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The positive outcomes of pelvic floor muscle exercise during pregnancy in relation to postpartum urinary incontinence

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ABSTRACT

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This study aimed to evaluate the effectiveness of pelvic floor muscle exercise during pregnancy as a preventive and therapeutic intervention for postpartum urinary incontinence. The research was conducted through a systematic literature review that critically analysed existing empirical evidence on prenatal pelvic floor muscle exercise interventions and their impact on postnatal urinary continence outcomes.

Results demonstrated that structured pelvic floor muscle training during pregnancy significantly reduced the risk of postpartum urinary incontinence by up to 50%, with measurable preventive effects detectable approximately six weeks after delivery. The analysis revealed that supervised training protocols yielded superior outcomes compared to self-directed exercise regimens, regardless of whether supervision occurred in a group or individual setting. Moreover, findings indicated differential effectiveness among various patient populations, with previously unaffected women showing stronger preventive benefits compared to those with pre-existing incontinence symptoms, who primarily experienced symptom relief rather than complete resolution.

The research concluded that pelvic floor muscle exercise training represents a cost-effective and efficacious conservative intervention for urinary incontinence in the perinatal context. However, despite the promising outcomes, significant research gaps were identified, particularly regarding standardised training protocols and long-term effectiveness. The thesis underscores the need for enhanced patient education, systematic integration of pelvic floor health assessments into routine parental care, and individualised physiotherapeutic guidance to ensure proper exercise execution. While pelvic floor muscle training during pregnancy cannot entirely eliminate the risk of incontinence, it can significantly reduce the symptom occurrence and severity, supporting its recommendation as a standard component of parental care.

Keywords: pelvic floor muscle training, antenatal exercise, pregnancy, postpartum urinary incontinence, prevention, conservative treatment

PREFACE

WORK SMARTER, NOT HARDER – Kristina Herrgård

A big thank you to Matilde, Iina, and Tuisku, who provided unwavering emotional support throughout this journey. Their willingness to listen patiently through countless conversations about this research, offer encouragement during challenging moments, and celebrate small victories along the way helped make this work possible. Their friendship and support were instrumental in helping me maintain perspective and perseverance throughout this process.

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1 INTRODUCTION

According to Tanzberger et al. (2019, p. 6), pregnancy and childbirth are some of the most common risk factors for developing urinary incontinence. Around 75% of pregnant women experience urinary incontinence in late gestation and in the postnatal period (Davenport et al., 2018, p. 1402). Furthermore, every third woman suffers from urinary incontinence the first three months after giving birth (Thom & Rortveit, 2010a, p. 1520). However, only 25% of these women even talk to a doctor about their problems. A few years ago, involuntary loss of urine was a taboo subject that women often did not even talk about with their general practitioner or their gynaecologist. The assumption that this was an unavoidable cost of having children and /or an unalterable side effect of ageing is widespread and persists to this day. However, urinary incontinence significantly restricts the quality of women of all ages – in everyday life, in contact with family and friends, when travelling and during sporting activities. (Fink et al., 2006, pp. 77–78) Moreover, it is also rarely or never discussed in education or only inadequately by specialists, making this an even more important topic to bring awareness to and talk about so medical professionals and people affected by it feel more confident and reassured when talking about urinary incontinence. (Fuith & Dachs, n.d., p. 2)

As one of the most used therapeutic interventions, pelvic floor muscle exercise is used. It was shown that pelvic floor muscle training decreased the likeliness of urinary incontinence by 8 times compared to no activity. (Davenport et al., 2018, p. 1402) However, most people do not know that they can already start the pelvic floor muscle exercise during pregnancy, if they do even know about pelvic floor muscle exercises, they usually start after they give birth. birth. (Woodley et al., 2017, p. 2)

Therefore, this thesis wants to figure out the benefits of starting pelvic floor muscle exercises already during pregnancy rather than beginning after. The

thesis will make it easier for physiotherapists and physiotherapy students to access information about the importance of strengthening the pelvic floor muscles during pregnancy.

2 THE PURPOSE, OBJECTIVES, AND SEARCH TASK OF THE THESIS

The aim of this thesis is to increase the knowledge about the positive outcomes pelvic floor muscle training can have on decreasing urinary incontinence after giving birth. And furthermore, increasing the chance of the mother staying continent during the pregnancy and after. This will be done with the use of reliable and scientific studies and literature.

Moreover, the thesis will give other and future physiotherapists a chance to understand how pelvic floor muscle exercise is related to urinary incontinence. With the dissemination of this knowledge, physiotherapists will be able to help more people with urinary incontinence. In addition, it also shows that it is a topic that needs to be talked about more openly and should be considered more in the daily practice of physiotherapists.

3 URINARY INCONTINENCE

In the following paragraphs, the topic, definition, types, and prevalence of urinary incontinence will be discussed. Urinary incontinence affects millions of women worldwide in their daily living and quality of life (Moalli & Bowen, 2023, p. 36). Just a few years back, involuntary loss of urine was a taboo subject that women usually did not even talk about with their general practitioner or their gynaecologist. The assumption that this was an unavoidable cost of having

children and/or an unalterable side effect of ageing is widespread and persists to this day. (Fink et al., 2006, p. 77)

3.1 Definition

Urinary incontinence is not seen solely as one disease but as a symptom of different diseases. The definition of urinary incontinence is the inability to hold back the urine arbitrarily. Often associated with cerebral circulatory disorder, reduced mobility, recurrent infections and chronic obstructive pulmonary disease (COPD), urinary continence comes hand in hand with many factors. (Hader et al., 2003, p. 746) There are no studies that show specific numbers regarding the prevalence of urinary incontinence in women. However, approximately 20-30% of women will develop urinary incontinence during their lifetime. (Moalli & Bowen, 2023, p. 37)

In the last years, there have been many different approaches to measuring the severity of urinary incontinence. However, there has never been one that is the official measurement. Assessing urinary incontinence according to the quantity and frequency of the involuntary micturition (e.g., weighing the pads) is recommended. (Betschart et al., 2010, p. 21)

There is a variety of types of urinary incontinence, which will be shortly described and explained in the following paragraphs:

1. Stress urinary incontinence

   Epidemiologically, stress incontinence is the most common form, with a prevalence of up to 57%. Moreover, pregnancy is one of the most common reasons for stress incontinence. (Kuhn & Kessler, 2021, p. 83) Females are more likely to develop stress urinary incontinence due to their urethral anatomy. The urethral canals are shorter, and the neck of the bladder is weaker in females compared to males, which increases the chances of developing stress urinary incontinence. (Cobley et al., 2023, p. 267) Often, stress urinary incontinence is associated with weak pelvic floor muscles (Hader et al., 2003, p. 748).

2. Urgency urine incontinence

   Urgency urinary incontinence “is the uncontrolled loss of urine after a short moment of urgency” (Jäger et al., 2020, p. 2927). As urgency is considered a sensation, it must be differentiated from detrusor overactivity, which, in usual terms, is only responsible for contracting while voiding. Once the pressure inside the bladder during a contraction is greater than the urethral pressure, the involuntary urine loss is linked with the urgency in urgency urine incontinence caused by detrusor overactivity. (Cobley et al., 2023, p. 269)

3. Mixed urinary incontinence

   Mixed urinary incontinence is diagnosed when the patient has both symptoms of an overactive bladder and also symptoms of stress urinary incontinence (Perucchini & Schär, 2021, p. 427).

