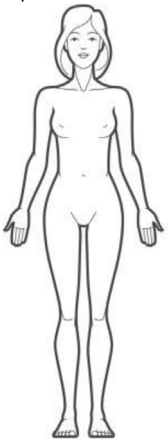
1) How old are you? … years
2) Mark your highest degree of education:
   ☐ Elementary School ☐ High School ☐ University/ College
3) What is your current occupation (profession)?.....
4) Nationality: Mark to which group you belong:
   ☐ Belgian ☐ Moroccan ☐ Polish
   ☐ Dutch ☐ Turkish ☐ Others: …
5) Origin: Indicate your native origin:
   ☐ Belgian ☐ Moroccan ☐ Polish
   ☐ Dutch ☐ Turkish ☐ Others:….

If you have never been pregnant, proceed to question 11 .

6) Are you currently pregnant? ☐ Yes ☐ No ☐ I don't know
   If so: How many weeks are you pregnant now? … weeks
7) How many times have you been pregnant? … times
8) How many times did you give birth already? … times
9) In which year did you last give birth? .....
10) In which ways did you give birth (type of delivery)? And how many times?
    - Vaginal Yes / no … times
      - Did they have to cut? (episiotomy) Yes / no … times
      - Did you tear? (rupture) Yes / no … times
    - Caesarean Yes / no … times
    - Spoons / Forceps Yes / no … times
    - Vacuum extraction Yes / no … times
    - Others: .....

11) Are you currently in transition or in your postmenopausal period? ☐ Yes ☐ No ☐ I don't know

12) What is included in the pelvic floor? Multiple answers are possible.
    ☐ Muscles ☐ Tendons and ligaments ☐ Abdominal organs: Uterus, bladder, bowel, kidneys
    ☐ Skin and fat ☐ Arteries and nerves
    ☐ Bone and joints ☐ Other: .....
13) Where can you localize the pelvic floor muscles? Please mark on this graph.



14) What do the pelvic floor muscles do? ☐ I don't know

.....

.....

Why do we need them? ☐ I don't know

.....

.....

15) Is a healthy woman able to control (contract and relax) the pelvic floor muscles whenever she wants?
☐ Yes ☐ No ☐ I don't know

16) Which movement do the pelvic floor muscles make? Please mark, multiple answers are possible.
☐ Pinching movement ☐ Outward pushing movement
☐ Inwards lifting movement ☐ No conscious control possible

17) How many openings do women have in the pelvic floor? ☐ I don't know

.....

Which are they? ☐ I don't know

.....

.....

18) Which are the possible causes of bad functioning of the pelvic floor muscles? Please mark the three most common causes.
☐ Pregnancy ☐ Surgery of to the urinary tract, uterus or abdomen ☐ Caesarean delivery
☐ Heredity ☐ Constipation (blockage of the bowels)
☐ Vaginal delivery
☐ Straining during peeing ☐ Drinking Alcohol ☐ Others: …
☐ Overweight (obesity) ☐ Smoking

19) Does a healthy person occasionally loses urine?
☐ Yes ☐ No ☐ I don't know

20) Does a healthy person loses urine during exercise or effort, such as intensive sports?
☐ Yes ☐ No ☐ I don't know

21) Do you find it normal if women daily use a precautionary pad to control urine leakage?
☐ Yes ☐ No ☐ I don't know

22) Are the pelvic floor muscles not as strong as before, after childbirth?
☐ Yes ☐ No ☐ I don't know

If yes, mark which consequences after childbirth are normal, multiple answers are possible:
☐ Gapping vagina ☐ Pain in the pelvic floor
☐ (Involuntary) loss of urine ☐ Pain during intercourse
☐ Stool problems (blockage, diarrhea, etc.) ☐ Diminished orgasm during intercourse
☐ Flatulence

23) Does a healthy woman experiences pain in the pelvic floor?

Immediately after delivery	☐ Yes	☐ No	☐ I don't know
1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

24) Does a healthy woman occasionally loses urine?

Immediately after delivery	☐ Yes	☐ No	☐ I don't know
1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

25) Does a healthy woman occasionally loses stool?

Immediately after delivery	☐ Yes	☐ No	☐ I don't know
1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

26) Does an average women experiences pain during intercourse?

1 month after delivery	☐ Yes	☐ No	☐ I don't know
6 months after delivery	☐ Yes	☐ No	☐ I don't know

27) **Circle per line** which way of delivery may have the most negative consequences for the pelvic floor muscles:

- Caesarean Section OR vaginal delivery
- Fast vaginal delivery OR vaginal delivery that takes longer
- Vaginal delivery with episiotomy (cut) OR vaginal delivery with rupture (tear)
- Vaginal delivery with spoons / forceps OR vaginal delivery with vacuum

28) What can be cut or tear during vaginal delivery? ☐ I don't know

.....

.....

29) What does the term "prolapse/sagging in the small basin" means for you? ☐ I don't know

.....

.....

What can prolapse/sag/descend in the small basin? ☐I don't know

.....

.....

30) Do pelvic floor muscles play a role in getting a sexual orgasm?
☐ Yes ☐ No ☐ I don't know

31) Does a healthy woman frequently experiences pain during sexual intercourse?
☐ Yes ☐ No ☐ I don't know

32) Does a healthy woman leaks a little bit urine during sexual intercourse?
☐ Yes ☐ No ☐ I don't know

33) Do you think that prenatal physiotherapy (during pregnancy, before delivery) is useful?
☐ Yes ☐ No ☐ I don't know

34) Do you think that postnatal physiotherapy (after delivery) is useful?
☐ Yes ☐ No ☐ I don't know

35) Do you know the therapy that is given to women with pelvic floor problems? Yes / No

36) Did you ever receive pelvic floor therapy? Yes / No
If yes, why? .....

37) How much do you know about the pelvic floor muscles on a scale from zero to ten, whereas zero is absolutely nothing and ten is expert in the domain? Mark your knowledge with a cross on the horizontal line.
0 ---------- 10

38) Did you ever receive information about the pelvic floor muscles? Yes / No
If yes: When? .....

For which reason? .....

From who/what? - multiple answers or possible -

☐ Gynecologist ☐ Nurse ☐ General practitioner
☐ Friends/family ☐ Midwife ☐ Information Evening
☐ Physiotherapist ☐ School ☐ Others: .....

39) Did you ever search for information about this topic on your own initiative? Yes / No
If yes: Through which source? - multiple answers are possible -

☐ Books ☐ Internet ☐ Gynecologist
☐ Physiotherapist ☐ Friends/family ☐ General practitioner
☐ Others: .....

40) Do you find yourself good enough informed about the pelvic floor muscles? Yes / No

41) Do you want more information about the pelvic floor muscles? Yes / No

42) Which is your biggest anxiety or fear about the pelvic floor? ☐ I don't know ☐ None

.....

.....

Thanks for your cooperation!

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Short Communication OMICS International

Are Women Aware of the High Prevalence Rates of Anorectal Dysfunction After Childbirth?

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Abstract

Urinary and fecal incontinence are common and successful indications for pelvic floor muscle training (PFMT) in the first year postpartum, but it is often not addressed by healthcare providers. Only a minority of the women that suffer from pelvic floor dysfunction (PFD) receives a routine inquiry about PFD and is advised to seek for help. This brief communication highlights the need for healthcare providers to discuss postpartum incontinence symptoms with women.

Keywords: Anal incontinence; Childbirth; Episiotomy; Fecal urgency; Vaginal delivery; Knowledge; Pelvic floor muscle training

Discussion

Pregnancy and childbirth are the most important risk factors that contribute to PFD. Disorders of defecation are undoubtedly the most severe adverse events of PFD associated with childbirth. Anal incontinence (AI), the involuntary loss of flatus, liquid, or solid stool, is a distressing and debilitating condition with considerable impact on occupational, social, and sexual quality of life. Rusavy et al. investigated AI following mediolateral (n=300) or lateral (n=360) episiotomy during a first vaginal delivery [1].

Their study showed AI among 7 and 3% of patients who underwent mediolateral and 7 and 6% of who underwent lateral episiotomy, at respectively 3 and 6 months postpartum. They concluded that AI was comparable between both groups and that the association between lateral episiotomy and fecal urgency merits further scientific interest. Next to the high prevalence of AI after childbirth in primiparous women.

Previous research has showed that nulliparous (n=212) and primigravid (n=221) women have a significant lack of knowledge about the pelvic floor and the risk of PFD postpartum [2,3].

Table 1 shows that the risk of urinary incontinence after delivery is known by most women; but disorders of defecation and flatulence were only known by a minority. The majority of the nulliparous and primigravid women never receive any information about PFD. But almost all women confirm that they are interested to receive more information (Table 1) [2,3].

How much do you know about the pelvic floor muscles on a scale from zero to ten, whereas zero is absolutely nothing and ten is expert in the domain?				
NP (212)	2.4 to 10 (SD 2.01)			
PG (221)	3.7 to 10 (SD 2.59)			
Does a healthy woman occasionally lose stool, immediately after delivery, 1 month after delivery and 6 months after delivery?				
1-5 d PP	NP (212)	51 (24%) Yes; 85 (40%) I don't know	PG (221)	34 (15%) Yes; 63 (29%) I don't know
1 m PP	NP (212)	52 (25%) Yes; 156 (74%) I don't know	PG (221)	2 (1%) Yes; 61 (28%) I don't know
6 m PP	NP (212)	45 (21%) Yes; 165 (78%) I don't know	PG (221)	1 (1%) Yes; 55 (25%) I don't know
Which consequences can you expect after delivery?				
UI	NP (184)	147 (80%)	PG (221)	162 (73%)
Stool problems, AI	NP (185)	26 (14%)	PG (221)	35 (16%)
Flatulence	NP (182)	18 (9%)	PG (221)	16 (7%)

Experience with education and gathering of information on this topic				
Ever received information?	NP (208)	40 (19%) Yes	PG (219)	62 (28%) Yes
Sufficiently informed?	NP (205)	15 (7%) Yes	PG (221)	178 (81%) Yes
Interested in more information?	NP (206)	191 (93%) Yes	PG (221)	195 (88%) Yes

Table 1: Pelvic floor Knowledge of nulliparous women (nulliparous and primigravid group) [d: Days; m: Months; PP: Postpartum; SD: Standard Deviation; UI: Urinary Incontinence; AI: Anal Incontinence; NP: Nulliparous Women; PG: Primigravid Women].

The research about postpartum AI performed and the latest IUGA consensus about anorectal dysfunction in women are a significant aid to clinical practice and a stimulus for research. While the taboo about these PFD is clearly diminishing in scientific research, the performed research highlights the taboo and ignorance that prevails among women about AI [2,3]. Therefore, we emphasize the need of a good education about the pelvic floor and PFD in young women, before they are exposed to the greatest risk factors such as pregnancy and delivery. Education might offer the first way to reduce dysfunction by promoting help seeking behavior, prevention and treatment.

Conflict of Interest

The authors of this brief communication report no conflicts of interest.

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ARE FEMALE ADOLESCENTS EAGER TO KNOW MORE ABOUT THE PELVIC FLOOR?

Neels H, Tjalma W, De Wachter S, Wyndaele J, Vermandel A.
Neurourol Urodyn; 2017; 303. **ICS Award winning Abstract**

Hypothesis / aims of study

Female Pelvic floor dysfunction (PFD) is an important health care issue, because of its high prevalence, its invalidating effect on quality of life and its impact on the health care system. Multiparity, menopause, pregnancy and childbirth are some of the most important risk factors for PFD. Feelings of embarrassment and shame, combined with insufficient knowledge and misperceptions about PFD are the largest barriers to seeking care [1, 2]. PFD remains a taboo topic and is underreported.

The prevalence of PFD in healthy female adolescents (4 to 6% occasionally urinary incontinence) is low [3], but nevertheless, their exposure to the most common risk factors (such as pregnancy and delivery) is approaching while they are growing up to sexual active young females.
Therefore the aim was to investigate the knowledge and the interest of PFD and pelvic floor muscles (PFM) in female adolescents; and through which canals they would prefer to get informed.

Study design, materials and methods

Cross-sectional survey design. A reliable and valid questionnaire was distributed to female adolescents (12-18 years old) in High Schools. All participants and their parents were informed about the research goals and were asked to sign an informed consent form. A small sample received four supplementary questions about the function of the PFM. Descriptive statistics were generated for all variables, Chi-square tests were used.

Results

A total of 399 questionnaires were distributed, the responses of 381 female adolescents (mean age= 15.0, SD= 1.78) were included (response rate 95.5%). 16% (n= 61) of the 381 adolescents ever received information about PFM, mostly during comprehensive sex education on School. A total of 166 (44%) girls wants to receive further information on this topic; 136 (36%) are not interested and 65 (17%) are undecided. 140 (36%) girls answered that they searched for information on their own, through friends or family; while 58% (n= 221) would prefer to be informed through school, in group. A sample of 100 girls were asked if they knew the function of the PFM: 76 (76%) declined, 25 (25%) knew something about the closure; the support and/or the sexual function of the PFM.

Discussion

The test results reveal that most adolescent girls have a lack of knowledge about the PFM function. Most adolescent females were never informed about the PFM and PFD. Although the majority of the adolescents would prefer to get better informed about these topics, through school, in group. We therefore argue that education about the PFM and possible PFD should be introduced during adolescence in High Schools, as first step in primary prevention of PFD later in life. It might also diminish the taboo to talk about it.

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Review article

Vaginal wind: A literature review

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ABSTRACT

Objective: In the medical literature, there is little known about vaginal wind, though from clinical expertise, it turns out to be a consistent and underreported problem. The aim of this review was to collect the available literature about the different aspects of vaginal wind.
Study design: A systematic literature search was conducted using three databases until December 2015. The search strategy was built using relevant synonyms of vaginal wind. Study characteristics were extracted. Risk of bias, the quality of the relevant studies and the level of evidence was judged.
Results: Eleven studies met the inclusion criteria. Vaginal wind occurs on random movements and during or after coitus. The prevalence ranges from one to 69%. The pathophysiology is unclear and the incidence unknown. Known risk factors are vaginal delivery and urinary incontinence. Provoking factors are coitus, digital stimulation, cunnilingus and exercising. Female sexual function is decreased. The sexual function of male partners with vaginal wind is not influenced. Overall vaginal wind leads to a decrease in the quality of live and can have cause social isolation. The treatment is related to the cause and mainly not successful. Tampons can be used for treatment as well as prevention.
Conclusion: Vaginal wind is an underestimated health issue with a severe impact on sexual functioning. Adequate research is needed regarding the influence of sexual activity, weight, age, parity, the underlying pathophysiological mechanisms, prevention and treatment.

Contents

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Introduction

From clinical expertise of pelvic floor therapists and gynaecologists, vaginal wind is a rather frequent complaint. However, in the medical literature, little is known about this problem. Vaginal wind is an embarrassing problem for the patient with an important impact on the quality of life (QoL). It can lead to shame, sexual dysfunction, and even social isolation [1]. More medical attention regarding this complaint is needed in order to improve the care.

The aim of this review is to collect data about all the different aspects of vaginal wind.

Materials and methods

This systematic literature search was performed according the preferred reporting items for systematic reviews and *meta*-analyses (PRISMA) guidelines [2].