4. Reflex urinary incontinence

   Reflex urinary incontinence results from an irruption of the nerve control in which the spinal cord above the sacral medulla or the brain is affected (e.g. paraplegia or multiple sclerosis). Detrusor-based urinary incontinence is characterised by the involuntary loss of urine resulting from either excessive balder muscle activity (detrusor hyperreflexia) or inappropriate relaxation of the balder neck. This form of incontinence occurs without the patient experiencing the normal sensory cues that typically precede urination, making it particularly challenging to manage clinically. Due to the loss of voluntary control over the bladder centre, the bladder behaves reflexively, as in an infant. High intravesical pressure can occur as a complication. This can lead to secondary reflux with dilation of the upper urinary tract and possibly to renal insufficiency. (Hader et al., 2003, p. 748)

5. Dysuria

   The term dysuria covers all forms of difficult urination. This includes a weak urinary stream, delayed onset of micturition, interrupted micturition, urine dribbling, Alguire and any sensation in the bladder, bladder neck and urethra. Mechanical or functional increases in resistance can cause dysuria. A detrusor disorder can also be the cause of dysuria. (Michels & Sands, 2015, pp. 778–779)

6. Overflow urinary incontinence

   Overflow urinary incontinence usually results from an interrupted bladder closing mechanism with an intact bladder closure mechanism. As a result, the bladder is constantly overfilled and uncontrollably squeezes out small amounts of urine (urine dribbling). This can be caused by an enlarged prostate, bladder stones, urethral stenosis or tumours. (Hader et al., 2003, p. 748)

7. Extra-urethral urinary incontinence

   The extra-urethral urinary incontinence is a congenital malformation or acquired fistula formation of the urinary tract. Urine from the bladder does not pass through the urethra. Therefore, the loss of urine does not occur via the urethra. (Braun & Pfisterer, 2008, p. 449)

3.2 Pathology of stress urinary incontinence

Stress urinary incontinence is the most common type of incontinence among pregnant people. Occurring twice as often compared to urgency incontinence. (Wesnes SL. et al., 2009, as cited in Thom & Rortveit, 2010, p. 1520) Therefore, the following paragraphs will be looking more into stress urinary incontinence.

Incontinence is the pathology of the bladder's storage function (Kuhn & Kessler, 2021, p. 82). As the bladder pressure increases due to the compliance of the bladder wall, only a small positive pressure gradient in the urethra is required during phases of physical rest to prevent involuntary loss of urine. However, changes under physical exertion, such as sneezing and coughing, can rapidly and significantly increase intra-abdominal pressure and easily exceed the best urinary tract closure pressure. Two mechanisms are necessary to prevent this. The first one is the “guarding reflex”, which actively increases the muscle tone in the required situations. The second one is the passive transmission of the intra-abdominal pressure, followed by increased pressure on the urethra. The more this pressure transmission decreases, the greater the likelihood of stress incontinence. Conversely, excellent pressure

transmission is required in the individual urinary sphincter, with very low pressure. Pressure transmission depends on the pelvic floor muscles' tone and the connective tissue's elasticity. (Kuhn & Kessler, 2021, pp. 80–83) For a better understanding, see below Figure 1.

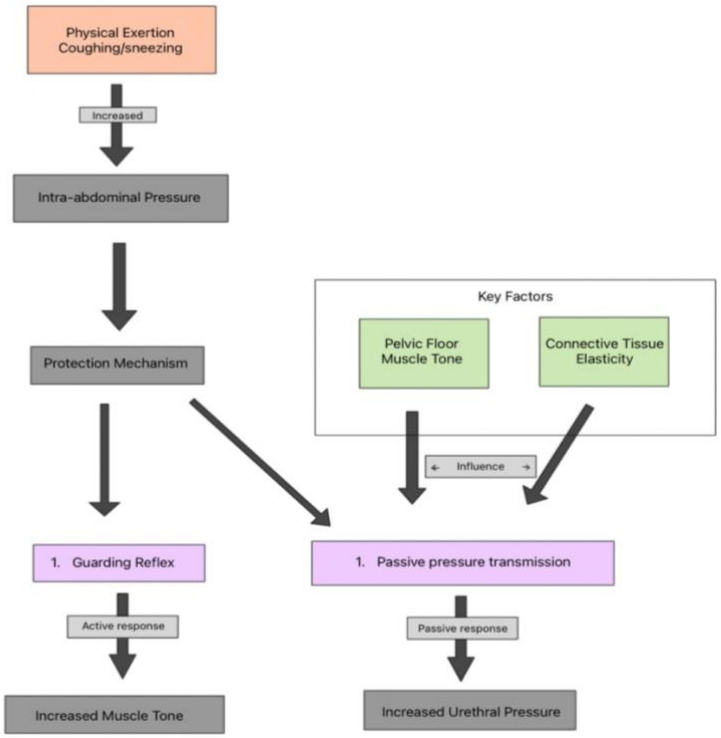

Figure 1 Illustration of the factors that influence stress urinary incontinence

3.3 Diagnosis of urinary incontinence

The diagnosis of urinary incontinence is based on anamnesis and clinical findings (internal medicine, neurological & urological/gynaecological). Urodynamic examinations are only needed if a trial therapy is unsuccessful or if surgery is planned on the continence apparat are planned. (Hader et al., 2003, p. 749)

3.3.1 Basic Diagnostics

The clarification of storage and emptying disorders of the bladder, pathologies and urethral obstruction, and disorders of the orderly interaction of the various

sphincter parties requires comprehensive diagnostics, which should be focussed primarily on functional aspects (Naumann & Kölbl, 2021, p. 167). Before conservative or surgical treatment of urinary incontinence, diagnosis is of crucial importance. This is because treatment can be only successful if the diagnosis has been carried out correctly. At the same time, targeted diagnostic planning – as carried out in a modern specialised urodynamic consultation – is important. This saves the patients from having to undergo unpleasant examinations and allows women to receive personalised advice. (Fink et al., 2006, p. 77)

3.3.2 Urodynamic Diagnostics

This type of examination is commonly used to examine and manage urinary incontinence in women. Urodynamic diagnosis not only provides “objective pathophysiological explanations for the symptoms and /or dysfunctions of the lower and upper urinary tracts and information about pre and postvoid flow patterns”(Palaiologos et al., 2019, p. 4). Urodynamic examinations provide the necessary information to complete the morphological pathophysiology. A urodynamic examination aims to diagnose the function of the bladder and the urethra and objectify the symptoms patients report. The measurement can only record volume, pressure and temporal changes quantitatively or electromyographic signals qualitatively. Using existing explanatory models, these measurement parameters are then converted into pathophysiologically usable target parameters. (Naumann & Kölbl, 2021, p. 167)

According to Palaiologos et al. (2019, pp. 7–8) urodynamic examinations were very accurate for patients who were referred due to stress urinary incontinence (54%). The recommendation of the Royal College of Obstetricians and Gynaecologists (RCOG) is to undergo testing of a urodynamic examination before getting a surgical treatment for stress urinary incontinence. This is especially important for patients who are suspected of voiding dysfunction or detrusor overactivity, as those symptoms would count as complicating factors. (Gillian & Richmond, 2006, as cited in Palaiologos et al., 2019, p. 7)

Urodynamic diagnosis can usually be divided into two different execution methods:

- Conventional urodynamic measurement: In this method, which is most commonly used, the measurements are carried out in a facility (practice, pelvic floor centre, clinic, etc.) under standardised conditions with artificial retrograde filling of the bladder via the urethra using special catheters and a special medium at a defined speed. The advantages of this method are that the measurement is under defined conditions, and the retrograde bladder filling allows a faster measurement procedure. The disadvantages of this option include that the measure does not capture everyday situations or stress, the retrograde bladder filling does not correspond to slower natural filling, and the sense of shame can influence the measured result. (Naumann & Kölbl, 2021, p. 169)
- Outpatient urodynamic measurement: In outpatient urodynamics, a special catheter inserted into the bladder is used to test the functional status of the bladder and urethra over a longer period under home conditions in an everyday situation. This utilises the natural antegrade filling of the bladder. However, this method has not yet become established in everyday practice. (Naumann & Kölbl, 2021, p. 169) Furthermore, there has been a new device called telemetric ambulatory urodynamic monitoring (TAUM), which is a catheter-free, battery-powered device to improve outpatient urodynamic measurement (Abelson et al., 2019, pp. 292–295). The advantage is that the measurement takes place under everyday conditions and records the individual load, and there is no sense of shame. The disadvantages of this are the fewer standardised options and changing the position of the catheter in everyday situations can lead to different results. (Fink et al., 2006, p. 169)

3.4 Physiotherapeutic Diagnostic

Physiotherapists can diagnose urinary incontinence in multiple ways. In general, it is important to let the woman know what will happen during the examination. Mini-mental state exams and assessments can be performed before the examinations start to assess the woman's cognitive ability to participate in therapy. These results are also useful for determining compliance in follow-ups and next treatments. (Cardozo & Staskin, 2017, p. 242)
The physiotherapeutic diagnosis of urinary incontinence compromises several important components. As a basic assessment, physiotherapists have a standardised questionnaire according to the ICF classification at their disposal, which uses twelve questions to determine the type of urinary incontinence and records the level of suffering from a scale of 1-10. (Hochschild, 2024, pp. 166–171)

A key diagnostic tool is the bladder diary or micturition log. This log should be kept for at least three consecutive days and cover different levels of activity (work and rest periods). It documents the frequency of micturition, urine volume, incontinence products used, and the amount drunk. This method is considered reliable and quantifies voiding and incontinent episodes. (Enzelsberger, 2012, as cited in Lubandy, 2012, p. 12,13,23,24)

Multiple easy-to-perform diagnostic clinical assessments can be used to assess urinary incontinence.

- Cough test
  The patient is asked repeatedly with a full bladder (volume over 200ml) to cough repeatedly while lying down and standing up. Observed cough-synchronised urine leakage from the urethra is considered clinical evidence of stress incontinence. (Lubandy, 2012, p. 12)
- Pad test
  The pad test is the most useful test in clinical practices for evaluating objective urine loss. There are two tests going over two different periods of time: the short-term test (1 hour) and the long-term test (24 hours). The one-hour test has been standardised by ICS but shows limited

reproducibility and a high rate of false negative results. It is also only suitable for determining the severity of urinary incontinence to a limited extent. The long-term test, however, has proven to be more reliable, with good sensitivity and fewer false-negative results. It is considered a suitable instrument for recognising and quantifying incontinence. However, neither of the two versions of the test can distinguish between different urodynamic diagnoses.(Harvey, 2017, pp. 251–254)

- Micturition Diary

  The micturition diary should be kept consecutively over a period of at least 48 hours. The gravimetric method is recommended for precise quantification of the amount of urine loss, in which the weight of an unused road is first determined. The used pads are then collected, and the difference between the weight of the dry pads and the used pads is determined. That makes it possible to accurately determine the volume of urine. The diary should document the following parameters in tabular form: Micturition frequency, the timing of micturition, volume details, subjective assessment of urge intensity, frequency and quantity of urine leakage events (graduation of pad soaking), type and numerical details of incontinence aids used, fluid intake with volumetric and qualitative specifications. If Algurie is present, the intensity of the pain should be evaluated using a numeric rating scale with a value range of 0-10. (Hochwimmer, 2018)

- Sensitivity test

  Sensory disturbance in the dermatomes S2-S5 (so-called saddle area) can be indications of neurogenic lesions. More differentiated neurological examinations with corresponding reflex tests are the responsibility of a specialist.(Deutschen Gesellschaft für Geriatrie et al., 2024, p. 14)

3.4.1 Urinary incontinence due to pregnancy

Bladder complaints are common during pregnancy as well as in the postpartum phase. They can manifest themselves in the form of pollakiuria,

urge symptoms and stress incontinence due to physiological changes. One of the first changes during pregnancy is the increase in urine production of around 25%. This happens due to increased blood flow in the kidneys. In addition, antidiuretic hormone (ADH) is produced in greater quantities, which leads to more frequent micturition and nocturia. With the uterus growing, the abdominal pressure also increases. In the third trimester, the head of the child takes away the space of the bladder. Therefore, the functional bladder capacity is decreased, requiring pregnant people to go to the toilet more frequently. Furthermore, the bladder neck lowers during pregnancies and thus favours the development of stress incontinence. (Tanzberger et al., 2009, pp. 179–181)

According to the study performed by Rortveit et al. (2001, pp. 1008–1010), parity plays a significant role in developing urinary incontinence for the female population under 65 years as well as nulliparous women. The study also suggests that both stress urinary incontinence and mixed urinary incontinence have increased prelevance in parity but not urge urinary incontinence.

3.5 Prevalence of urinary incontinence among pre- and postnatal women

In pregnant people, there is a significant increase regarding urinary incontinence compared to the general population. According to Peschers (2021, p. 24), the prelevance of stress incontinence among pregnant people is believed to be around 40-59%. According to Fink et al. (2006, p. 77), even every third woman after pregnancy and giving birth suffers from problems with urinary incontinence.

This type of urinary incontinence mostly affects women, particularly women who give birth more than once, followed by long birth processes or traumatic vaginal deliveries. (Moalli & Bowen, 2023, p. 41)Postpartum urinary incontinence has a great impact on not only the physical but also the mental health of women. Due to this, it is so crucial to provide preventive treatment but also treatment after giving birth to help regain life quality back as fast and efficiently as possible. (Dai et al., 2023, p. 11)

4 PELVIC FLOOR

In the following paragraphs, the anatomy of the pelvic floor will be discussed in further detail. Furthermore, it will also deal with the changes in the pelvic floor during and after the pregnancy.

According to Fritsch (2012, pp. 1–3), the abdominal and pelvic cavities are bounded cranially by the diaphragm, ventrally by the anterior abdominal wall musculature, dorsally by the spine and the dorsal abdominal wall muscles and caudally by the pelvic floor, see figure 1.

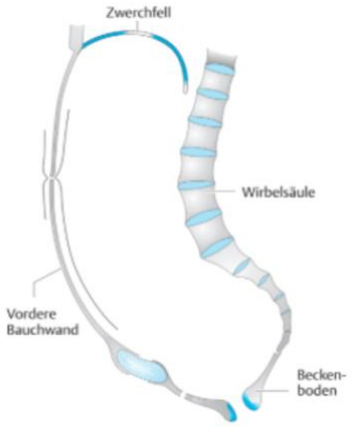

Figure 2. Sagittal plane of abdominal and pelvic cavity (Fritsch, 2012, p.1)

4.1 Pelvic floor muscles

The pelvic floor muscles are a striated muscle group that marks the lower end of the pelvis. The muscles in this group are mainly known for their function to hold the organs' weight, meaning they are load-bearing and supporting muscle force in the lower pelvis. However, phylogenetically, the large pelvic bones (Ossa ilii), the sloping groin of the Os pubis and the concave inner surface of the sacral cavity have developed in human bipeds for the transfer of organ weights. In addition, the sinewy Linea alba reinforces the load-bearing capacity of the lower abdomen. (Tanzberger et al., 2009, p. 31)

4.1.1 Pelvic diaphragm

The pelvic diaphragm is the deepest layer of the pelvic floor muscles, as seen in the figure below (figure 2). It comprises two muscle groups, the M. levator ani and the M. iliococcygeus (coccygeus). The M. levator ani consists of three smaller muscles, the M. puborectalis, M. pubococcygeus and the M. iliococcygeus. The M. pubococcygeus is responsible for muscular restoration and the suppression of detrusor activity. (Henscher, 2004, pp. 83–87) The detrusor activity is a neurogenic dysfunction of the lower urinary tract (Lorenz et al., 2011, pp. 60–69). The M. iliococcygeus is liable for the unilateral movement of the coccyx and the elevation of the rectum. The M. puborectalis opens and closes the vagina and rectum, as well as lifting the organs higher.(Henscher, 2004, p. 89)

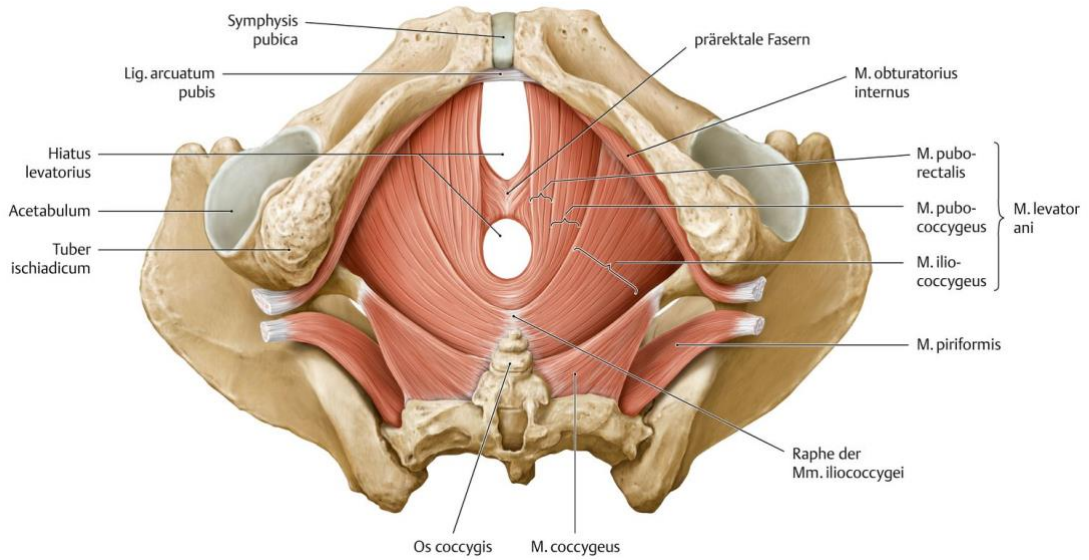

Figure 3. C Musculature of the pelvic floor after removal of the urogenital diaphragm muscles (Schünke et al., 2022, p. 193)

4.1.2 Urogenital diaphragm

The urogenital diaphragm, also known as the perineal membrane, is the middle layer of the pelvic floor muscles, as seen in the figure below (figure 3). It is a fibromuscular layer that consists of three muscles (Henscher, 2004, pp. 85–89). The M. transversus perinei profundus, the M. transversus perinei

superficialis and the M. sphincter urethrae externus. The M. transversus perinei profundus is responsible for closing the levator opening, compressing the urethra and tensioning the perineal tendon centre. (Tanzberger et al., 2009, pp. 33–34) The M. transversus perinei superficialis is mainly accountable for tensioning both sides of the diaphragm urogenitale, which allows the superficial pelvic floor layers to be lifted (Henscher, 2004, p. 89; Tanzberger et al., 2009, p. 34). The M. sphincter urethrae externus is a voluntary sphincter of the urethra. It is vegetatively and psycho-somatically hypotonic during micturition. (Tanzberger et al., 2009, p. 34)

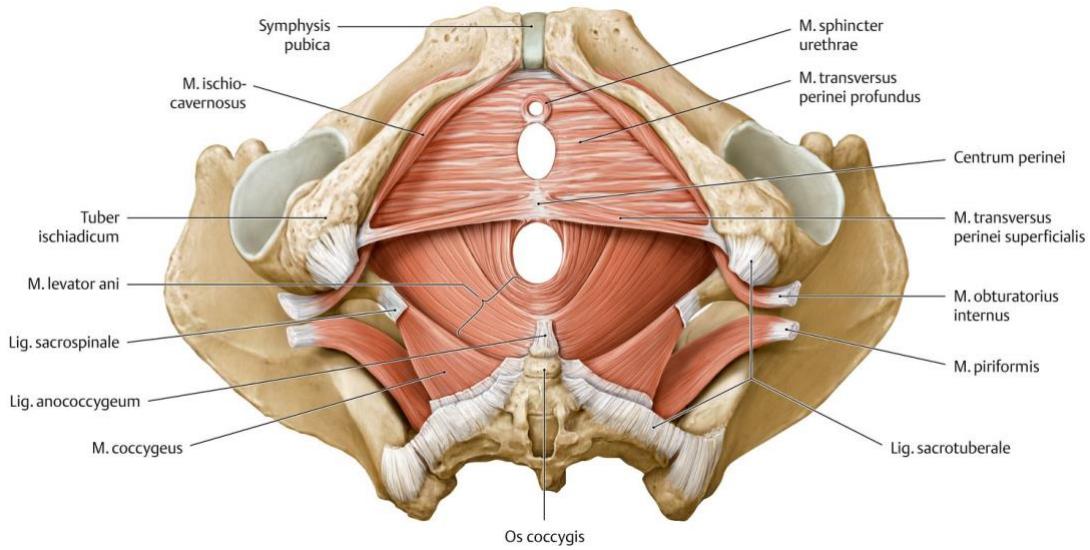

Figure 4. B Musculature of the pelvic floor after removal of the sphincter muscles (Schünke et al., 2022, p. 192)

4.1.3 Perineal body

The perineal body is the most superficial layer of the pelvic floor muscles, as seen in the figure below (figure 4). This layer includes the M. sphincter ani externus, the M. bulbospongiosus as well as the M. ischiocavernosus. (Tortora & Derrickson, 2016, p. 358)The M. sphincter ani externus consists of three striated muscle cords, which are wrapped around the end of the rectum. They close the anus arbitrarily. (Tanzberger et al., 2009, pp. 40–41) The M. bulbospongiosus is responsible for constricting the vaginal entrance and for the erection of the clitoris (Henscher, 2004, p. 89). Furthermore, according to

Totora & Derrickson (2016, p. 359), the M. bulbospongiosus is also needed for urination. The M. ischiocavernosus “maintains the erection of the clitoris by decreasing urine drainage.” (Tortora & Derrickson, 2016, p. 359).