Search strategy

The reviewers started with a search for synonyms of vaginal wind. Subsequently, these terms were inserted one by one in three databases (PubMed, MEDLINE, Cochrane Database), to see which of them gave relevant results within the scope of the research question. Based on this, a number of terms were excluded from the research, in particular vaginal flatulence, vaginal gas, vaginal fart, queefing, queef, varting, vart, garrulitas gravita, chattering vulva, fanny fart, and incontinentia vulvae. The criteria for exclusion that were used are language (other than English), intentionally blowing of air in the vagina, enterovaginal fistulas or air embolism as the main subject.

With the following keywords, the search strategy was performed: *"vaginal flatus" OR "vaginal wind" OR "vaginal air" OR "garrulitas vulvae" OR "flatus vaginalis" OR "vaginal noise" OR "noisy vagina"*.

The flowchart of the search strategy is presented in Fig. 1. The exclusion criteria were applied and all remaining results from the different databases were then screened independently by two reviewers (SDG, XM), based on their title and abstract. In case of disagreement, a third reviewer (HN) was consulted.

Data items

The following data were abstracted from included studies: methods of measurement, definition, pathophysiology, symptomatology, incidence, prevalence, risk factors, provoking factors, protective factors, associated conditions, impact on QoL, suggested treatments, prevention. Table 1 provides an overview of these data.

Risk of bias in individual studies

The assessment of methodological quality was done independently by two reviewers (SDG, XM). In case of disagreement, a third reviewer was consulted (HN). For prevalence studies, the assessment criteria for methodological evaluation of observational research (MORE) (http://www.ncbi.nlm.nih.gov/books/NBK53279) were used. For qualitative studies, the assessment criteria for qualitative research provided by the Dutch Cochrane Collaboration were used (http://netherlands.cochrane.org). The other studies were assessed using criteria composed by the reviewers, which are described in the results.

Results

Selection of studies

The flow chart for study selection and exclusion is presented in Fig. 1. The search strategy applied to the three databases mentioned above, PubMed (number of results n = 16), MEDLINE (n = 16), and Cochrane Database (n = 0), through December 16, 2015, identified 32 studies. One additional study was found by hand screening the references of all the articles [3]. After removing duplicates, 18 studies were screened by assessing their title and abstract. The reviewers compared and discussed both lists of included and excluded studies, which has led to a list of included (n = 11) and excluded (n = 7) studies.

The remaining articles were read and the reviewers independently assessed the quality of the studies (Table 1). The outcome was discussed and merged into one table (Tables 2 and 3).

Methodological quality

The methodological quality assessment was done separately by two reviewers. Three studies were evaluated using the assessment criteria for prevalence research by MORE [4–6]. One study was evaluated based on the assessment criteria for qualitative research by the Cochrane Collaboration [7]. All four studies had a low quality, as can be observed in Tables 2 and 3. The other included studies were case reports and letters to the editor [3,8–13]. They were assessed using the following criteria: year of publication, methodology, reproducibility, amount of included patients, applicability in practice, and biases. Results are presented in Tables 2 and 3, they were generally of a low quality. There was no systematic methodology reported in any of these studies. The results that were described in the studies, were possibly reproducible in only one case [3]. In one other study, the reproducibility was doubtful [12]. In most case reports and letters to the editor, the number of included patients was very low (1–6 patients per study) [8–13]. Except for one study, with 27 included patients [3]. Financing was not described in any of these studies. The year of publication of the studies covered a wide range. Two of the studies were published between 1990 and 1999 [3,9], three between 2000 and 2009 [10–12], and two in 2010 or later [8,13]. Most researches suggested treatments that were (fairly) applicable and available in daily practice. One study described surgery as a treatment option, which is less available and also more invasive [9]. For biases, it can be stated that generally, there is an important publication and selection bias in case reports. This causes the reliability of these studies to be low.

Methods of measurement

In the included studies, many methods of measurement and examination have been described for vaginal wind and co-

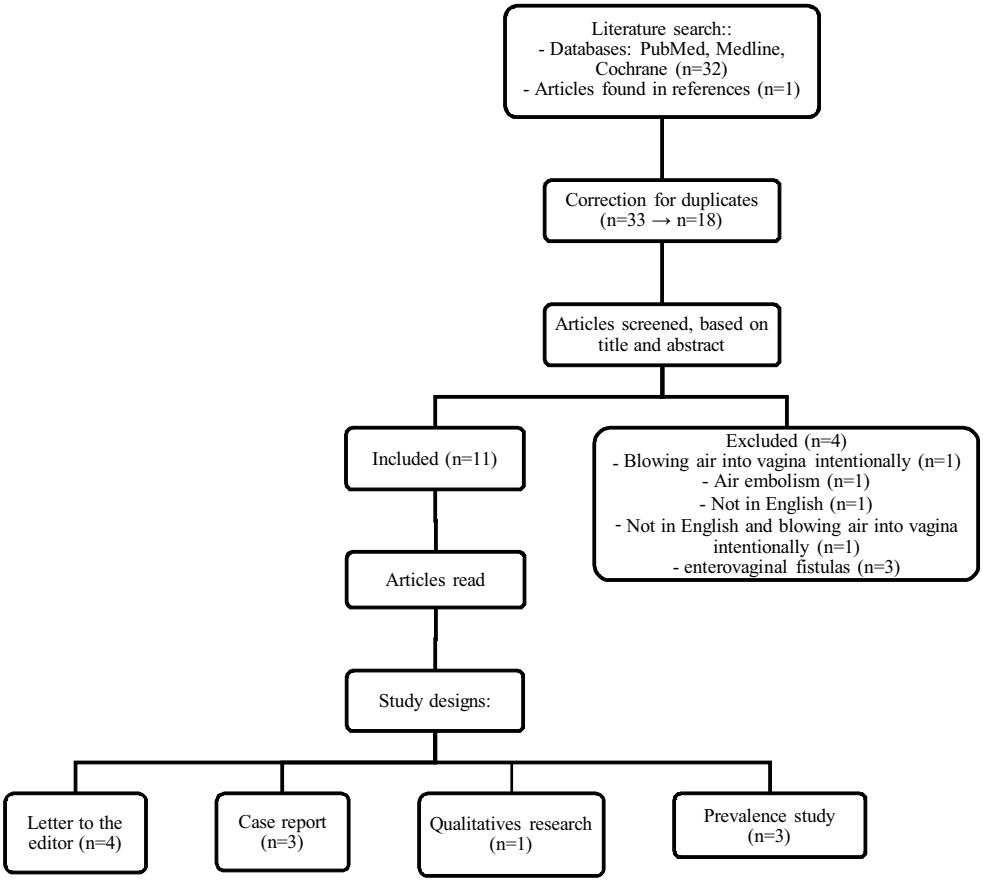

Fig. 1. Flowchart of the Search Method (PRISMA).

morbidities (Table 1a-b). Vaginal wind caused by an enterovaginal fistula can be detected using an anorectal 360° ultrasound or a rectovaginogram [10]. Air in the vagina can be visualized using CT [3]. Other authors have stated, without evidence, that ultrasound, CT, and MRI do not provide any useful information about vaginal wind [12]. A gynaecological examination with pelvic muscle strength assessment, like for diagnosing a vaginal prolapse or pelvic organ prolapse (POP), is according to several authors a

Table 1
Methodological quality review of individual studies.

	Research question	Observational method	Research population	Controllability	Adequate analysis	Aim of study	Conclusion
[7]	+	+	+/–	+	–	+	+

	External validity			Internal validity					
	Sampling	Sampling bias	Response rate	Method of measuring	Validation	Results	Prevalence	Incidence	Financing
[4]	–	?	+	+	?	+	+/–	?	–
[5]	–	+/–	?	+	?	+	+/–	?	+
[6]	+/–	+/–	+	+	?	+	+/–	?	+

	Methods	Reproducibility	+ Included patients	Financing	Applicability	Selection bias (– means present)
[8]	+	–	1	?	+	–
[9]	+	–	6	?	+/–	–
[3]	+	+	27	?	+	+
[10]	+	–	1	?	+	–
[11]	+	–	1	?	+	–
[12]	+	+/–	6	?	+/–	–
[13]	+	–	1	?	+/–	–

+ = criterion achieved; – = criterion not achieved; +/– = criterion is not clearly achieved; ? = not mentioned.

Table 2
Study characteristics and overview of results (part 1).

Author, year	N	Method of measurement	Definition	Pathophysiology	Symptoms	Prevalence
Allahdin, 2011 [6]	1	–	Expulsion of trapped air from vagina	Air pressed into vagina → expelled by vaginal wall contraction	Odourless, harmless flatus	–
Attapattu, 1995 [9]	6	–	Involuntary, audible passage of vaginal flatus	Risk factors → air in vagina in certain positions → expelled on change of posture	–	–
Hsu et al., 2007 [10]	27	CT	Air bubble >2cm Ø or on >1 successive CT slice	Rigidity, fibrosis	Small air bubble, large air bubbles in pelvic malignancy	0,96% in 2800 general female abdominopelvic CT scans.
Hsu, 2007 [3]	1	Rectovaginogram	–	Pelvic floor disease	Vaginal wind	–
Jeffery et al., 2008 [11]	1	Clinical examination for vaginal prolapse	–	–	Vaginal wind, multiple times/d	–
Krissi et al., 2003 [12]	6	Questionnaire, vaginal examination, Oxford scale, complaint	Noise	Air in vaginal cavity at rest → introitus closes on movement → air trapped → abdominal and pelvic pressure ↑ → air expelled	Vaginal wind 20×/d, sucking water during bath, stress urinary incontinence	–
Lonnee-Hoffmann et al., 2014 [7]	35	Questionnaires	–	–	Vaginal wind	27% in women with SUI, 47% in women with POP
Miranne et al., 2015 [4]	110	Questionnaires	Audible passage of vaginal air	Unknown, possibly: air in vagina → trapped → expelled with vibration vaginal walls at level of introitus	Vaginal wind 2,1×/w, 87% reports symptoms during coitus	73% in women with SUI 69% in women with POP, prevalence ↑ for age↓
Renckens et al., 2012 [13]	1	–	Involuntary passage of vaginal flatus	–	–	–
Slieker-ten Hove et al., 2009 [6]	800	Questionnaires, vaginal examination (POP, oxford)	Symptom of pelvic floor dysfunction	Anatomical changes → vaginal noise	Very weak noise, other symptoms of pelvic floor dysfunction	12,80% in general women (45–85y)
Veisi et al., 2012 [5]	942	–	Involuntary air passage through genital tract	Low BMI → vaginal wall support↓	54% after coitus, 1–2x/w up to a few times/d	20% in general women

N number of included patients; SUI stress urinary incontinence; POP pelvic organ prolapse.

sufficient measurement method [6,11,12]. Questionnaires are also an important diagnostic instrument [4,6,7,12]. Various validated questionnaires have been used, such as the Urogenital Distress Inventory and the Defecation Distress Inventory [6], the Pelvic Floor Distress Inventory Short Form and the revised Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire [4], and the Brief Sexual Function Instrument for male sexual function (in male partners of women with, among other symptoms, vaginal wind) [7]. Finally, invalidated questionnaires were also used, in which vaginal wind, vaginal prolapse and gastrointestinal and sexual symptoms were assessed [12].

Definition

In some research, vaginal wind is described as an involuntary air passage through the genital tract [4,5,9]. Vaginal wind can also be defined as the expulsion of air that has been trapped in the vagina [8]. It is sometimes audible [4,6,9]. According to one study, vaginal air on CT can be defined as an air bubble with a diameter larger than 2 cm or which is visible in more than one successive CT-slice [3]. Overall, no consensus was found.

Pathophysiology

The mechanism that causes vaginal wind has not been adequately explained. Numerous mechanisms have been described in the included studies. One mechanism by which vaginal wind could be caused is a deficient perineum. This can lead to a loose and open vagina, which makes the vaginal cavity a real instead of a potential space. In some positions in which the pelvic floor muscles relax, for instance during intercourse, air can flow into the vagina. By changing positions, the air can be expelled, which causes a sound similar to anal flatus [4,9,10,12].

Vaginal wind can also be caused by vaginal rigidity or inelasticity. These problems can be caused by pelvic inflammation, radiotherapy in the pelvic region, tumour invasion of the vaginal wall, oedema or fibrosis after vaginal surgery. The exact mechanism by which vaginal rigidity and inelasticity cause vaginal wind is unclear [3].

Anatomical changes of the vagina with an altered Bp-point (the lowest point of the posterior vaginal wall) can also lead to vaginal wind. The underlying mechanism could be that the vagina does not remain closed when posture is changed, which can cause an airflow [6].

Lastly, it has been described that a low BMI (BMI limit has not been specified) can cause inadequate support of the vaginal wall, which makes it possible for the anterior and the posterior vaginal walls to fold over each other. This causes an airflow with noise [5].

Symptomatology

Vaginal wind often occurs on random movements, and during or after coitus [4,5]. It is an odourless movement of air (different from anal flatus), that can have a frequency of few times a week up to multiple times a day [5,6,8,11,12]. Some women with vaginal wind complain of sucking in water in the vagina when taking a bath. When they leave the bath, the water flows consequently out of the vagina [12].

Table 3
Study characteristics and overview of results (part 2).

Author	Risk factors	Provoking/	Associated conditions	Impact on QoL	Suggested treatment
Allahdin, 2011 [6]	vaginal surgery	Coitus, physical activity	genital prolapse	Distress, confidence ↓, social isolation, embarrassment	Pelvic floor muscle exercises, vaginal pessary, tampons (also preventive, 1×/d)
Attapattu, 1995 [9]	Deficient perineum, loose and open introitus	Change of posture	–	Embarrassment	Posterior colpoperineorraphy
Hsu et al., 2007 [10]	–	–	Malignancies,	–	–
Hsu, 2007 [3]	Multiple caesarean sections	–	–	Distress, embarrassment	Tampon 1×/d (also preventive), pelvic floor physiotherapy
Jeffery et al., 2008 [11]	–	–	–	Distress, embarrassment	Cube/ring pessary, physiotherapy, anterior colporraphy
Krissi et al., 2003 [12]	Vaginal delivery, POP, urinary incontinence	physical activity	–	Social distress + embarrassment → severe social restriction + QoL↓	Modified Bard pessary to prevent vagina and introitus of closing, physiotherapy, posterior colporraphy
Lonnee-Hoffmann et al., 2014 [7]	SUI, POP	–	–	Male sexual function unaffected	Pelvic floor surgery (POP/SUI surgery)
Miranne et al., 2015 [4]	Larger genital hiatus/vagina, anterior/ posterior vaginal wall prolapse, pelvic floor abnormalities	Abdominal pressure ↑, coitus, digital stimulation, cunnilingus, sit-ups	–	64% bothered, 22% QoL↓ (QoL↓ for vaginal wind frequency ↑), 23% sexual satisfaction ↓	Posterior colporraphy, pelvic floor physiotherapy, tampon, pessary, POP surgery
Renckens et al., 2012 [13]	Open vagina, weak perineum	Change of posture	–	QoL↓, social isolation	Specific surgery, tampon, round pessary (+catheter), urine catheter
Slieker-ten Hove et al., 2009 [6]	Parity, urge incontinence/SUI, vaginal bulging, manual stool evacuation, POP, flatal/ anal incontinence	Change of posture, coitus	–	96% not or a little bothered, 3,4% moderately or very bothered	–
Veisi et al., 2012 [5]	Low BMI, low PFM strength, reproductive age, delivery of large neonate, low grade POP, caesarean section, Hysterectomy, pelvic floor reconstruction	spontaneously	–	Impact on QoL at all ages, social/ psychological problems, "impairment of religious duty practice"	–

BMI body mass index, PFM pelvic floor muscles, POP pelvic organ prolaps, Qol Quality of Life.

Incidence

Up until now, the incidence of vaginal wind has not been described.

Prevalence

In several studies, no prevalence values was mentioned [8–13]. Prevalence values that were described (Table 2) varied from approximately one [3] to 69% [4–7]. Between these extremes, a few different values for prevalence have been described. In patients with POP, the prevalence of vaginal wind is 47% [7] up to 66% [4], whereas in patients with stress urinary incontinence (SUI), the prevalence of vaginal wind is 27% [7] up to 73% [4].

Risk factors

Numerous risk factors for developing vaginal wind have been described (Table 3). One that is mentioned frequently is a history of one or more vaginal deliveries [5,6,12] others doubt that this is a cause [4]. Two studies described vaginal wind as a result of one or more caesarean sections [5,10]. Anterior and posterior vaginal wall prolapse or a deficient perineum (which can be associated with a loose and open vagina) can also cause vaginal wind [4,9,13]. Medical interventions, like vaginal surgery (e.g. hysterectomy, pelvic floor reconstruction), is also a provoking factor [5,8]. There is inconsistency about POP as a risk factor for developing vaginal wind: some studies state that POP is an important and significant risk factor [5–7], while others mention that POP is not associated with vaginal wind [4]. Urinary stress incontinence and urge incontinence, as well as anal and flatal incontinence have also been described as risk factors [6]. Vaginal wind seems according to some to be associated with a lower age (defined as the reproductive age) and a relatively low BMI (BMI-limit has not been defined), which results in a lower pelvic floor muscle strength [5]. An explanation for this wasn't given [5].

Provoking factors

An important provoking factor of vaginal wind is coitus [4,6,8]. Digital stimulation and cunnilingus (oral stimulation of the female genitalia) provoke also vaginal wind [4]. Exercise can be a provoking factor of vaginal wind, due to an increasing intra-abdominal pressure and posture changes [4,6]. This, for example, happens when jogging or when performing sit-ups [4].

Protective factors

Only one study described protective factors, namely higher age (after the reproductive age) and postmenopausal status [4].

Associated conditions

In the urogenital system, POP can cause vaginal wind. Conditions that are in the category POP are cystourethrocele, rectocele, enterocele, uterine prolapse, and prolapse of the vaginal

cavity [7,8,12]. Malignancies can also be associated with vaginal wind [3].

Impact on QoL

In only one study vaginal wind is described as having a minimal impact on the QoL as 4% of the patients as bothered [6]. All other studies indicate that vaginal wind is a relevant symptom which causes considerable distress, leading to a severe decrease in QoL [4,5,8,10–13]. Female sexual function decreases due to the presence of vaginal wind [4]. Many patients are ashamed and feel less confident [8,10,11]. In some cases, it made them so insecure that it caused social isolation [5,8,13]. It appears that the majority are not seeking medical help [9,12].

The sexual function, evaluated by sexual urge, erection, and overall satisfaction, of male partners from women with vaginal wind, is not influenced. Only the ejaculation score was a little lower in the presence of vaginal wind [7].

Suggested treatments

Many different treatment options have been described in the included studies (Table 3). Physiotherapy with exercises to strengthen the pelvic floor muscles can be an effective option for some patients [4,8,10–12]. A pessary could also be an option [4,8,11–13]. A solution that is easily applicable in daily practice is the use of a tampon [4,8,10,13]. If the vaginal wind has been caused by a vaginal wall rupture a surgical correction, like an anterior and/or posterior colpoperineorraphy can be a solution [4,9,11–13]. Other surgical procedures which have been suggested are cervix amputation, vaginal hysterectomy, and sacrospinal vaginal fixation [4,7].

Comment

As described in the methodology, a several terms have been excluded (vaginal flatulence, vaginal gas, vaginal fart, queefing, queef, varting, vart, garrulitas gravita, chattering vulva, fanny fart, and incontinentia vulvae) from the search strategy. Nonetheless, these terms can still be useful in daily practice, because patients use these terms to describe their complaint.

In the result section numerous items have been described as being provoking factors of vaginal wind. The mechanisms behind these provoking factors is still unclear. Examining these factors in depth would give more inside in the pathophysiology of vaginal wind. Which would consequently lead to better treatment options. One of the provoking factors that has been described in medical literature is coitus [4,6,8]. The underlying mechanism is probably that during intercourse air is pressed in the vaginal cavity by the penetration. This would also explain while certain intercourse positions are more associated to vaginal wind then others. For instance in doggy position during intercourse the pelvic floor muscle tone and intraabdominal pressure are lower compaired to missionary position, thereby causing the vagina to open up and suck air. This makes the vaginal cavity a real rather than a potential space. It is also possible that an active inward pelvic floor muscle contraction, performed during sexual stimulation or during certain positions of the pelvis, causes a negative change of pressure in the pelvic region. This could cause air to be sucked into the vagina, so that a cavity is created. Whenever that air is pushed outwards later on, vaginal flatulence occurs. Changes of posture have also been described as a provoking factor of vaginal wind [4,6]. This is possibly caused by moving from a posture with a lower pelvic floor muscle tonus and a lower intraabdominal pressure to a posture with a higher pelvic floor muscle tonus and a higher intra-abdominal pressure. This can press air from the vagina outwards, which could possibly cause noise. The provoking changes of posture can occur during coitus, but also during exercising (like jogging, sit-ups), or daily activities. Other positions in which vaginal wind could occur are the extreme movements and large amount of stretch which are made in, for example, gymnastics. In these young athletes there is often a combination of risk factors (young age and low BMI [5], certain positions), which could make them sensitive to develop vaginal wind later on in life.

Digital stimulation and cunnilingus also cause vaginal wind [4]. The explanation is similar to that of coitus: penetration causes air to flow into the vaginal cavity. Another possibility is that during digital stimulation and cunnilingus, certain positions are held, in which pelvic floor muscles tonus and intraabdominal pressure changes. This can cause air to be sucked into the vagina, which can later be expelled from the vagina. These positions also cause an open vagina.

It is possible that congenital connective tissue disorders, such as hypermobility syndrome, Marfan's syndrome, and Ehlers-Danlos' syndrome cause vaginal wind. Women with these conditions have a weakness or increased extensibility of the pelvic floor. Additionally, congenital dysplasia or aplasia of certain pelvic floor muscles, can cause the pelvic floor to have an abnormal form and in which case the vagina might be standing open or might open up more easily than in the normal situation. A similar abnormal form of the pelvic floor could be acquired as a result of vaginal surgery or pelvic floor surgery (due to resection of parts of the pelvic floor or due to scarring). This hypothesis would explain why surgery is seen as a provoking factor of vaginal wind [5,8]. Pregnancy and deliveries can also cause pelvic floor abnormalities; for example, due to strain or weakening of the pelvic floor muscles. This can also result in an elongation or a lower muscle tonus of the pelvic floor muscles, which could be associated with an open or looser vagina, which can open up more easily.

One could also notice that the most recent studies are reporting a higher prevalence of "vaginal wind". That bias could be a consequence of the attention "vaginal wind" is receiving on social media. It may have become more easy to talk about.

Further research is needed to define and explain the mechanism vaginal wind. Based on the literature and our clinical experience the definition of vaginal wind is "an involuntary passage of odourless air through the vagina, which is often audible and/or sensible, and usually associated with posture changes" [3–6,8,9,12,13]. This must be distinguished from flatus that is passed through the vagina in case of an enterovaginal fistula. This type of "vaginal wind" will not be odourless [14–16]. Knowledge of the pelvic floor is important in order to improve the prevention and the treatment [17].

The level of evidence of this literature study is rather strong, despite a few flaws. For example, comparisons are difficult because of the inconsistency in described underlying pathophysiological mechanisms, in prevalence, in risk factors, in impact on QoL, in methods of measurement and in suggested treatments. This makes the information that has been collected in this study difficult to use in daily practice. In addition, the various suggested treatments have only been implied in very small populations. Another flaw could be that most of the studies about vaginal wind are outdated; only five of the included studies have been published in the past five years, and four of the studies are over twenty years old. To compensate for these flaws, the reviewers have also included case studies and letters to the editor. In order to have a complete overview of all the literature that has been published concerning this subject.

In conclusion, vaginal wind is not frequently discussed in the liturature, but due to social media it is more highlighted. Based on the current evidence, the prevalence of vaginal wind varies widely and it has a negative impact on the quality of life of women. Little

evidence exists about the factors that cause it and the underlying mechanisms. Prospective studies are necessary to identify the influence of weight, sexual activity, age, parity, mode of deliveries, the willingness to talk about it, etc. together with prevention and treatment options.

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4

FEAR OF PAIN

Does pelvic floor muscle contraction early after delivery cause perineal pain in postpartum women?

You can't go back to the beginning, but you can start where you are and change the ending.
C.S. Lewis

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Full length article

Does pelvic floor muscle contraction early after delivery cause perineal pain in postpartum women?

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ABSTRACT

Objective: Pelvic floor muscle training is effective and necessary in the prevention and treatment of pelvic floor dysfunction during pregnancy and after childbirth. But because of the high prevalence of perineal pain observed in women after childbirth, many women and caregivers fear to start pelvic floor muscle training immediately after childbirth. However, it is unknown whether pelvic floor muscle contractions (PFMC) provoke perineal pain in women shortly after childbirth. Therefore, the main objective is to study whether PFMC performed immediately after childbirth is painful or not.
Study design: Observational longitudinal study. Perineal pain was assessed (1–6 days and 9 weeks postpartum) using a visual analogue scale (VAS 0–10) during PFMC and during several activities of daily living (ADL), during micturition and defecation. Descriptive statistics, Wilcoxon and McNemar tests were used.
Results: A total of 233 women participated (148 primiparous and 85 multiparous). Immediately postpartum the prevalence and intensity of pain during ADL (73%; VAS 4.9 (±2.3)), micturition (47%; VAS 3.4 (±1.7)) and defecation (19%; VAS 3.6 (±2.2)) were significantly higher (all $p < 0.000$) than during PFMC (8%; VAS 2.2 (±0.9)). At 9 weeks postpartum, 30% experienced perineal pain during sexual intercourse (VAS 4.6 +/− 2.3) and 18% during defecation (VAS 4.7 +/− 2.3), but none during PFMC.
Conclusion: Perineal pain is highly prevalent immediately after childbirth during ADL, micturition and defecation, but not during PFMC (only 8%). In case perineal pain occurs during PFMC, the intensity of pain is low (VAS 2). These results show that fear of perineal pain should not discourage women to start pelvic floor muscle training shortly after childbirth.

Introduction

Pregnancy and childbirth are main risk factors for pelvic floor dysfunction such as urinary incontinence (UI), anal incontinence, pelvic organ prolapse and sexual problems [1,2].

Pelvic floor muscle training (PFMT) is known to be effective in the prevention and treatment of pelvic floor dysfunction during pregnancy and after childbirth [3,4], and therefore has an important role in the peripartum period. Muscular reinforcement during perineal rehabilitation reduces urinary stress incontinence and anal incontinence [5]. PFMT after delivery should at first be focused on restoring voluntary contraction of the weakened musculature [6].

Pregnancy and delivery are also the most common risk factors for perineal pain in the early postpartum period. Perineal pain is defined by the International Continence Society as the complaint of pain felt between the posterior fourchette (posterior lip of the introitus) and the anus [7,8]. Some researchers define perineal pain in a broader region: as any pain occurring in the perineal body, the area of muscular and fibrous tissue, which extends from the symphysis pubis to the coccyx [9]. Recent research found a high prevalence of perineal pain postpartum, ranging from 74% to 90%, with 37% reporting moderate or severe pain [10,11]. Evidence shows that perineal tissue damage is the most important risk factor for perineal pain postpartum. Perineal tissue damage can occur with diverse birth interventions including episiotomy, forceps, vacuum extraction, prolonged expulsive period and

Abbreviations: PFMT, pelvic floor muscle training; PFMC, pelvic floor muscle contractions; UI, urinary Incontinence; VAS, visual analogue scale.

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newborn characteristics including birth weight [12], head circumference and position of the baby at birth [13,14].

Perineal pain can impact a woman's daily activities including sleep patterns, urinary and bowel function and practical care of her infant [15,16]. Although preventive PFMT has an important role in peripartum pelvic floor dysfunction, the prevalence of perineal pain during PFMT after delivery has never been studied before. Recent research revealed that PFMT started early after obstetrical anal sphincter injuries (within 30 days) reduces anal incontinence significantly compared to PFMT given within 6–8 weeks postpartum [6]. But many women and caregivers are cautious or even restrained to start PFMT early after childbirth because of the pain they complain about.

The aim of this study is to investigate whether and to which extent pelvic floor muscle contraction (PFMC) provokes perineal pain in women shortly after delivery and nine weeks later. Secondary we will register which activities of daily living provoke perineal pain shortly after delivery and nine weeks later. And also the influence of parity, delivery methods, newborn anthropometric characteristics, pain medication and prepartum pelvic floor dysfunction on the prevalence of perineal pain will be investigated.

Materials and methods

Design

Observational longitudinal survey. Study subjects were recruited within 1–6 days after delivery at the maternity ward, University Hospital Antwerp. A good knowledge of the Dutch, French or English language was a prerequisite for inclusion. Exclusion criteria were the presence of an indwelling bladder catheter. Written informed consent was obtained from all participating women. The study was approved by the local ethics committee (BE300201318334).

Questionnaire immediately after delivery

The date of delivery, characteristics of the mother and newborn, number of parity and gravidity, and characteristics of most recent delivery (perineal trauma, use of epidural analgesia and method of delivery) were obtained through medical records of the women. Participants were asked whether they ever experienced urinary incontinence before and during pregnancy (yes or no question).

The postpartum complaints which were evaluated consisted of use of abdominal pressure during voiding (straining), pain during micturition and defecation and the intensity of this pain (visual analogue scale (VAS) from zero to ten, zero = no pain, ten = worst pain ever). The subjects were also questioned regarding the use of laxatives and pain medication. Finally, subjects were invited to point the localization of the perineal pain on an illustration figure of a vulva.

Validation of the anamnestic questions and physical exam, as described, has been done (first by peers, then in a pilot sample of 22 women, of which were not included in the sample).

Clinical examination immediately after delivery

The clinical examination was performed by a physiotherapist, specialized in PFMT. Activities with a risk of provoking pain were assessed: activities of daily living (ADL) and pelvic floor muscle contractions. Perineal pain was scored on a VAS [0–10] during: sitting on a chair, standing up from a chair, standing, adduction-abduction in supine position, turning in bed from supine to prone position and coughing. Subjects were also asked to perform a Valsalva maneuver (Valsalva pushing: women were asked to strain as if they wanted to make stool and Valsalva blowing: women were asked to breath out forcibly while the mouth and nose were firmly closed). Then, women were, undressed, positioned in the lithotomy position. First assessment of the dermatomes (L1-S5) was performed using a cotton swab. Second, visual observation of the perineal area and vagina was performed during PFMC. A normal analytic PFMC was defined as a ventral and inward displacement of the perineum [17,18]. Women were asked to perform three consecutive contractions and relaxations. Women who did not show correct PFMC after three consecutive tries received verbal instructions on how to contract the pelvic floor muscles and were then re-evaluated. Perineal pain was again scored on VAS.