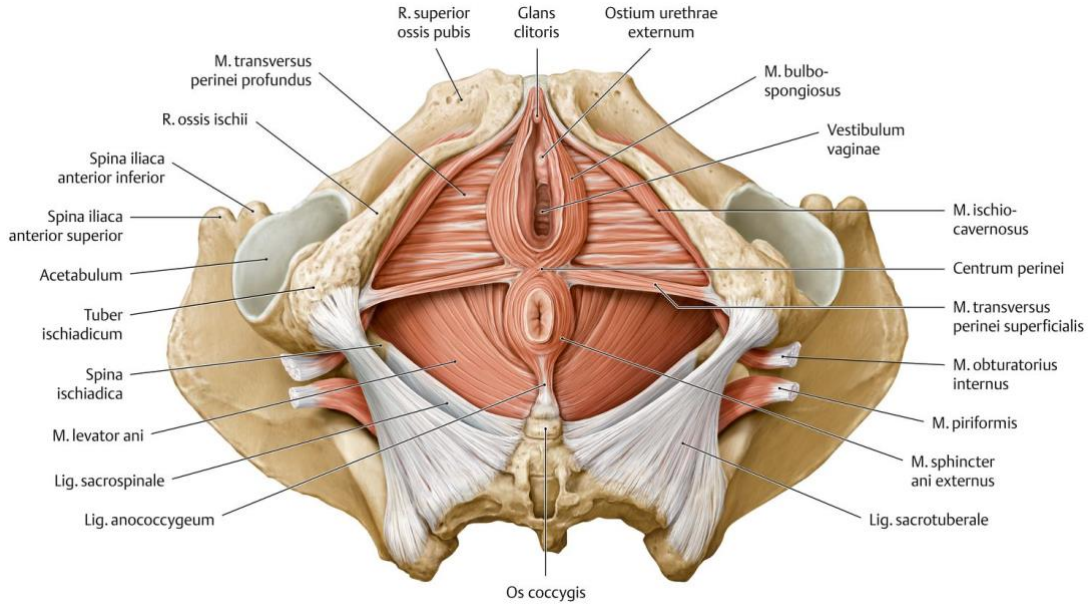

Figure 5. A Musculature of the pelvic floor after removal of the fascia (Schünke et al., 2022, p. 192)

4.2 Function of the pelvic floor

The pelvic floor muscles secure the position of the stomach and pelvic organs due to closing the stomach and pelvic space caudally, carrying most of the weight of the organs. Furthermore, they play a crucial role in the opening of the rectum, urinary and genital tracts, also known as the sphincter function, the passage of which reduces the mechanical resistance of the pelvic floor. (Schünke et al., 2022, p. 171)

4.3 Pelvic floor and changes during pregnancies

An extreme increase in intra-abdominal pressure and strain, especially at the end of pregnancy can lead to weakening of the surrounding connective tissue or damage the pelvic floor muscles. Overstretching and injuries in the pelvic floor muscles or the surrounding nerve tissues can cause long-term pelvic floor

insufficiency. Then being able to cause virial clinical consequences, such as a prolapse of the pelvic floor (descensus perinei) or of the pelvic organs e.g. the uterus (descensus uteri). However, there are also extreme cases in which the uterus may protrude from the vagina with inversion of the vagina (prolapsus uteri). (Schünke et al., 2022, p. 171) However, according to Reimers et al. (2016, pp. 822–828), the commonness of a prolapse is smaller than 10% and can usually be fully recovered within the first year after giving birth.

Often, the changes will be documented as a function of the three trimesters. The trimesters are three equally long periods, each 13 weeks of the pregnancy. (Goerke, 2006, pp. 2–5) We will take a closer look at those changes, however, only taking into consideration the changes in the pelvic floor and the urinary tract.

- First trimester: At the beginning of the pregnancy, the corpus luteum starts to produce the hormone progesterone to maintain the pregnancy (Goerke, 2006, p. 8). The corpus luteum is a collection made out of cells, which form with each menstrual cycle and play an important role regarding fertility in the luteal phase (Oliver & Pillarisetty, 2024). From the tenth week onward, the quantity of progesterone which the placenta can produce is enough. The main effect of progesterone in the motherly body is to immobilise the muscles of the uterus, loosing and relaxing the connective tissue as well as dilating the hollow organs. The dilation of the hollow organs increases the risk of urinary tract infections, as the urinary tract is dilated as well. With the loosening of the connective tissue, the pelvic floor muscles become weaker, which reduces urine retention. In addition, the pressure of the uterus on the bladder leads to a reduced bladder capacity and, thus, to pollakiuria. (Goerke, 2006, pp. 9–15)
- Second trimester: In this trimester, there are major changes on the outside; the belly grows, and the pregnancy mostly becomes noticeable. Inside the belly, the uterus growing over the pelvis, the pressure on the bladder often becomes less, and therefore, the pollakiuria also becomes less. However, the weakness of the pelvic muscles remains, as the progesterone concentration during the growth

of the uterus stays high throughout the whole pregnancy. (Goerke, 2006, pp. 15–18)

- Third trimester: As the urinary tract remains open due to the higher progesterone, vaginal infections are quite common and have to be treated locally to prevent the ascending of germs. Due to the pressure of the uterus, the baby and the amniotic fluid on the pelvic floor increasingly stretch its muscles and the connective tissue. (Goerke, 2006, p. 18)

According to Virtanen (1995, as cited in Petri & Kölbl, 2013, p. 90), 26-48% of pregnancies also result in genital prolapse symptoms, which can trigger urinary incontinence symptoms. Looking further into those problems, Herscher (2004, p. 28,43) states that physiotherapeutic treatments are possible and sufficient to reduce and treat those symptoms. One of the most efficient and important treatment options during pregnancy and after giving birth is, therefore, functional pelvic floor training.

4.4 Patient education about pelvic floor functions

This chapter discusses various methods of evaluating the pelvic floor muscles, from external palpation to functional examinations, with a particular focus on patient understanding and the correct execution of the exercises. In addition, the essential role of patient education in the prevention of maladaptive continence strategies and the maintenance of optimal bladder health will be addressed. The pelvic floor function can be tested using various methods. External palpation is performed on the ischial tuberosities with the patient seated, either by the therapist or by self-palpation. A contraction of the pelvic floor muscles increases pressure on the tuberosities. In addition, the function can be checked by palpation of the M. transversus abdominis, as this works synergistically with the pelvic floor muscles.(Hochschild, 2024, pp. 132,33,166-171) It can be helpful to give the patient the image of a “lift ride”, imagining a lift travelling up the abdomen by contracting the bladder muscles. The exercise is simplified by the correct breathing rhythm. As the diaphragm lowers on the

inspiration and exerts pressure on the bladder, according to Van den Berg (van Gestel & Teschler, 2014, pp. 246–262), the producer should be as follows: Tense, exhale, relax, inhale.

Teaching patients how to urinate adequately should prevent them from utilising armature incontinence strategies. These can lead to secondary disease and an increasing decline in continence. For example, those affected reduce their optimal drinking quantity. This can lead to kidney stones and an increasingly sensitive bladder, which can no longer maintain a normal amount of urine. Therefore, it makes sense to educate the patient during the physiotherapy appointment on the correct way to urinate, what irritates the bladder, and what can lead to a weakening of the bladder. (Hochschild, 2024, pp. 166–172)

5 PHYSIOTHERAPY IN PELVIC FLOOR MUSCLE

Pelvic floor muscle exercise is of fundamental importance in the conservative treatment of urinary incontinence. Perabo and Müller (2009, p. 163) believe that patients who are willing to train should first be properly educated. Those to be treated must first be given an insight into the anatomical basics, and the functions of the pelvic floor must be explained to them. (Perabo & Müller, 2009, p. 163) The pelvic floor muscles, which are located below the pelvis, are rarely activated consciously, which is why many women have difficulty tensing these muscles in a targeted manner. In healthy individuals, unconscious contractions of the pelvic floor muscles occur simultaneously or shortly after an increase in intra-abdominal pressure. Voluntary activation typically manifests itself as a mass contraction of the three-layered musculature, recognisable by an inward movement and tension around the pelvic opening. Correct pelvic floor muscle contraction is characterised by the absence of visible movement of the pelvis or external body parts. Adequate contractions can be verified by vaginal palpation and can be observed as a cranially directed movement of the

perineum. Less intense contractions may be isolated. (Bø, 2012, p. 146) Therefore, physiotherapists should use visualisations to illustrate the pelvic floor and to simplify the happening of the contractions to the patients. Using metaphors and symbols may also help the patient to target the muscles better. (Hayder et al., 2012, pp. 107–112)