Questionnaire around nine weeks after delivery

All participants were contacted by phone or by email at around nine weeks after delivery.

Women were asked if they still experienced perineal pain (VAS and location). If they felt no pain at the time of the interview, they were asked to recall if they had experienced perineal pain after the first part of the study, how long that pain had lasted, where exactly they had felt it and how intense that pain had been (VAS).

Women were also asked if they felt pain during micturition and defecation and during sexual intercourse at that moment, nine weeks after delivery. Perineal pain during ADL and Valsalva maneuver was assessed again with VAS scores.

Finally, study subjects were asked if they had performed the PFMC exercises as they had been taught on the maternity ward. And if they felt perineal pain during PFMC performed at nine weeks postpartum, during the assessment. Immediately after childbirth they were advised to perform at least two times per day, 20 contractions in a row, each day. During the data analysis, a minimum of 20 PFMC, at least four days a week was used as definition for "performing regular exercises".

Statistical analysis

Equivalence/non-inferiority test was performed to the hypotheses that the prevalence of perineal pain during PFMC immediately after delivery would be less than 5% (actual proportion = 0.02). The objective to include 230 participants was determined. Statistical analysis was carried out using SPSS version 22.0 for Windows. Descriptive statistics, Wilcoxon, McNemar and Chi-Square tests were used. Non parametric tests were used to compare VAS scores between groups.

Results are given as number (n), percentage of whole group, mean +/− standard deviation (M (±SD)).

Results

Two hundred thirty-three women (148 primiparous and 85 multiparous) participated in the study (M 2.4 ± 1.2 days postpartum) immediately after delivery. Hundred ninety-nine of them agreed to participate also in the second part of the study, approximately nine weeks after delivery. Eight women were excluded for the second part because they were not able to perform an analytic PFMC immediately after childbirth. Mean age of the participants was 30.4 ± 4.4 years old; characteristics are presented in Table 1. Nine women (4%) delivered twins.

A descriptive overview of urinary incontinence, primiparity, use of epidural anesthesia, method of delivery, perineal trauma and the use of painkillers can be found in Table 2. The clinical evaluation of perineal sensation using the Q-tip test for light touch was normal in all participants in all dermatomes.

The prevalence and intensity of perineal pain immediately after childbirth are presented in Table 3. Pain was significantly less

Table 1
Characteristics of Mother (N = 233) and Newborn.

Mother					
	M	SD	Min	Max	SEM
Age	30.3	4.4	19.4	42.5	0.29
Height (cm)	167.3	0.1	150.0	185.0	0.0040
Pre pregnancy Weight (kg)	65.5	11.4	44.0	112.0	0.75
Pre pregnancy BMI (kg/m2)	23.4	3.9	15.9	41.9	0.25
Weight-gain (kg)	13.4	5.5	0.0	38.0	0.36
Parity	1.5	0.8	1.0	5.0	0.33
Newborn					
Weight (g)	3155.1	663.8	760	4450	43.5
Head circumference (cm)	34.4	1.9	27	44.0	0.12

M = mean, SD = Standard Deviation, Min = minimum, Max = maximum, SEM = standard error of the mean.

prevalent during PFMC ($p < 0.01$) and less intense (VAS, $p < 0.05$), compared to the pain felt during ADL activities and micturition, Table 3.

Most women who felt perineal pain localized it between the posterior fourchette (posterior lip of the introitus) and the anus (n = 113 (70%)), although a broader region (urethra, around the anus, around the vagina, around the labia) was also depicted by 100 participants.

Primiparous women and women with episiotomy or a perineal rupture suffered significantly more from perineal pain shortly after delivery. Women with an intact perineum after vaginal delivery and women who had a caesarian section experienced significantly less perineal pain. The use of painkillers had no significant influence on the prevalence (Table 2).

Table 2
Influencing factors on the occurrence of perineal pain in 233 women immediately after delivery.

	n	Prev (%)	No Peripain N = 44	Peripain N = 189	Significant influence (p-value) Chi-Q
			n	n	
UI pre pregnancy	44	19	8	36	0.910
UI per pregnancy	144	63	28	116	0.737
Primiparity	148	64	22	126	0.039
Epidural anesthesia	128	55	25	103	0.781
Vacuum delivery	45	20	4	41	0.064
Forceps delivery	6	3	1	5	0.888
Caesarian section	26.0	11	16	10	<0.001
Intact perineum	59	25	27	32	<**0.001**
Episiotomy	52	22	3	62	**0.001**
Perineal rupture	106	45	15	106	**0.009**
Painkiller	149	64	33	116	0.090

Differences between groups of Peripain (occurrence of perineal pain immediately after delivery (2–6 days postpartum) during ADL, micturition, defecation or PFMC) were calculated using Chi-Square test. Level of significance ($p < 0.05$). N = total number of participants, n = number of participants with a specific influencing factor, UI = urinary incontinence, Prev = prevalence.

Table 3
Prevalence and Intensity of Perineal Pain.

Shortly after Childbirth							
	N (missing)	Prev% (n)	M (VAS)	SD (VAS)	Med (VAS)	Difference in Prev of pain with Prev during PFMC (p-value)**	Difference in VAS of pain with VAS during PFMC (p-value)***
During:							
PFMC	225 (8)	**8** (18)	**2.2**	**0.9**	**2**		
ADL sit	230 (3)	57 (132)	3.9	2.1	4	**0.001**	**0.000**
ADL standUP	218 (15)	52 (114)	4.4	2.2	5	**0.001**	**0.000**
ADL stand	229 (4)	23 (54)	3.6	2.0	3	**0.023**	**0.000**
ADL Add-abd	221 (12)	7 (16)	3.7	1.8	3.5	0.068	1.000
ADL turn	225 (8)	37 (84)	4.1	2.0	4	**0.001**	**0.000**
ADL cough	229 (4)	48 (110)	4.2	2.2	4	**0.005**	**0.000**
ADL int touch	154 (79)	27 (41)	4.6	2.3	5	0.102	**0.000**
micturition	233 (0)	47 (109)	3.4	1.7	3	**0.026**	**0.000**
defecation	130 (103)	19 (24)	3.6	2.2	3	0.564	**0.002**
vasalva blowing	227 (6)	7 (16)	2.2	1.6	2	0.180	0.856
valsalva pushing	227 (6)	13 (29)	2.8	1.7	2	0.705	0.061
MAX ADL score	233 (0)	73 (169)	4.9	2.3			
At nine weeks postpartum							
During:							
PFMC		199 (0)		0 (0)	0	0	0
micturition		198 (1)		2 (4)	3.8	2.2	4
defecation		198 (1)		18 (38)	4.7	2.3	5
sexual intercourse		155 (44)		30 (64)	4.6	2.3	4
MAX ADL score		199 (0)		0 (0)	0	0	0

N (number of all participants); Prev=Prevalence of Perineal Pain (n = number of participants with VAS > 0). Statistics on VAS scores are calculated only for the sample with VAS>0. ADL sit = sitting on a chair; ADL standUP = standing up from a chair; ADL stand = standing upright; ADL Add-Abd = abduction and adduction of the legs; ADL turn = turning in bed; ADL cough = coughing; ADL int touch = touching/washing intimate zones; MAX ADL SCORE = the highest VAS score that was experienced during ADL.

** Wilcoxon test is used to compare the prevalence of pain during ADL, micturition and defecation with pain during PFMC.

*** Mc Nemar test is used to compare the intensity (VAS) of pain during ADL, micturition and defecation with pain during PFMC.

One hundred ninety-nine women participated in the second part of the study. They completed the questionnaire after 9.3 ± 2.5 weeks. Thirty (14%) women still experienced occasionally perineal pain at the time of the questionnaire (M VAS ± SD: 4 ± 2.3). Of them, twenty-five women localized their perineal pain between the posterior lip of the introitus and the anus. The remaining 5 women felt pain in a broader area (around the anus).

One hundred seven (51%) women recalled that they had experienced perineal pain during 19.4 ± 13 days after delivery, but were pain free at the time of the 9-week questionnaire.

The prevalence and intensity of perineal pain during PFMC, micturition, defecation and during sexual intercourse is presented in Table 3. Most women (n = 178 (84%)) had performed PFMC regularly between the first and second evaluation.

Comment

The results of this study indicate that pelvic floor training shortly after delivery is not painful in most women, even if many report pain during ADL, micturition or defecation. Those women who experienced pain reported a lower level of pain during PFMC than during ADL, micturition and defecation. Perineal pain, immediately after delivery was significantly more prevalent in primiparous women and women with perineal trauma. None of the participants felt any pain during a PFMC performed at nine weeks postpartum.

The importance of perineal trauma and primiparity in the risk for perineal pain has already been shown in previous research [10,14]. But the absence of pain during PFMC has not been previously established.

Previous research also revealed that sitting, walking, micturition and movement into and out of bed could provoke perineal pain [10,19], similar to our results. During all these activities pressure on the affected area can be expected. Valsalva pushing and blowing were less painful, although they increase the intra-abdominal and intrapelvic pressure. One reason could be that the subjects were cautious and did not push or blow hard enough to reach the pain threshold, or perhaps internally augmented pressure is less painful compared to external pressure such as sitting on a chair.

Perineal pain postpartum can be provoked by ischemia/reperfusion injury [20], by nerve damage [21] and by referred pain from nerve roots, but also from muscle damage or damage and edema of the pubic bone, the skin and superficial tissues [22]. Our study evaluated the occurrence of perineal pain, and was not designed to explore the mechanisms behind it. It is noteworthy that contraction of the pelvic floor muscles was not painful while ADL, micturition and defecation that provoke pressure and tension in the pelvic floor were. The clinical superficial sensory evaluation indicated that the somatic sensation was not disturbed overall, although nerve damage from compression or tension cannot be excluded.

Morkved and Bo have shown that PFMT pre- and postpartum is successful in preventing and treatment of UI when supervised training is followed, and up to six months after delivery [3,4]. It has been suggested that all pregnant and postpartum women with or without UI after delivery should perform PFMC [23]. Although recent research performed in the Netherlands revealed that less than half of all pregnant women received PFMT in an antenatal and approximately one in ten in a postnatal pregnancy course [24]. And a Belgian study found that 75% of peripartum women felt insufficiently informed about PFMT [25], and a sparse knowledge about the pelvic floor in nulliparous women [24].

The number of institutional deliveries worldwide is high [26]. Also, in most home deliveries, a medical care giver is present. Thus, it would not be too difficult for healthcare providers to teach women the advantages and the technique of PFMT immediately after delivery, without fear for pain, as shown in our study. Pelvic floor dysfunction should be explained, because these intimate problems are often a taboo to talk about For example, we first gave a brief explanation about the anatomy, functions and possible dysfunctions of the pelvic floor muscles. Secondly, we explained how to perform PFMC and provided oral feedback after visual observation. Their first trial of PFMT after delivery should be focused on proprioception and feeling their own muscles contract again after delivery, despite the pain felt during ADL. Boyle et al. also suggested that women should be encouraged to continue PFMT during and after every pregnancy, and once their families are complete. Most of our participants (84%) reported performing PFMT after the advice of the physiotherapist they had seen on the maternity ward. Although, if women would not have been educated properly shortly after childbirth, we think that many would never got informed afterwards. In that case many would never have benefitted from the preventive value of PFMT.

The results showed that micturition immediately after childbirth provoked perineal pain in almost half of the subjects (47%), while defecation caused pain in only 19%. These higher numbers may be due to irritation of the urine on superficial wounds from delivery. We found that pain during micturition was gone after approximately nine weeks. To the contrary, the prevalence of perineal pain during defecation only diminished by 1% and the VAS score increased by one point. Further research should focus on these prevalent pain complaints during defecation in the postpartum period. Perhaps women are straining to achieve a bowel movement. The consistency of the stool can change as a result of hormonal influences [27]. It is also possible that some of the subjects feel pain due to dyschezia or coccygodynia. The prevalence of postpartum constipation has been estimated to be up to 24% at three months postpartum [27]. Lactulose has shown to be effective in treating these types of constipation [28]. However, it would also be interesting to study the influence of the pelvic floor muscle activity on constipation and pain during defecation.

Perineal trauma causing pain that persists beyond the immediate postpartum period may also have longer-term effects, such as painful sexual intercourse for up to 18 months after giving birth [29,30]. The results of the present study also indicate that sexual intercourse and defecation were provoking perineal pain at approximately 9 weeks postpartum in 30% and 18% of our group, respectively. In the present study, the most important fact was that none of the subjects felt perineal pain during a PFMC.

The limitation of the present study is that some data were self-reported, although most were obtained through medical records. However, the use of a visual analogue scale for pain is in the pelvic floor is valid and reliable [31]. The prevalence of perineal pain is rather high, but the VAS scores are relatively low. This could be due to the common use of painkillers prescribed on the maternity ward. And the scant number of forceps delivery, limit the results for these patients. Although performing PFMT short after forceps delivery seems to have more advantages than performing these exercises later in the postpartum period [6]. And, finally, we have not used diaries to collect data during the period in between the first and the second evaluation. Therefore only the data of the first evaluation and the data about pain felt at the moment of the seconds questionnaire are valid. Recall bias could have influenced the pain scores of the intermediate period.

To conclude, perineal pain is highly prevalent immediately after childbirth during ADL, micturition and defecation, but not during pelvic floor muscle contraction. If pain occurs during pelvic floor muscle contraction, its intensity is low. Starting pelvic floor muscle training shortly after childbirth is possible in the majority of women and fear of perineal pain should not be an obstacle. Further research should be done to reveal if initiation of PFMT immediately

after childbirth may reduce the prevalence of pelvic floor dysfunction later postpartum.

Conflict of interest

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

Financial disclaimer/conflict of interest

None.

Contribution to authorship

H Neels: Project development, data collection, management data analysis, manuscript writing.

S De Wachter: Project development, manuscript editing.

JJ Wyndaele: Project development, manuscript writing/editing.

M Wyndaele: management data analysis, manuscript editing.

A Vermandel: Project development, manuscript writing/editing.

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5

COMMON ERRORS

Common errors made in attempt to contract the pelvic floor muscles in women early after delivery: A prospective observational study.