With the help of pelvic floor muscle training, women have the chance to increase the intraabdominal pressure by doing targeted contractions of the pelvic floor. Due to the increasing abdominal pressure, the lowering of the pelvic organs counteracts. Furthermore, the contraction force and abilities to coordinate the pelvic floor muscles increase with increased pelvic floor muscle training. Starting with training during early pregnancy can prevent pelvic floor dysfunctions at the end of pregnancy and after giving birth. (Mørkved & Bø, 2014, pp. 300–307)

There are no standardised recommendations, and from study to study, there are different approaches when it comes to the norm of pelvic muscle floor exercises. For example, Mantilla et al. (2024, p. 324,325) suggest strengthening pelvic floor muscle training with near-maximal contractions for at least 6 weeks. With this training, the advantage compared to moderate intensity is that the 6 weeks of training can strengthen the muscle the same way as 4 months of moderate training would. The study performed by Castro et al. (2008, pp. 469–472) shows that pelvic floor muscle training is more effective in strengthening the pelvic floor muscle compared to electrical stimulation, biofeedback and the vaginal cone.

5.1 Biofeedback

Biofeedback can be seen as a supportive measure to help women understand the contractions better. Usually, this technique is used when the women are learning and focusing on using the correct techniques in contractions. Electrodes are inserted vaginally or rectally. They start to beep or flash as soon as the electrodes recognise the smallest contractions in the muscles. This is a

very good way to determine whether the pelvic floor muscles are working and with what intensity they are contracting. (Hayder et al., 2012, p. 107)

These vaginal and anal probes allow precise views and give a good understanding of the functional state of the pelvic floor muscles, as well as a precise view of the functional condition of the pelvic floor. That means that diagnoses can be made quicker, and follow-ups are easier to compare. (Jürgens, 2007, p. 89,90) This type of training is often used for women with stress and urinary incontinence and is, therefore, often used during the prenatal or postpartum phase. With the devices, there is a wider range of tensing and relaxation exercises for the pelvic floor muscles. (Perabo & Müller, 2009, p. 167) Jürgens (2007) speaks of the scientifically proven efficiency of biofeedback in the treatment of stress incontinence (Jürgens, 2007, p. 92).

5.2 Electrical stimulation

Electrostimulation is usually used at the beginning of the pelvic floor muscle therapy. It is used to help against stress and urge urinary incontinence. However, compared to biofeedback, electrical stimulation is a passive treatment option. (Hayder et al., 2012, p. 108) This is due to the electrical impulses which are being sent to the muscles with electrodes. Those electrodes then trigger contractions, and the patient does not have to actively control the contractions. This method is ideal for women who have trouble or are unable to tense their pelvic floor muscles independently. Exercises should be performed once or twice a day for around 20 minutes. This should happen constantly for at least 3 months. Individual studies indicate that symptoms of stress urinary incontinence are improved by electrostimulation, but there are no studies that indicate that electrical stimulations make pelvic floor muscle training more efficient. (Perabo & Müller, 2009, p. 168)
Jürgens also mentions that electrotherapy is also very effective and, therefore, used for unclear lower abdominal complaints and pelvic floor pain. Moreover, electrotherapy also acts as a kind of pain therapy. (Jürgens, 2007, p. 93,94)

5.3 Vaginal cone

The use of vaginal weights or Kegels is an evidence-based method of pelvic floor muscle training. The vaginal cone is applied vaginally superior to the levator plate. The therapeutic effect is based on the principles of muscle contraction to retain the weight against gravity. The proprioceptive perception of muscle activity is trained at the same time. In the beginning, the time of use is around one minute under load (standing), aimed at progressive increase of the exercise. The first improvements in the pelvic floor muscles can usually be seen around 2-3 weeks after the start. The typical duration of the therapy with the cone is around 2-3 months. (Bø et. al, 1990, as cited in Rochera et al., 2017, p. 101)

5.4 Chinese vaginal geisha balls

Many studies support the efficiency of the vaginal ball if patients want to increase the strength of their pelvic floor muscle strength. The balls are applied vaginally posterior to the pubococcygeus muscle. The therapeutic principle is based on the stimulation of vaginal vibration receptors by the movement of a smaller ball integrated into the main ball and the activation of the baroreceptors of the pelvic floor muscles by the ball's weight. (Rochera et al., 2017, p. 101,102) As the muscles fatigue, a continuous application is not possible and is not indicated to be longer than three hours. (Ruiz et al., 2014, as cited in Rochera et al., 2017, p. 102)

5.5 Kegel exercise

Kegel's systematic rehabilitation of the pelvic floor muscles was established in 1950 by the gynaecologist Arnold Kegel, who was able to demonstrate the correlation between pelvic floor dysfunctions and muscular hypotension. The method he developed, based on repetitive contraction and relaxation cycles to optimise the pelvic floor muscle strength and resistance, demonstrated significant therapeutic effects. The Kegel method has been shown to be

successful in the treatment and prevention of dyspareunia and urinary incontinence, as well as other associated pathologies. (Pena-Outeiriño et al., 2007, as cited in Rochera et al., 2017, p. 102)

6 PELVIC FLOOR MUSCLE EXERCISE IN RELATION TO URINARY INCONTINENCE

Pelvic floor muscle training is one of the cheapest and most effective conservative treatment methods for urinary incontinence to this day. Furthermore, it is also convincing because of its lack of side effects as well as its missing side effects for following treatments. (Vaz et al., 2019, p. 117) For a long time, women have been told to do exercises to increase their strength in the pelvic floor to treat urinary incontinence (Mørkved et al., 2003, p. 313). Pelvic floor muscle training has been shown to be a very effective solution in reducing urinary incontinence during and after pregnancy (Davenport et al., 2018, pp. 1402–1404). Davenport et al.(2018, pp. 1397–1403) show that pelvic muscle floor training, regardless of with or without other types of exercise performed during pregnancy, can reduce the risk of developing urinary incontinence after birth by 37%, and in Woodley et al.(2017, p. 2), the risk was reduced by 29%.
As seen in the study carried out by Vaz et al. (2019, pp. 117–123), pelvic floor muscle training starts to be an effective treatment for mixed stress and urge urinary incontinence after only 6 weeks of starting.

However, there are multiple studies that show that pelvic floor muscle exercises are more beneficial when performed under the supervision of physiotherapists or other trained healthcare personnel (Kharaji et al., 2023; Mishra et al., 2022; Paiva et al., 2017). Pelvic floor muscle training is shown to bring better results when it is performed under supervision rather than exercises that are performed at home (Mishra et al., 2022, pp. 74–79). Furthermore, Kharaji et al. (2023, pp. 1339–1349) showed with their research

that supervised pelvic floor muscle training was not only more effective when it comes to the function of the pelvic floor muscles. Rather, it also showed a very beneficial effect of supervised pelvic floor muscle training in regard to the women's Quality of life and better understanding and execution of the contraction of the pelvic floor muscle.