A person who never made a mistake never tried anything new.
Albert Einstein

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Common errors made in attempt to contract the pelvic floor muscles in women early after delivery: A prospective observational study

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ABSTRACT

Objectives: The ability to perform a correct pelvic floor muscle contraction (PFMC) is necessary to start pelvic floor muscle training after delivery. COMMOV are "**c**"ontractions of "**o**"ther "**m**"uscles (m. rectus abdominus, the gluteal muscles, and the adductors), and other "**mov**"ements (pelvic tilt, breath holding, and straining) performed in addition to or instead of the PFMC. COMMOV are probably the most common errors in attempt to contract the pelvic floor muscles during the first days after delivery. The aims of this study were to observe the prevalence of COMMOV, to investigate whether COMMOV influence the ability to perform a PFMC, and whether verbal instructions are effective to unlearn the COMMOV postpartum.
Study design: A Prospective Observational Study was performed in women during the first through sixth day postpartum. PFMC and COMMOV were evaluated with visual observation. Women who did not show correct isolated PFMC received verbal instructions and were re-evaluated. Interobserver variability and agreement were calculated. Chi-square, Kappa, Risk Ratio, and McNemar were used.
Results: A total of 382 women participated, 2.36 (±1.2) days postpartum. Twohundred sixteen, 57%, CI (52–62%), showed COMMOV. The chance to perform a correct PFMC was 2.65 times higher without COMMOV (p = 0.0001). Verbal feedback was effective (57% reduced to 3%) to abandon COMMOV during PFMC.
Conclusion: COMMOV are common errors performed during attempts to contract the pelvic floor muscles after delivery. They can reduce the ability to contract the pelvic floor muscles, but can easily been unlearned with visual observation and verbal feedback.

Introduction

Symptoms related to pelvic floor dysfunction (PFD) including urinary incontinence (UI), fecal incontinence (FI), pelvic organ prolapse, and sexual problems are common in women. They can impose a significant burden [1] and are associated with high cost of additional care [2]. Pregnancy and childbirth are two of the most important causal factors of PFD [3]. Up to 64% of pregnant women experience UI during pregnancy [4], about a third have UI after childbirth, and up to 10% have FI [5,6].

Pelvic floor muscle training (PFMT) is recommended as first-line treatment peripartum for both prevention and treatment of UI and FI [5,7,8]. One-to-one PFMT for prolapse was shown to be effective for improvement of prolapse symptoms [9].

But prior to starting PFMT, the importance of an assessment of the pelvic floor muscle contraction (PFMC) has been emphasized [8]. This becomes necessary since up to 30% of women are unable to perform a correct PFMC during their first attempt [10]. Visual observation of the inward movement of the pelvic floor muscles (PFM) is effective to evaluate the PFMC and verbal feedback to improve the PFMC, have a positive effect [10,11].

An isolated submaximal voluntary contraction of the PFM is possible, while a maximal PFMC most likely results in co-contraction of transversus abdominis and the obliquus muscles [12,13]. Common errors have been registered during attempts to contract the PFM: some women (co-)contract the gluteal muscles,

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hip adductors, or abdominal muscles [14] or stop breathing, perform a pelvic tilt or straining. But, to the best of our knowledge, there is no consensus found as to whether these "**c**"ontractions of "**o**"ther "**m**"uscles (gluteal muscles, adductors, rectus abdominus) and common "**mov**"ements (breath holding, pelvic tilt, straining) (COMMOV) performed in addition to or instead of a PFMC are supportive or rather an impediment to the performance of a PFMC. Although they could disturb the woman's sensory awareness and the proprioception of the PFM [13].

It has been shown that an early start of PFMC after delivery is advisable to prevent and treat PFD [15]; and performing PFMC immediately after childbirth does not cause any burden or pain [16].

The aims of this study are to examine COMMOV performed in addition to or instead of the PFMC immediately after childbirth, to investigate whether they influence the performance of a PFMC, and whether verbal feedback is effective to unlearn COMMOV.

Materials and methods

A prospective observational study was performed in women early after delivery to study the prevalence and influence of COMMOV on PFMC. Effectiveness of verbal feedback was studied with a pretest and posttest design evaluating COMMOV before and after verbal feedback. Women were recruited postpartum (day 1–6) during their stay in the Antwerp University Hospital. Good knowledge of Dutch, French, or English language was a prerequisite for inclusion. Exclusion criteria were the presence of an indwelling bladder catheter and a newborn in critical condition. Written informed consent was obtained from all participating women. The study was approved by the local ethics committee (B300201422643).

Age, weight before pregnancy and on the day of the delivery, body height, gravidity, and parity of the participants were gathered from the medical records. A physiotherapist experienced in women's health asked the women whether they experienced perineal pain (Visual Analogue Scale), UI before and during pregnancy, had hemorrhoids, ever received information about PFM, ever previously learned a PFMC, and whether they felt afraid to exercise due to pain.

Information about PFM anatomy and functions and the possible consequences of pregnancy and delivery was given. The meaning of the squeezing contraction and the necessity of an internal displacement during PFMC were explained. Instructions on how to perform a PFMC were given by the description "squeeze and lift your PFM as if trying to stop the flow of urine."

The evaluation was done in the supine position, with hips and knees bent, soles flat on the same level of the trunk, in the hospital bed. All clothes of the lower body were removed. In order to respect the setting early after delivery, PFMC were evaluated with a validated visual observation on a three-grade scale (grade 0 = no movement; grade 1 = weak movement; grade 2 = strong inward displacement/lift of perineum). Grade 2 was accepted as sign of a correct PFMC [10]. Concomitantly contracting m. rectus abdominus, the gluteal muscles, and the adductors, or a pelvic tilt, breath holding and straining were considered to be COMMOV. The performance of COMMOV was also evaluated with visual observation. Women who did not show correct isolated PFMC, or who performed COMMOV, received more detailed verbal instructions on how to contract the PFM specifically without the concomitant contraction of the m. rectus abdominus, the gluteal muscles, and the adductors, without tilting their pelvis or straining and while they were continuing to breath normally. They were re-evaluated afterwards.

The observation was done while the women performed nine consecutive contractions, with evaluation and feedback after three, six, and nine attempts to contract PFM. Women were asked if they felt the PFM contracting.

In 32 women, the evaluation and scoring of PFMC and COMMOV through visual observation was done simultaneously by two independent observers (physiotherapists) to determine interobserver variability.

Sample size was counted on the aim to estimate the prevalence of COMMOV. With 329 patients, one can estimate a prevalence of 50% COMMOV with a precision of 7% (95% confidence interval). Level of significance was chosen on 0.05. Statistical analysis was carried out using SPSS version 24.0 for Windows. Descriptive statistics, Risk ratio, Wilcoxon, McNemar, Kappa statistics and Chi-Square tests were used.

Results

Three hundred eighty-two (199 primiparous; 183 multiparous) women participated in the study immediately after delivery, 2.36 (±1.2) days postpartum. Descriptive statistics of the demographic characteristics and the data obtained through questioning about perineal pain, hemorrhoids, UI, and information about PFM and exercises are presented in Tables 1 and 2.

Sixty-six percent of all participants were informed about PFM before, 65 (25%) through pregnancy information evenings, 53 (21%) through prenatal physiotherapy, and 74 (29%) when having an earlier delivery. Table 3 presents the influence of parity on the information women already received before delivery. Significantly more multiparous women were informed about PFM, learned PFM exercises before delivery, and had been controlled during a PFMC.

At the first evaluation 224 [59%, CI (54–64%)] women performed a correct PFMC, 69 [18%, CI (15–23%)] were not able to contract the PFM. After one or two sessions of verbal feedback, only two women scored zero on PFMC, 341 [90%, CI (86–92%)] performed a correct PFMC. Table 4 presents the prevalence of PFMC immediately after childbirth, obtained through verbal feedback.

The prevalence of COMMOV is also presented in Table 4. Two hundred sixteen women [57%, CI (52–62%)] performed at least one of the following COMMOV: contraction of m. rectus abdominus, the gluteal muscles, the adductors, or a pelvic tilt, breath holding or straining. Contraction of the m. rectus abdominus [n = 131; 35%, CI (30–40%)], breath holding [n = 123; 33%, CI (28–38%)] and contraction of the gluteal muscles [n = 84; 22%, CI (18–27%)] were the most common.

If COMMOV were observed the ability to perform a correct PFMC was significantly (p = 0.0001) lower. Of 216 (57%) women with COMMOV, only 75 (20%) showed a correct PFMC. The chance for a correct PFMC is more than doubled in the absence of COMMOV (RR = 2.65).

Table 1
Participant's demographic characteristics (N = 382).

	Mean (±SD)	Range (MIN-MAX)
Participants characteristics		
Days postpartum	2.36 (±1.16)	0–7
Age (years)	30.74 (±4.91)	16–44
Weight before pregnancy (kg)	65.81 (±11.66)	42–118
Weight before delivery (kg)	79.05 (±13.31)	49–133
Weightgain (kg)	13.00 (±6.35)	0–35
Body Height (cm)	166.57 (±6.81)	148–186
BMI before pregnancy	23.68 (±3.84)	17.0–39.4
Gravidity	2.02 (±1.31)	1–12
Parity	1.68 (±0.95)	0–9

BMI = Body Mass Index, SD = Standard Deviation, Min = minimum, Max = Maximum.

Table 2
Influencing factors on the presence or absence of COMMOV in women immediately after delivery (N = 382).

Question (Yes anwers)	Missing	n (%)	n (%) without COMMOV	N (%) with COMMOV	P value
Perineal Pain (VAS 3.93 ± 1.85)	12	157 (42)	67 (18)	90 (24)	0.867
Hemorrhoids	25	82 (23)	33 (9)	49 (14)	0.568
Information received about PFM	1	251 (66)	112 (29)	139 (37)	0.369
Learned PFME before delivery	2	183 (48)	88 (23)	95 (25)	0.053
PFME were controlled before delivery	7	79 (21)	43 (12)	36 (9)	0.021*
Fear of pain during PFME	21	61 (17)	26 (7)	35 (10)	0.688
UI before pregnancy	7	68 (18)	30 (8)	38 (10)	0.739
UI during pregnancy	7	206 (55)	88 (24)	118 (32)	0.281

COMMOV (Contraction of other muscles and common movements performed in addition to or instead of the specific pelvic floor muscle contractions); Chi-square test was performed to calculate the influence on the prevalence of COMMOV (*significant influence if $p < 0.05$); Question (Y/N) = Yes or no questions were asked, n (%) prevalence and percentage of Yes-answers are presented; UI = Urinary Incontinence; PFME = pelvic floor muscle exercises.

Table 3
The influence of parity on education of PFME; peripartum complaints, COMMOV and PFMC.

	Primipara (N = 199) n (%)	Multipara (N = 183) n (%)	p-value
Perineal Pain	95 (47)	62 (34)	0.022*
Hemorrhoids	43 (21)	39 (22)	0.685
Information received about PFM	121 (60)	130 (73)	0.010*
Learned PFME before delivery	72 (36)	111 (62)	<0.001*
PFME were controlled before delivery	9 (5)	68 (38)	<0.001*
Fear of pain during PFME	35 (18)	26 (15)	0.491
UI before pregnancy	20 (10)	48 (27)	<0.001*
UI during pregnancy	97 (49)	109 (61)	0.008*
COMMOV	111 (56)	103 (58)	0.761
PFMC	120 (60)	101 (55)	0.707

PFME = Pelvic Floor Muscle Exercises; COMMOV (Contraction of other muscles and common movements performed in addition to or instead of the specific pelvic floor muscle contractions); PFMC = Pelvic Floor Muscle Contraction, Chi-square test was performed to calculate the influence of parity on the prevalence of yes-answers to these questions (*significant influence if $p < 0.05$); n (%) prevalence and percentage of Yes-answers are presented; UI = Urinary Incontinence.

Table 4
The prevalence of PFMC and COMMOV immediately after childbirth (N = 382).

	Missing (n)	Effort 1 n (%)	Effort 2 n (%)	Influence of feedback	Effort 3 n (%)	Influence of feedback
Evaluation of PFMC	4					
Score 0		69 (18%)	12 (3%)		2 (0.5%)	
Score 1		85 (22%)	48 (13%)		35 (9%)	
Score 2		224 (59%)	318 (84%)		341 (90%)	
Evaluation of COMMOV	4	216 (57%)	65 (17%)	<**0.001***	12 (3%)	<**0.001***
Commov: Glut Max	6	84 (22%)	15 (4%)	<**0.001***	4 (1%)	**0.007***
Commov: RA	0	131 (35%)	32 (9%)	<**0.001***	2 (0.5%)	<**0.001***
Commov: Pelvic tilt	0	36 (10%)	0 (0%)		0 (0%)	
Commov: Add	0	29 (8%)	12 (3%)	<**0.001***	2 (0.5%)	**0.002***
Commov: breath holding	5	123 (33%)	34 (9%)	<**0.001***	7 (2%)	<**0.001***
Commov: pushing mov	5	5 (1%)	0 (0%)		0 (0%)	

Evaluation PFMC = visual evaluation of pelvic floor muscle contraction; Evaluation COMMOV (Y/N) = Visual evaluation of Contraction of other muscles and common movements performed in addition to or instead of the specific pelvic floor muscle contractions, yes or no answer: prevalence and percentage of yes answers is presented; Glut Max = contraction of Gluteus maximus; RA = contraction of Rectus Abdominis, Add = contraction of adductors; pushing mov = outward pushing movement of the pelvic floor. The influence of verbal feedback is counted with Mc Nemar test, if <0.05 results were considered significant and an * was added.

The prevalence of all COMMOV was significantly ($p < 0.05$) reduced after verbal feedback and instruction (Table 4). After one session of verbal feedback, a total of 151 (40%) women showed no more COMMOV; in 65 (17%) women COMMOV persisted. The contraction of m. rectus abdominis (32 (9%)) and breath holding (34 (9%)) were the most difficult COMMOV to avoid. After a second session of verbal feedback, COMMOV persisted in 12 (3%) women. The chance of a correct PFMC was significantly higher in women who learned not to perform COMMOV ($p < 0.0001$) after verbal feedback, which demonstrates that verbal instructions are effective to unlearn COMMOV and improve PFMC.

The results showed that if perineal pain (157 (42%)) was present, feelings of fear concerning exercise (61 (17%) were significantly more prevalent ($p < 0.0001$)). The Chi-square test ($p = 0.867$) regarding the influence of perineal pain on the prevalence of COMMOV was not significant. Neither was the influence of fear to exercise on the prevalence of COMMOV ($p = 0.373$).

Table 3 shows a significantly higher occurrence of perineal pain in primipara; and a significantly higher occurrence of UI before and during pregnancy in multipara. The data in Table 2 show the influencing factors on the presence or absence of COMMOV in women immediately after delivery. Women who's PFMC had been

controlled before (with observation or palpation), and received feedback about PFMC and avoiding COMMOV before delivery, performed significantly less COMMOV during our evaluation [79 (21%), p = 0.021].

The agreement between the specialist observation and the woman's pelvic floor awareness was moderate (k = 0.565). The occurrence of COMMOV did not negatively influence the agreement.

The agreement between observations of two specialized pelvic floor physiotherapists was high (k = 0.832).

Comment

The ability to perform a correct PFMC is a necessary prerequisite for PFMT after delivery. Nearly 57% of the participants of this study performed COMMOV during or instead of a PFMC attempt. The most prevalent COMMOV were contraction of the m. rectus abdominus, breath holding, and contraction of the gluteal muscles. The results showed that COMMOV might interfere with a good PFMC, but are not difficult to unlearn after verbal instructions.