When pelvic floor muscle training is performed under supervision, it makes no difference if it is a group training program or an individual. However, when comparing the supervised pelvic floor muscle training and unsupervised muscle training, the supervised brings out better results in treatment for urinary incontinence. (Paiva et al., 2017, pp. 351–359)

7 ANTENATAL PELVIC FLOOR MUSCLE TRAINING TO PREVENT AND TREAT URINARY INCONTINENCE IN POSTNATAL WOMEN.

Significant findings have been made regarding the effectiveness and prevention strategies of pelvic floor muscle training in relation to urinary incontinence both pre- and postnatally. Therefore, pelvic floor muscle training is recommended as the first step. According to Mantilla Toloza et al. (2024, pp. 322–325), there have been notable improvements in stress urinary incontinence after childbirth when pelvic floor muscle training was implemented. The presence of a physiotherapist greatly assists expectant mothers with the correct execution and performance of the exercises. Thereby enhancing the positive effects of pelvic floor muscle training. Moreover, practising pelvic floor exercises three times a week for expectant mothers over a period of 22 weeks during the gestation period is effective for preventing stress urinary incontinence (Mantilla Toloza et al., 2024, p. 322).

Assis et al. (2015, as cited in Mantilla Toloza et al., 2024, p. 321) indicate that a reduction in stress urinary incontinence and an enhancement in muscle tone

of the pelvic floor muscles have been found in women who practised pelvic floor muscle training starting from the eighteenth week of gestation.

Davenport et al. (2018, pp. 1397–1403) reported significant results in reducing urinary incontinence through pelvic floor muscle training during pregnancy. Their findings revealed that prenatal urinary incontinence could be decreased by 50%, while urinary incontinence after pregnancy was reduced by 37%. Additionally, for women who had not experienced urinary incontinence prior, those who developed it during pregnancy saw lesser symptoms and severity if they engaged in pelvic floor muscle training, compared to what is typically expected. However, it should also be noted that women with pre-existing urinary incontinence could not be treated effectively. Nevertheless, the strengthened pelvic floor muscles did alleviate the severity and symptoms in subsequent pregnancies. (Davenport et al., 2018, p. 7)

Johannessen et al. (2021, pp. 296–300) found in their study that women who participated in an exercise program with pelvic floor muscle training had a lower rate of urinary incontinence 3 months after birth (38%) compared to the group that did not (29%). For women who have reported urinary incontinence, the exercise program designed for said study did not give any difference in the likelihood of the women developing urinary incontinence after the study. However, for those women who were incontinent before the start of pregnancy, there was a lower percentage compared to the group who performed exercise (44%) and the control group (59%). (Johannessen et al., 2021, pp. 296–300)

In the study published by Szumilewicz et al. (2020, pp. 1–9), the research has shown that women participating in high-low-impact physical activity supplemented with pelvic floor muscle exercise and education experience significant benefits regarding postnatal urinary incontinence. The intervention group reported reduced life impact at both two months (37%) and one year postpartum (50%) and exhibited nearly double the improvement between these time points compared to the control group. Therefore, these findings also support pelvic floor training among pregnant women, especially those without preexisting pelvic floor disorders.

8 THESIS PROCESS AND METHODS

A systematic literature review is a scientifically sound method for recording and analysing the current state of research on a specific issue in a structured manner. This thesis is intended to emphasise the importance of pelvic floor muscle training. Further down, table 3 provides a better overview of the studies. The thesis presents a defined research question using the PICO framework as. This methodology is characterised by a highly standardised, transparent and reproducible process. This also includes the literature search in relevant databases using precisely defined inclusion- and exclusion criteria. The critical evaluation of the identified studies using standardised quality assessment tools and the structured synthesis of the findings. Methodological rigour is ensured by the detailed documentation of the search process, the independent selection of the studies and the systematic extraction of data. This all makes it possible to comprehensively record the available evidence and minimise potential bias. (Schardt et al., 2007, pp. 1–6)

The topic of pelvic floor muscle training was selected by the author and was then further narrowed down by searching for literature till the final title was chosen. The author had no problem choosing a topic, as they have been very interested in the general field of physiotherapy in pregnancy and postpartum. After reading a few studies, it became clear that it would be very beneficial for other physiotherapy students to have a thesis so they can read through the topic and see the progression of the discussed topic.

The author started the process of this thesis by looking for literature for the thesis starting in March 2024. Starting in April, the author focused on working out the theoretical framework, and the literature search continued till June 2024. In June, the plan was sent to the supervisor, and the author began to write chapters 3, 4 and 5. In October, the author and the thesis supervisor had a meeting to go over the plan of the thesis. Intensive work on the plan was done from 12.11-20.11.2024. After that, it was looked over again by the

supervisor, approved for submission and then submitted on 13.12.2024. Intensive writing of the thesis continued from December 2024.

The methodological and ethical orientation of this thesis is based on the comprehensive “ethical recommendations of thesis writing” of the Satakunt University of Applied Sciences. These institutional guidelines form the fundamental ethical framework that structures and guides the systematised literature review as well as the data collection, analysis and interpretation of the entire research work. Strict adherence to these ethical principles not only guarantees the scientific integrity of the study but also ensures the respectful and responsible treatment of all research participants and their data in the collection in the context of the selected studies.

PubMed, Springer link, PEDro, Library of UAS of Carinthia, Wiley and Elviser were used to search for the relevant studies. Locked studies and books with restricted access were accessed through the SAMK-Finna account or the UAS Carinthia account.

The keywords were systematically linked with the Boolean operators AND and OR in order to achieve optimal search results.
Keywords that were used to find suitable literature: pregnancy, pregnant, pelvic floor muscle exercise, PFME, pelvic floor muscle training, pelvic floor muscle exercises, Urinary incontinence, UI, pelvic floor, stress incontinence, postpartum, prepartum, prenatal, postnatal, prepartal, antenatal, prevention, avoidance, prelevance, Kegel exercise, biofeedback. A clearer table of the search words can be found in the table below.

Pelvic floor muscle training	Pregnancy	Urinary incontinence	Prevention	After pregnancy
“pelvic floor muscle training” “pelvic floor muscle exercise” “Kegel exercise” “Kegel” “PFMT” “PFME”	“pregnancy” “prepartal” “prenatal” “antenatal” “gravidity” “prepartum”	“Urinary incontinence” “stress urinary incontinence” “UI” “SUI”	“prevention” “avoidance”	“after pregnancy” “postpartum” “postnatal” “post pregnancy”

Table 1 search words that were used

Predefined inclusion and exclusion criteria were used to select the studies. The studies found were included or excluded on the basis of the criteria, which are now explained. The study designs were systematic reviews, reviews, and randomised controlled trials from the last 15 years. Study participants are pregnant women, as the focus is on this population. The people in the studies were people who started pelvic floor training during pregnancy. The studies relate to urinary incontinence after birth. In studies that included faecal incontinence, the focus was only on urinary incontinence. To gain as comprehensive a view as possible, literature concerning women of different races/ethnicities was considered. Studies in German and English were selected. The studies that met the selection criteria were chosen as the main studies.

In order to filter out the studies adequate for the thesis, the author used a PRISMA flow chart as a guide. The first search with the keywords resulted in 63 found studies. Then, 40 of the found studies were duplicates and therefore removed (n=23). After title and abstract screening, there were 9 other studies exuded, as well as 6 due to the year of publication (n=8). After assessing them

for eligibility, 6 of them were excluded due to inclusion- and Exclusion criteria and another one was excluded due to the study type (n=2).