Previous research found that about one to three women are not performing a PFMC correctly after delivery [10], if they only received information about the PFM and instructions to contract their muscles as if they would stop urination. However, it has also been shown that visually observing the performance of a PFMC, and adding verbal instructions to improve the PFMC, is effective [10]. The results of the current research show similar outcomes. In addition, the current research also focused on the sensory awareness of the PFMC immediately after delivery. We found that the agreement between the specialist observation and the woman's pelvic floor awareness was only moderate (k = 0.565). If women were performing COMMOV, their pelvic floor awareness was not significantly diminished. These results show that the impact of pregnancy and delivery on the sensory awareness of the muscles may not be ignored: secondary neurapraxia and vascular damage may cause temporary (partially) loss of motor and sensory function. Therefore individual control and verbal instructions are necessary to countervail these limitations and improve the PFMC.

The results of this research show that visual observation and verbal instructions based on these observations are effective to unlearn COMMOV. We found that only 2% of the participants were unable to avoid COMMOV after feedback.

Sapsford et al. showed that minimal abdominal muscle activity (m. transversus abdominus and m. obliquus internus) is normal during PFM exercises [17]. In our current research, however, our goal was to isolate the PFMC specifically without a maximal contraction of the abdominal muscles, because that causes an increase of abdominal pressure, which could bulge the perineum caudally [18]. Excessive undifferentiated recruitment of other muscles (gluteal muscles, abdominal muscles and adductors) will reduce the focus on the PFM and will prevent the woman from learning appropriate control [19].

Nevertheless, PFMT should not only consist of isolated PFMC. Simultaneous contraction of the abdominal muscles during attempts of a maximal PFMC can be important to achieve the best training effects in PFMT [11,17]. Also a good relaxation is necessary. Short, tender, and/or hypertonic PFM may worsen certain symptoms such as UI, pain, dyspareunia, and anorectal disorders [20].

Variables such as age, days post-delivery, parity, birth weight, episiotomy or perineal tear, epidural anesthesia, and cesarean section were not included because previous research performed on over 900 women post-delivery found no significant influence of these on the ability to perform a PFMC [10]. The current research revealed that the complaint of UI, before and during pregnancy, and hemorrhoids did not influence the prevalence of COMMOV. In addition, no significant influence was found if the women received information about the PFM and learned to perform PFMC before our study visit. As every woman in our study received information about the PFM and an explanation of how to perform PFMC before the visual observation, this may have biased the results. The only group of women that showed significantly less COMMOV were those who had an individual assessment of the PFMC before delivery, as during prenatal physiotherapy, during an assessment with the gynecologist or midwife, or during earlier postpartum physiotherapy sessions given after the delivery of an older child. We found that multiparous women who received information or PFM exercises without individual control were not better in performing an isolated PFMC. These results again emphasize the need to make an individual assessment of the PFMC in every woman. Nevertheless, we acknowledge that further investigation with longitudinal studies is needed to study the permanence and compliance of the feedback effect in the long run, and to investigate whether the ability to perform isolated PFMCs without COMMOV result in less PFD and its related symptoms, such as UI and FI.

In the current study we chose visual observation to evaluate a contraction of the m. rectus abdominus, gluteal muscles, and adductors instead of surface EMG testing. Surface EMG is a reliable and valid assessment method for muscle activity, and intramuscular electrodes are used for deep muscles activity [17]. In the current study, however, we were not looking for detailed parameters such as time and intensity of the muscle contractions, endurance, and exhaustion. We were interested in a non-invasive approach shortly after delivery. The reliability of surface EMG of the abdominal muscles immediately after delivery is not strong because of the possible diastasis of the recti and the altered morphology of the abdominal wall [18]. To evaluate the added movements such as breath holding, pelvic tilt, and pushing, visual observation was also preferred in the context of our study. We did not use biopressure feedback through stabilizers to assess a pelvic tilt [19] because the assessment was performed in a hospital bed. Neither was it practical to use a thoracic expander belt for the assessment of breath holding [20] in women immediately after delivery. Therefore, the visual assessment alone is a main strength of this study: it seems to be reproducible (interobserver reliability was very strong (k = 0.832)) and especially because this assessment can easily be done at most facilities even in lower resource settings. The visual observation and verbal instructions can easily been applied through nurses, midwifes, physiotherapists and gynecologists. Therefor the results of this large prospective observational study could be contributing to clinical relevant guidelines to improve the quality of women's healthcare postpartum.

In conclusion, contraction of the m. rectus abdominus, breath holding, and contraction of the gluteal muscles are the most common errors observed in attempt to contract the pelvic floor muscles immediately after childbirth. These errors (COMMOV) were associated with a reduced ability to perform correct PFMC, but were easily unlearned after verbal feedback. Visual observation of such COMMOV is reliable. Taking into account that PFM exercises are highly recommended during the postpartum period, it should be investigated whether the successful education of an isolated PFMC immediately after delivery guarantees that exercises will be performed correctly at home.

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6

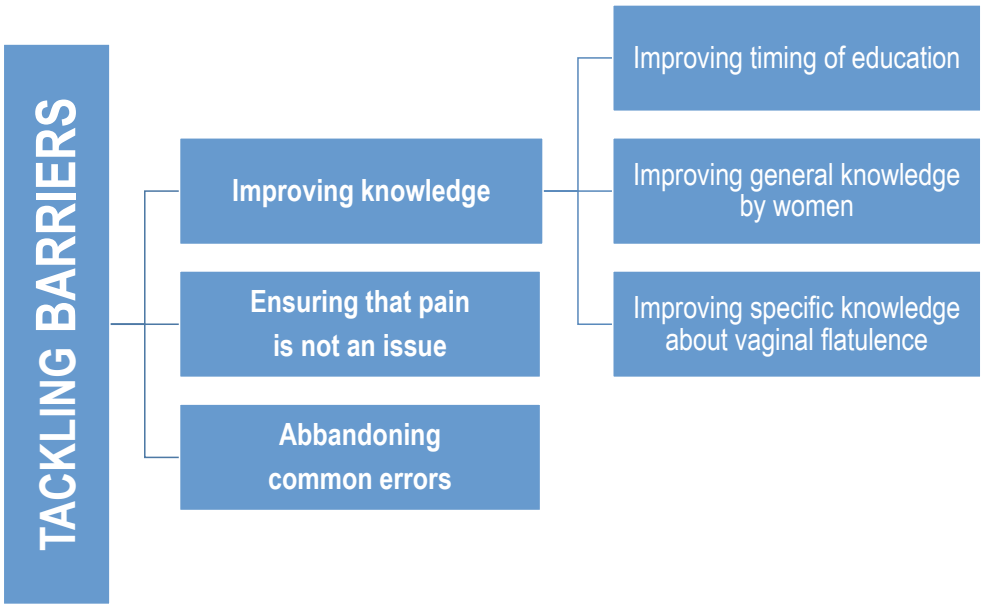
GENERAL DISCUSSION

Remember to celebrate milestones as you prepare for the road ahead.
Nelson Mandela

CHAPTER 6 General Discussion

6.1 Tackling barriers to prevention of PFD in women

Figure 6. Tackling Barriers to prevention of PFD in women



6.1.1 Improving knowledge

6.1.1.1 Improving general knowledge by women

Although the research for this thesis did not specifically address the question concerning the best time to reach women with information about the pelvic floor and PFMT, the results of our studies indicated that if we wait until a woman experiences pregnancy and delivery, the options for primary prevention are diminished.

Our results prove that young nulliparous women, and even adolescent girls, are interested in the pelvic floor. Therefore we propose that **primary prevention** should occur **much earlier in their lifecycle**. Our research also emphasizes that women of all ages, and specifically young women, do not seek such information on their own initiative. We found this to be a surprising result, especially in this world of readily

available digital information resources and social media. It was recently confirmed by others in a high level qualitative study of postnatal women that women rarely search information about the pelvic floor as well as prevention and treatment of PFD on their own (1).

Therefore we assume that integrating pelvic floor education **in the curriculum** of adolescent girls in high schools would be a major step in the right direction. This strategy would, on the one hand, be the perfect opportunity to instill knowledge that could **prevent PFD**. And, on the other hand, informing young girls and boys about the pelvic floor and possible PFD could **diminish the taboo** that still exists about discussing PFD if it is experienced later in life (2).

Primary prevention through early education will not cover all problems. Pregnancy and delivery will remain important risk factors for PFD and cannot be avoided in some women's lives (3, 4). Therefore, we argue that pelvic floor education should certainly be repeated before, during, and after pregnancy. We should strive for the same outcomes: empowerment of primary prevention and encouraging women to effectively deal with PFD if it develops later in life (= secondary and tertiary prevention). If women become better informed and are **aware** of the existing possibilities to treat PFD, we assume that **help-seeking behavior** will grow (2, 5, 6) and the taboo will diminish. Our results show that women often have misperceptions about PFD. Other research has also shown that there exists "a climate of normalization" about PFD: women hear of the PFD experiences of others and this leads to the conclusion that PFD is a normal consequence of their pregnancy and delivery, and that they should not complain about it (1). Commercials shown on television and social media for incontinence pads are considered to be normal in our society and promote that using the newest incontinence materials, would be the easiest solution for women with PFD symptoms. Which gives those women a distorted picture. Wearing incontinence pads is unpleasant for every women regardless of age. On the contrary, well-written professional information about the pelvic floor and PFD, and about the best treatment options (such as PFMT), could change the idea that PFD symptoms are normal in women. Improving knowledge through good education could, therefore, facilitate **secondary prevention** (=reducing the impact and appropriate treatment of PFD). It has also been shown that **raising the awareness** for a specific disease, disorder, or dysfunction will **increase adherence** to therapy (7, 8).

Finally, it is important to emphasize the need for continuing awareness and prevention of PFD in older women. Aging is also one of the most important though inevitable risk factors for PFD (3). Part of our research clearly found that post-menopausal women also have a poor knowledge about these topics. Fifty-six percent of them were never informed during their pregnancy or postnatal exercises, but received information much later (9). In our study, we did not collect data to present prevalence of PFD scores of post-menopausal women, but it could be assumed that those women who received information recently were probably those who were suffering from PFD. Further research to confirm our assumptions should be performed, but repeating or introducing pelvic floor education would most likely empower **secondary and tertiary prevention** in this group (10). Although these women also wanted to become better informed, they did not seek education or help on their own. One of the possible reasons could again be the **taboo that still exists** about PFD and the misperception, for example, that "leaking urine is normal as you grow older".

To conclude, if the question is raised as to the most appropriate timing for pelvic floor education, we can propose a single and easy answer: education should be given at three milestones in the female lifecycle. First, at adolescent age, second during the perinatal period and third when women approach the menopause. While pelvic floor education itself will not be the ultimate solution to avoid PFD in women, our research was the first to emphasize the need to introduce pelvic floor education much earlier in life (i.e., adolescence). We assume that **repeating the information** later in life can only be beneficial. **Therefore, improving women's knowledge and increasing their awareness of PFD could make primary, secondary, and tertiary prevention more effective.**

Recently, Cooke et al. published some interesting results about the **attitudes of urogynaecology providers** toward postnatal PFD (11). They collected data from 372 healthcare providers, of whom most were obstetricians, urogynaecologists, and obstetrics/gynaecology trainees; only a minority (less than 4%) were nurses, midwifes, or physiotherapists. They found that 99 (33%) participants denied asking patients about PFD prenatally and 75 (25%) postnatally; moreover 118 (39%) denied counseling on PFD prevention in general and 113 (38%) denied advising on antenatal PFMT. Although 254 (77%) expressed their positive beliefs regarding the protective effect of antenatal and postnatal PFMT as well as risk modification (e.g. smoking, diet,

BMI)(11). This, is contrary to the findings of Wagg et al. who found that health professionals were concerned about a lack of time and knowledge to inform women properly and were uncertain of the effect of pelvic floor muscle exercises due to some research indicating improvement may not be maintained over time (1). It should be noted that they performed qualitative research, using two multi-disciplinary focus groups, each with one general practitioner, two (continence) nurses, and one midwife. With such results, it is therefore speculative to conclude that specialized medical doctors would have greater belief in prevention of PFD through PFMT compared to general practitioners and midwives. Further research is necessary.

The results of Wagg et al. confirmed that women were willing to talk about PFD postnatally, but preferred the health professional to initiate discussion (1). Similar results were also published in 2001 by Mason et al (7). Women were reluctant to seek help, although they were often inconvenienced and troubled by their symptoms of PFD. They expressed their belief that health professionals should seek out information about occurrence and symptoms of PFD, rather than the women themselves broaching the subject (7). The results of our own research are similar, but even more extended. Women of all ages, adolescent, nulliparous, multiparous or post-menopausal, all showed poor help-seeking behavior in terms of searching for good information about PFD, but all expressed an interest in the topic. Therefore, **all health professionals caring for women need to raise awareness** of the condition, the treatments available, and to be pro-active in seeking out those experiencing incontinence and other symptoms of PFD , rather than expecting women to approach them for help.

Obstetricians, gynecologists, urologists, midwives, incontinence nurses, and physiotherapists are all educated to inform women about PFD. Therefore, all members of the **multidisciplinary** women's health team should contribute to increase primary and secondary prevention of PFD. We assume that introducing education earlier in life, as has been mentioned above, would be promising as a means to improve primary prevention. However, we need to acknowledge that other **sources of information** should also be investigated because young asymptomatic adolescent girls will likely not have significant contact with the multidisciplinary team of health professionals that are available for women during pregnancy, following birth, or later in life.

6.1.1.2 Improving specific knowledge of vaginal flatulence

The results of chapter 3 brought to light the lack of knowledge about vaginal flatulence. Vaginal wind is an understudied health issue which can have a severe impact on sexual functioning and quality of life (12). Little is known about the factors leading to vaginal flatulence (e.g. sexual activity, weight, age, parity), the underlying pathophysiological mechanisms, prevention, and treatment. Further research is needed to clarify the underlying mechanisms, better define the symptoms, and develop assessment tools. Hopefully, if more is known about vaginal flatulence, options to treat and prevent it will become clear. Education of healthcare providers and women will again be the first step toward **raising awareness** of the problem, **breaking the taboo** about this topic, and **improving the quality of life of women** suffering from this embarrassing problem.

6.1.2 Ensure that pain is not an issue

Pregnancy and delivery are some of the most important risk factors for PFD (3, 4). Therefore in many women secondary prevention of PFD is necessary to reduce its impact during pregnancy and/or after delivery. According to the WHO definition, **early detection and appropriate treatment** are key factors for **secondary prevention** (10). PFMT has been shown to be the first-line treatment option for PFD after delivery. It is also effective in the prevention of PFD in those women who are asymptomatic (= **primary prevention)** (13, 14). Therefore, early onset of PFMT would be advisable following pregnancy and delivery. Moreover, recent research has revealed that if PFMT is started early after obstetrical anal sphincter injuries (OASI) (i.e., within 30 days) there is a reduction in anal incontinence compared to PFMT given within six to eight weeks postpartum (15). On the contrary, many women experience perineal pain immediately after delivery and therefore have fear of starting exercises of the pelvic floor muscles too soon after delivery (16, 17).

Our research was the first to reveal that perineal pain is highly prevalent immediately after childbirth during activities of daily living (ADL), micturition, and defecation, but not during the basic exercise of PFMT, which is a PFMC. In the event where perineal pain occurred during PFMC (only 8%), the intensity of pain was low (mean VAS 2) and did not adversely affect the PFMC (18). **These results show that fear of perineal pain**

should not be a barrier for women to start pelvic floor muscle training early after childbirth. Future longitudinal research should be performed to study the long-term benefits of an early onset of PFMT after childbirth, on PFD.

6.1.3 Abandoning common errors

The ability to perform a correct PFMC is necessary to start PFMT after delivery (19). Our research has defined the most common errors performed in attempting to contract the pelvic floor muscles in women soon after delivery. **COMMOV** is an acronym for the "**C**"ontractions of "**O**"ther "**M**"uscles and other "**MOV**"ements that can take place during PFMT. For example, the contraction of other muscles might involve the m. rectus abdominus, the gluteal muscles, and the adductors and other movements could include pelvic tilt, breath holding, and straining. COMMOV were observed in 57% of women in addition to or instead of the PFMC. COMMOV have been shown to **reduce the ability to contract the pelvic floor muscles**, but can easily been unlearned with visual observation and verbal feedback.

These results are similar to previous research that found about one in three women are not performing a PFMC correctly after delivery (20); but was the first to prove that common contractions of other muscles performed in addition or instead of a PFMC, are **disturbing the awareness** of a proper PFMC. This finding has clinical significance in that it needs to be emphasized that women should, at first, be taught to contract the pelvic floor muscles in isolation, without the burden of the undifferentiated recruitment of other muscles. This research was also the first to show that visual observation and instructional feedback are reliable and effective strategies to reduce the COMMOV and improve PFMC in women early after delivery. These are **low-cost interventions** that can easily be performed by a **multidisciplinary team** of women's healthcare providers. Midwives, gynecologists, general practitioners, physiotherapists, and postnatal women themselves should all be aware of common errors as a barrier to start proper PFMT after delivery. This barrier can easily been addressed and could **improve efficient PFMT as primary prevention** of PFD in asymptomatic women (13). According to the WHO, in **secondary prevention** early detection of PFD and appropriate treatment are key factors to reduce the impact of PFD after pregnancy and childbirth (10). We assume that both detection and treatment will be improved by

implementing our research conclusions: abandoning common errors, through visual observation and instructional feedback.

6.1.4 Other barriers along the path to prevention of PFD

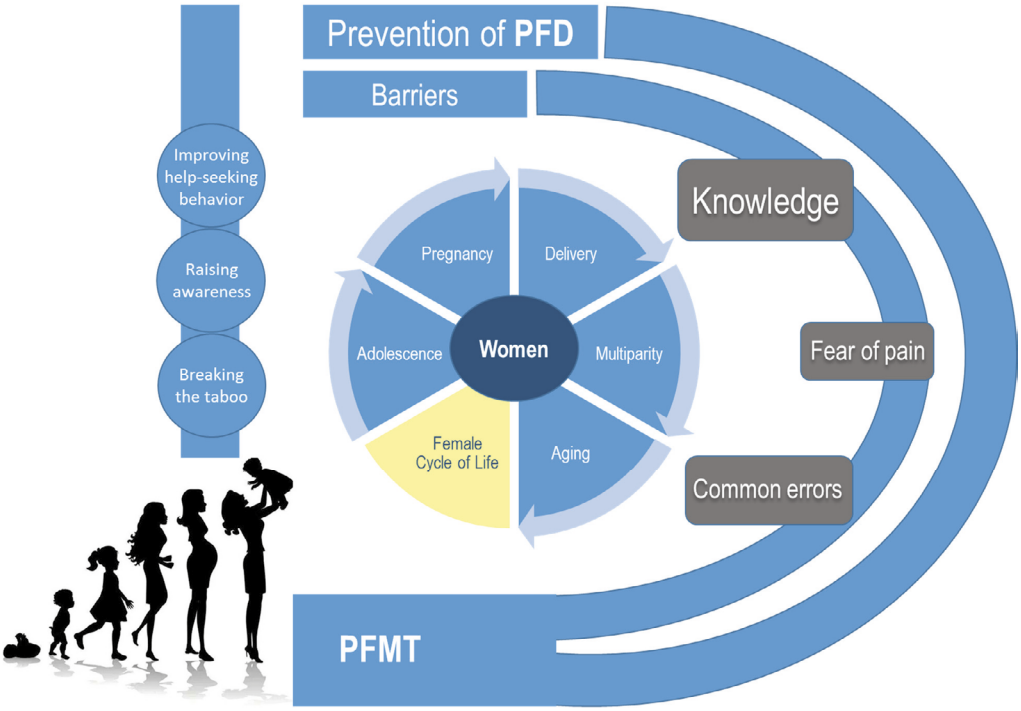
Epidemiological studies have shown that **obesity** is a strong and independent **risk factor for PFD** (21). The occurrence of UI increases up to 70% for each 5-unit increase in BMI (22). Being overweight is believed to cause UI through increased intra-abdominal pressure, increased intravesical pressure, stretching and weakening of the pelvic floor, and increased urethral mobility (23).

Although the etiology of urinary incontinence can be multifactorial, in some cases **weight loss** could be considered a necessary strategy in addition to the **primary, secondary, and tertiary prevention of PFD in overweight women**. We therefore performed a systematic review and meta-analysis, which showed evidence that a nonsurgical weight loss intervention has the potential to improve urinary incontinence and should be considered part of standard practice in the management of urinary incontinence in overweight women (24).

It would be interesting to investigate the **influence of weight increase due to pregnancy** and **weight retention after delivery** on the onset of PFD. Brown et al. reported an increased incidence of UI in pregnancy with increasing BMI before pregnancy (25). This leads to the assumption that women should strive to achieve normal weight before pregnancy (23). However, to the best of our knowledge, no randomized controlled studies have yet been performed to study the influence of weight loss interventions in pregnant women or women after delivery. The reduction of obesity before and after delivery could possibly yield a **new strategy** to prevent PFD **in parous women**.

6.2 Conclusion

Figure 7. Conclusion of the research: PFD in women: Tackling Barriers



The aims of this research were to study some of the possible barriers to PFMT in the prevention of PFD, and to tackle those barriers by proposing new strategies to empower primary, secondary and tertiary prevention of PFD.

Improving general knowledge about the pelvic floor and PFD in women of all ages should, in our opinion, be the first step in improving prevention and treatment of PFD. The timing as to when women should be informed about PFD should be decreased to the earliest childbearing years. Therefore, general information should be provided to adolescent girls in high schools since women of all ages are expressing interest in this topic, but fail to seek information on their own (9, 26, 27).

There is an important lack of evidence-based information about vaginal flatulence. Currently, vaginal flatulence is a taboo subject for most women who experience it and thus it is rarely discussed. Healthcare providers are often not aware of the problem, do

not ask their patients about it, and have no evidence-based guidelines to follow for the treatment of this condition. Further research will be needed to **improve the knowledge of healthcare providers** and to **increase the awareness** of this problem in women of all ages at risk of PFD. Better knowledge will increase help-seeking behavior in women who will need it the most (12).

Perineal pain is prevalent immediately after childbirth during ADL, micturition, and defecation, but not during a PFMC. Therefore, fear of **perineal pain should not discourage women from starting PFMT**, the first-line treatment and prevention intervention of PFD, shortly after childbirth (14, 18).

Common errors performed during attempts to contract the pelvic floor muscles (COMMOV) after delivery are: contraction of the m. rectus abdominus, breath holding, and contraction of the gluteal muscles. They are a barrier to the primary and secondary prevention of PFD because they reduce the ability to contract the pelvic floor muscles. The **common errors can easily be unlearned** with visual observation and verbal feedback.

This thesis was the first to highlight several barriers to prevention of PFD in women. But the results of this research have also shown that several low-cost strategies can be used to **tackle those barriers** and **improve primary, secondary, and tertiary prevention of PFD in women.**

6.3 Recommendations for future research

Although strategies have been formulated to address barriers to primary, secondary and tertiary prevention of PFD in women, it should be noted that further research will be necessary to study the effectiveness of the proposed strategies and their effects over the long term, preferably with randomized control trials and longitudinal research.

The current evidence available has not clearly demonstrated the **long-term effectiveness** of PFMT for PFD (13). The effectiveness of any training program will diminish with time, if the exercises are not continued (28). We assume that improving knowledge of PFD will raise awareness and will promote help-seeking behavior and a better adherence to therapy. Future research might indicate that interventions to improve PFMT (e.g. abandon common errors, start PFMC early after delivery) and

increase help seeking behavior (improved early education) should be repeated through the life cycle of women.

Further research should also be performed to address primary and secondary prevention of PFD in specific target groups, such as women who are performing **high-intensity sports**. Stress urinary incontinence does not occur exclusively in the postnatal period or in elderly women, but also in young female athletes (29-31).

Another recommendation for further research is to focus more specifically on **anal incontinence** in women. Anorectal dysfunctions are barely known by women. Only a minority of women ever receive a routine inquiry about it (before or after childbirth) from a healthcare provider and are advised to seek help (9, 32). However, Brown et al. found a prevalence of 20% in 5817 mature (age 45+) US women. It has been suggested that using the less intimidating terminology “accidental bowel leakage” instead of fecal incontinence, could decrease the embarrassment and improve detection and help-seeking behavior (33). Recently, it has been shown that an individually guided PFMT program for FI is a necessary element in the conservative treatment of postpartum anal incontinence (34). Although preventative measures such as education about high-fiber nutrition, physical activity, avoiding heavy lifting, good stool habits, positioning on the toilet, etc., could improve prevention of anal incontinence in women, more research is needed.

As has been mentioned before, more research should also be performed on **vaginal flatulence**. First we need to better define the underlying mechanisms and symptoms, as well as develop assessment tools. Also, epidemiological studies are needed to better define its prevalence and risk factors. Randomized control trials should also be performed to study treatment and prevention strategies.

Finally, the influence of weight increase and weight retention, associated with pregnancy, on PFD would be an interesting topic to study.

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SUMMARY
SAMENVATTING

SUMMARY

Pelvic floor dysfunction (PFD) in women is an important health care issue because of its high prevalence, its adverse effect on quality of life, and its impact on the healthcare system. Symptoms related to pelvic floor dysfunction (PFD) including urinary incontinence (UI), fecal incontinence (FI), pelvic organ prolapse (POP), and female sexual dysfunction (FSD) are common in women. The most important **risk factors** for PFD in general include age, multiparity, complicated vaginal deliveries, obesity, hysterectomy, respiratory problems, constipation, and menopause.

Although Pelvic Floor Muscle Training (**PFMT**) has been proven to be effective in the prevention and treatment of PFD in women during pregnancy and after delivery, the lifetime risk of PFD remains high. This raises questions about possible obstacles or barriers to the prevention and treatment of PFD.

Primary prevention aims to prevent the initial occurrence of PFD in asymptomatic women. S**econdary prevention** aims to reduce the impact of PFD (e.g., during pregnancy and after delivery). Therefore early detection of PFD symptoms (UI, AI, POP, FSD) and appropriate treatment, such as PFMT, should be promoted. **Tertiary prevention** aims to reduce the impact of existing PFD and its symptoms (UI, AI, POP, FSD), or to reduce the occurrence of relapses and the establishment of chronic PFD through effective PFMT.

The aims of this research were to study some of the possible barriers of PFMT in the prevention of PFD and to tackle those barriers by proposing new strategies to improve primary, secondary, and tertiary prevention of PFD.

In Chapter 3 we focused on the impact of **knowledge** of PFD. Several large cross-sectional survey studies were performed. A reliable and valid questionnaire (PelFloQ)

was constructed and distributed to women of different age groups. The results from 770 women (212 nulliparous, 402 peripartum, and 156 post-menopausal women) and 399 adolescent girls revealed insufficient knowledge and misperceptions about the pelvic floor among women of all ages. The data also showed that a major proportion of those completing the questionnaire were interested in becoming better informed. If education about the pelvic floor muscles, their (dys)function, and the possibilities of prevention and treatment of PFD is improved in women, the awareness about this important socio-economic problem could be raised. The results suggested that pelvic floor education should be introduced in adolescence and repeated throughout a woman's life cycle (e.g., during pregnancies and before menopause). Improvement of common knowledge could increase help-seeking behavior in women with symptoms of PFD and diminish the taboo.

Another study in Chapter 3 provided a systematic literature review of vaginal flatulence. The results brought to light the lack of specific knowledge about this condition among women and women's healthcare providers. Further research should be performed to improve specific knowledge about this understudied symptom of PDF.

In Chapter 4 we focused on the influence of **fear of pain** on the onset of PFMT. PFMT is the recommended first-line intervention to prevent and treat PFD during pregnancy and after delivery. But, as reported in the literature, there is a high prevalence (74-90%) of postpartum perineal pain after delivery. It has therefore been assumed that perineal pain is one of the reasons why women are afraid to start exercising the pelvic floor muscles early after delivery. The results of an observational longitudinal study performed on 233 women revealed that perineal pain was prevalent immediately after childbirth, during ADL, micturition, and defecation, but not during a pelvic floor muscle

contraction (PFMC). Therefore, fear of perineal pain should not discourage women from starting PFMT.

Chapter 5 focused on **common errors** performed during attempts to contract the pelvic floor muscles (COMMOV) after delivery. A prospective observational study was performed in 382 women immediately after delivery. The most commonly found errors were contraction of the m. rectus abdominus, breath holding, and contraction of the gluteal muscles. These results suggest that allowing these errors reduced the ability to contract the pelvic floor muscles in women immediately after childbirth. We found that COMMOV could easily be unlearned with visual observation and verbal feedback.

This thesis was the first to highlight several barriers to prevention of PFD in women. But the results of this research have also shown that several low-cost strategies can be used to reduce those barriers. Improving the general knowledge by women, improving specific knowledge about vaginal flatulence, and improving the timing of pelvic floor education are proposed. Also, reassuring women immediately after childbirth that pain will not be an issue if they start exercising the pelvic floor muscles. In addition, working to reduce common errors made by these women during a pelvic floor muscle contraction by visual observation and verbal feedback, could **improve primary, secondary, and tertiary prevention of PFD in women**.

These conclusions and the proposed strategies have **important clinical implications** in that they should **raise awareness** about PFD, could reduce **the taboo** about PFD, and could **improve help-seeking behavior** in women of all ages. Finally, recommendations for future research were included.

SAMENVATTING

Bekkenbodemdysfunctie (BBD) in vrouwen is een belangrijk probleem in de gezondheidszorg, om wille van de hoge prevalentie, het invaliderend effect op de kwaliteit van leven en de impact op de hele gezondheidszorg. Symptomen gerelateerd aan bekkenbodemdysfunctie, zoals urinaire incontinentie (UI), fecale incontinentie (FI), orgaanprolaps (POP) en seksuele dysfunctie (FSD) zijn veelvoorkomend in vrouwen. De belangrijkste **risicofactoren** voor BBD zijn leeftijd, multipariteit, gecompliceerde vaginale bevallingen, obesitas, hysterectomie, respiratoire aandoeningen met chronische hoest, constipatie en menopauze.

Hoewel de wetenschappelijke evidentie uitwijst dat **bekkenbodemspiertraining** effectief is in de preventie en behandeling van BBD in vrouwen gedurende de zwangerschap en na de bevalling, blijft de levenslange prevalentie van BBD erg hoog. Dit doet vragen oprijzen over mogelijke obstakels en hindernissen in de preventie en de behandeling van BBD.

Primaire preventie beoogt het voorkomen van het initiële optreden van BBD in asymptomatische vrouwen. **Secundaire preventie** beoogt de impact van BBD te reduceren, bijvoorbeeld gedurende de zwangerschap en na de bevalling. Daarom zouden een vroege detectie van BBD symptomen (UI, FI, POP, FSD) en een gepaste behandeling, zoals bekkenbodemspiertraining gepromoot moeten worden. En **tertiaire preventie** beoogt de impact van bestaande BBD symptomen te verminderen en het voorkomen van recidieven en het ontwikkelen van chronische BBD door effectieve bekkenbodemspiertraining.

De **doelstellingen** van dit onderzoek waren het bestuderen van mogelijke hindernissen voor bekkenbodemspiertraining in de preventie van BBD en die hindernissen neer te halen door nieuwe strategieën voor te stellen om primaire, secundaire en tertiaire preventie te verbeteren.

In Hoofdstuk 3 werd er gefocust op de impact van **kennis** over BBD. Verschillende grote cross-sectionele onderzoeken werden uitgevoerd. Een betrouwbare en valide vragenlijst (PelFloQ) werd opgesteld en verdeeld onder vrouwen van verschillende leeftijdsgroepen. De resultaten van 770 vrouwen (212 nullipare, 402 peripartum en 156 post menopauzale vrouwen) en 399 adolescente meisjes toonden een tekort aan van kennis en misvattingen over de bekkenbodem in vrouwen van alle leeftijden. En het

merendeel van de vrouwen was geïnteresseerd om beter geïnformeerd te worden. Indien de educatie over de bekkenbodem, bekkenbodem(dys)functie en de mogelijkheden van preventie en behandeling verbeterd zou worden, zou dit het bewustzijn over dit belangrijke socio-economische probleem kunnen verhogen. De resultaten suggereren dat bekkenbodemeducatie al op adolescente leeftijd zou moeten opgestart worden en herhaald zou moeten worden gedurende de levenscyclus van vrouwen (bijvoorbeeld tijdens zwangerschappen en de menopauze). Verbeterde algemene kennis over dit onderwerp zou het hulpzoekend gedrag van vrouwen kunnen verhogen en zou de taboe kunnen doorbreken.

Een andere studie in hoofdstuk 3 gaf een systematisch literatuur overzicht over vaginale flatulentie. De resultaten toonden aan dat er een tekort is aan specifieke kennis over vaginale flatulentie bij vrouwen en bij dienstverleners die werken in de vrouwelijke gezondheidszorg. Verder onderzoek zou uitgevoerd moeten worden om de kennis over dit weinig bestudeerde symptoom van BBD te verbeteren.

In Hoofdstuk 4 werd er gefocust op de invloed van **angst voor pijn** op het starten van bekkenbodemspiertraining na de bevalling. Bekkenbodemspiertraining wordt aangeraden als de eerstelijns interventie in de preventie en behandeling van BBD tijdens de zwangerschap en na de bevalling. Desalniettemin is, uit literatuuronderzoek geweten, dat er een hoge prevalentie (74-80%) van perineale pijn postpartum bestaat, net daarom, wordt er verondersteld dat perineale pijn één van de redenen is waarom vrouwen terughoudend zijn om bekkenbodemspieroefeningen op te starten na de bevalling. De resultaten van een observationele longitudinale studie, uitgevoerd op 233 vrouwen onthulden dat perineale pijn vaak aanwezig was onmiddellijk na de bevalling tijdens activiteiten van het dagelijks leven en tijdens mictie en defecatie maar niet tijdens het opspannen van de bekkenbodemspieren. Daarom zou perineale pijn vrouwen niet mogen ontmoedigen of afschrikken om bekkenbodemspieroefeningen op te starten.

In Hoofdstuk 5 werd er gefocust op de **meest voorkomende fouten** die uitgevoerd worden tijdens een poging om de bekkenbodemspieren op te spannen na de bevalling. Een prospectieve observationele studie werd uitgevoerd op 382 vrouwen onmiddellijk na de bevalling. De meest voorkomende fouten waren een contractie van de rechte buikspieren (m. rectus abdominus), de adem die werd ingehouden en het opspannen van de bilspieren (mm. gluteï). De resultaten suggereerden dat het uitvoeren van deze

fouten, samengaat met een verminderde mogelijkheid om de bekkenbodemspieren op te spannen na de bevalling. De veel voorkomende fouten kunnen echter gemakkelijk gecorrigeerd worden door visuele observatie en verbale feedback.

Dit doctoraat is het eerste onderzoek dat deze verschillende hindernissen voor de preventie van bekkenbodemdysfunctie in vrouwen benadrukt heeft. Maar de resultaten van deze studie hebben ook aangetoond dat er verschillende goedkope strategieën gehandhaafd kunnen worden om deze hindernissen neer te halen. Het verbeteren van de algemene kennis in vrouwen, het verbeteren van de specifieke kennis over vaginale flatulentie en het verbeteren van de timing van bekkenbodemeducatie werden voorgesteld. Ook zou het geruststellen van vrouwen dat pijn geen probleem zou mogen vormen voor het opstarten van bekkenbodemspieroefeningen onmiddellijk na de bevalling; en het afleren van fouten tijdens het opspannen van de bekkenbodemspieren, aan de hand van visuele controle en verbale feedback, een **verbetering kunnen brengen in de primaire, secundaire en tertiaire preventie van BBD in vrouwen.**

Deze conclusies en de voorgestelde strategieën hebben een belangrijke klinische implicatie, vermits verondersteld wordt dat ze het **bewustzijn over BBD** zouden kunnen verhogen, dat ze zouden kunnen helpen bij het doorbreken van het **taboe rond BBD** en **hulpzoekend gedrag** in vrouwen van alle leeftijden zouden kunnen verbeteren. Tot slot werden er aanbevelingen voor toekomstig onderzoek beschreven.

LIST OF ABBREVIATIONS AND DEFINITIONS

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ADL	Activities of Daily Living
AI	Anal Incontinence
BBD	Bekkenbodemdysfunctie
COMMOV	Contractions of Other Muscles (m. rectus abdominus, the gluteal muscles, and the adductors), and other MOVements (pelvic tilt, breath holding, and straining) performed in addition to or instead of the PFMC
FI	Fecal Incontinence
FSD	Female Sexual Dysfunction
ICF	International Classification of Functioning disability and health
ICS	International Continence Society
IUGA	International Urogynecological Association
m.	musculus
mm.	musculi
MultiP PP	Multiparous Pregnant women
NP	Nulliparous women
NulliP P	Nulliparous Pregnant women
OASI	Obstetric Anal Sphincter Injury
PelFloQ	Pelvic Floor Questionnaire
PF	Pelvic Floor
PFD	Pelvic Floor Dysfunction
PFMC	Pelvic Floor Muscle Contraction
PFME	Pelvic Floor Muscle Exercises
PFM	Pelvic Floor Muscles
PFMT	Pelvic Floor Muscle Training
PFT	Pelvic Floor Training
PG	Primi Gravid women
PMP	Post-menopausal women
POP	Pelvic Organ Prolapse
PP	Peripartum women
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-analyses
QOL	Quality of Life
SUI	Stress Urinary Incontinence

UI	Urinary Incontinence
VAS	Visual Analogue Scale
WHO	World Health Organization

TERMINOLOGY AND DEFINITIONS

Urinary Incontinence (UI)	Complaint of any involuntary leakage of urine
Anal Incontinence (AI)	Complaint of involuntary loss of feces or flatus
Fecal Incontinence (FI)	Complaint of involuntary loss of feces. A0 solid, b) liquid, c) passive fecal incontinence: such as soiling without sensation or warning or difficulty wiping clean, d) coital fecal incontinence: occurring with vaginal intercourse
Flatal incontinence	Complaint of involuntary loss of flatus
Pelvic organ prolapse (POP)	Prolapse symptoms: A departure from normal sensation, structure or function, experienced by the woman in reference to the position of her pelvic organs. Symptoms are generally worse at the times when gravity might make the prolapse worse (e.g. after long periods of standing or exercise) and better when gravity is not a factor e.g. lying supine. Prolapse may be more prominent at times of abdominal straining e.g. defecation.
Female Sexual Dysfunction (FSD)	Symptoms: Dyspareunia: complaint of persistent or recurrent pain or discomfort associated with attempted or complete vaginal penetration. Superficial (introital) dyspareunia: complaint of pain or discomfort on vaginal entry or at the vaginal introitus. Deep dyspareunia: complaint of pain or discomfort on deeper penetration (mid or upper vagina). Obstructed intercourse: complaint that vaginal penetration is not possible due to obstruction. Vaginal laxity: complaint of excessive vaginal laxity. Other symptoms.
Straining to defecate	Complaint of the need to make an intensive effort (by abdominal straining or Valsalva) to either initiate, maintain or improve defecation
Constipation	Complaint that bowel movements are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate.
Perineal Pain	Complaint of pain felt between the posterior fourchette (posterior lip of the introitus) and the anus
Dyspareunia	Complaint of persistent or recurrent pain or discomfort associated with attempted or complete vaginal penetration
Pelvic Floor Training (PFT)	Defined as repetitive selective voluntary contraction and relaxation of specific pelvic floor muscles
Pelvic floor muscle contraction (PFMC)	Voluntary contraction of the pelvic floor muscles and relaxation. May be assessed by visual inspection, by digital palpation

	(circumferentially), electromyography dynamometry, perineometry or ultrasound.
Primary Prevention	Primary prevention aims to prevent the initial occurrence of a disorder.
Secondary Prevention	Secondary prevention aims to reduce the impact of a disease or injury that has already occurred through early detection and appropriate treatment.
Tertiary Prevention	Tertiary prevention aims to soften the impact of an ongoing disease and its effects or to reduce the occurrence of relapses and the establishment of chronic conditions through, for example, effective rehabilitation.

Standardization of Terminology and Definitions (1-3)

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CURRICULUM VITAE

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Personalia

Surname	Neels
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Education

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2004 Bachelor in Rehabilitation Sciences and Physiotherapy - Great distinction
Catholic University of Leuven, Leuven, Belgium

2007 Master in Rehabilitation Sciences and Physiotherapy, musculoskeletal therapy - Great distinction.
Catholic University of Leuven, Leuven, Belgium
Master's thesis: "Reduced proprioceptive postural control variability in persons with low back pain causes postural instability." (promotor Prof. dr. S. Brumagne)

2016 Gunstig advies voor erkenning in de Bekkenbodemreëducatie en Perinatale Kinesitherapie.
Agentschap Zorg en Gezondheid, Vlaamse Overheid, Brussels, Belgium

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Employment

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2010 – 2018 Assistant Rehabilitation Sciences and Physiotherapy, University of Antwerp, Faculty of Medicine and health sciences, Antwerp, Belgium.

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Additional courses and training

2008 Mulligan Manual Techniques (course A and B), IRSK, Ghent, Belgium

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2010 Myofascial Therapy vzw Trigger, Torhout, Belgium

2011 Diploma Onderwijskundige Professionalisering, University of Antwerp, Belgium

2013 Academic Writing in English, DOCOP, University of Antwerp, Belgium

2014 Qualitative Research, University of Antwerp, Belgium

2015 Diploma Interuniversitaire Opleiding tot 'Bijzondere Bekwaamheid in de Pelvische en Perinatale Kinesitherapie'. University of Antwerp, Belgium

2015 Coccygodynie, BICAP, Antwerp, Belgium

2015 Elective Course in "International Council of Harmonization – Good Clinical Practices", Antwerp University Hospital, Belgium

2016 Post ICS IUGA Workshop and Conference 2016, Bunnik, The Netherlands

2016 Bekkenpijn Tijdens en na de Zwangerschap, Methode Cécile Rost, Hilversum, The Netherlands

2016 IUGA Workshop Perineal Management during Delivery: Prevention, Evaluation, Education and Repair of Obstetric Perineal Trauma, Capetown, South Africa

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2016 Neels H, De Wachter S, Wyndaele M, Vermandel A. The prevalence of compensatory contractions and movements during analytic pelvic floor muscle contractions is high in women immediately after delivery. 2016 IUGA Capetown, oral presentation

2017 Neels H, Tjalma WA, De Wachter S, Wyndaele JJ, Vermandel A. Are female adolescents informed about and interested in the pelvic floor?", 2017 IUGA Vancouver. Abstract # 381. Accepted Poster presentation

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2017 Neels H, Tjalma W, De Wachter S, Wyndaele J, Vermandel A. Are female adolescents eager to know more about the pelvic floor? 2017 ICS Florence. Podium Short Oral. **2017 Ethics Prize Award**

Invited Lectures

2014 Neels H, Vermandel A. Wat weten vrouwen (uit verschillende leeftijdsgroepen) over “de bekkenbodem”? Interuniversitaire opleiding Pelvische Revalidatie en Perinatale kinesitherapie, Universiteit Antwerpen, Belgium

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2016 Neels H, De Wachter S, Tjalma W, Vermandel A. Vaginal Wind: A Literature Review. Inter-university course Pelvic Rehabilitation and Perinatal Physiotherapy, University of Antwerp, Belgium

2017 Neels H, Vermandel A. De samenwerking tussen kinesitherapeuten en vroedvrouwen, AXXON, Zaventem, Belgium.

2017 Neels H, Vermandel A. Advies van de Federale Raad voor de Kinesitherapie i.v.m. de effectiviteit en het socio-economische belang van kinesitherapie en bekkenbodemreëducatie in de preventie en behandeling van perinatale symptomen. AXXON, Zaventem, Belgium.

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2017 Neels H, Tjalma W, De Wachter S, Wyndaele J, Vermandel A. Knowledge of the Pelvic Floor in Peripartum Women. ISPP 2017 International Society for PelviPerineology, Hasselt, Belgium.

2017 Neels H, De rol van de ouders. Wetenschappelijk Zindelijkheidscongres, Universiteit Antwerpen

Scientific prizes and grants

2016 FWO Travel Grant for participation in a conference abroad: Capetown, South Africa.

2017 FWO Travel Grant for participation in a conference abroad: Vancouver, Canada.

2017 FWO Travel Grant for participation in a conference abroad: Florence, Italy.

2017 International Continence Society Ethics Award for best Ethics Presentation. Are female adolescents eager to know more about the pelvic floor? Florence, Italy.

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Educational activities

Co-supervision of Master in Sciences (MSc) theses, University of Antwerp, Faculty of Medicine and Health Sciences, MOVANT

- **14** MSc theses completed in the field of musculoskeletal therapy
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- **15** MSc theses completed in the field of pelvic rehabilitation

Co-supervision of Master in Sciences (MSc) thesis, University of Antwerp, Faculty of Medicine and Health Sciences, Urology and Gynaecology, masters in Medicine: 1 MSc thesis completed.

Lecturer “Basic Principles of Physiotherapy, Exercise and Prevention”, University of Antwerp, Faculty of Medicine and Health Sciences, 1st bachelor REVAKI.

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2016 Bestuurslid en lid Wetenschappelijk team BICAP (Birth Core and Pelvic Therapy)

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Share your sparkle wherever you are.
Dodinsky

DANKWOORD

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