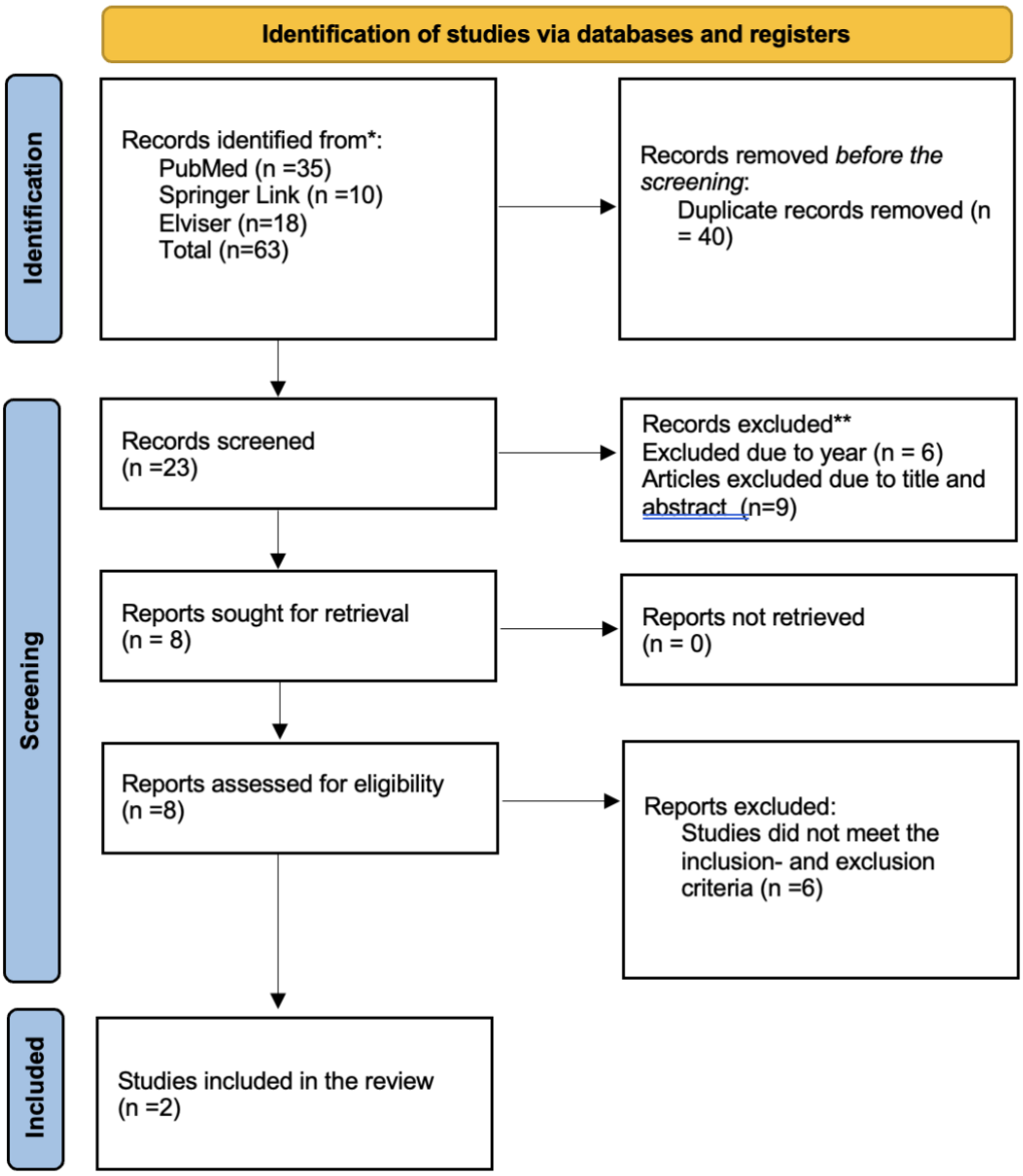

Table 2 Selection of the studies shown in a PRISMA flowchart

The two studies included in the thesis were:

Author	Title	Outcome
Johannessen, H. H. et al. **(2021)**	"Regular antenatal exercise including pelvic floor muscle training reduces urinary incontinence 3 months postpartum—Follow up of a randomized controlled trial"	At 3 months postpartum, urinary incontinence was lower in the exercise group (29%) compared to standard care (38%). Among women incontinent at baseline, 44% of the exercise group and 59% of controls remained incontinent.
Szumilewicz, A. et al. **(2020)**	"Prenatal high-low impact exercise program supported by pelvic floor muscle education and training decreases the life impact of postnatal urinary incontinence"	The training group showed less impact of urinary incontinence at 2 months as well as 1 year postpartum, with lower IIQ scores at 2 months (9.4 vs 18.9). Incontinence symptoms decreased by 38% in the training group versus 20% in controls between the assessments.

Table 3 Summary of the studies

9 DISCUSSION

Based on the two studies and the results of previous studies, both the research question and the hypothesis can be answered and confirmed. It should be noted that the same pelvic floor muscle exercises were not used in the studies. There are significant results that show that pelvic floor muscle training during pregnancy reduces the risk of urinary incontinence after the pregnancy. It can be assumed that pelvic floor muscle training during pregnancy cannot

completely eliminate the risk of urinary incontinence. Pregnancy is and remains a major risk for the development of urinary incontinence. In practice, pregnant women need to be better informed about the existence of this condition. Furthermore should, pelvic floor muscle training be more accessible to all women. Midwives should draw attention to the pelvic floor during routine examinations during pregnancy. This will take away the woman's fear and shame of urinary incontinence. Pregnant women also need more motivation to take part in training and to carry out additional home programs. A prerequisite for optimal pelvic floor muscle training would be an individual consultation with a physiotherapist to learn and test the correct contraction of the pelvic floor muscles.

This systemised literature review highlights a substantial research gap with regard to the preventive effects of prepartum pelvic floor muscle training on postpartum urinary incontinence. While the studies analysed show positive trends, various methodological limitations make it difficult to clearly evaluate the effectiveness. In particular, the heterogeneous study designs, the different intervention protocols, and the mostly small sample sizes limit the generalisability of the results. It is also worth noting that the few available studies provide contradictory results in some cases, which emphasises the need for further research. The methodological weaknesses identified in previous studies should serve as a starting point for the design of future research projects. Of particular interest would be randomised controlled trials with larger cohorts that implement standardised training protocols and whose follow-up studies extend over a longer postpartum period. Evidence-based recommendations for physiotherapy practice can only be derived from such methodologically robust studies. This seems all the more important given that postpartum urinary incontinence is a widespread problem that significantly affects both the physical and the psychological health of the women affected.

10 CONCLUSION

This systematic literature review emphasises the significant importance of pelvic floor muscle training as a preventative and therapeutic intervention for urinary incontinence. The primary focus here is in the context of pre and postnatal care. The analysis of the current research situation clearly states that pelvic floor muscle training is one of the most cost-effective and, at the same time, most effective conservative treatment methods. Pelvic floor muscle training is characterised by the low side effects and the lasting effectiveness. The evidence demonstrates that structured pelvic floor muscle training can reduce the risk of postpartum urinary incontinence by up to 50%, with the preventive effects being detectable after around 6 weeks. The studies also clearly demonstrate the superiority of supervised training over independent exercises, regardless of whether this takes place in a group or individual setting.

Despite these promising findings, the current research is still very limited, and only a small number of new studies can be found on this topic. The varying effectiveness in different patient groups is particularly noteworthy:
While preventive effects are clearly demonstratable in previously unaffected women, patients with pre-existing urinary incontinence primarily show symptom relief but not complete remission.

These findings have several practical implications for the healthcare system. Firstly, there is an urgent need for improved patient education and increased accessibility to pelvic floor muscle training programmes. Those should be especially accessible for people during pregnancy. Secondly, midwives and other healthcare providers should systematically integrate pelvic floor health into their routine examinations. Thirdly, individual physiotherapeutic counselling to ensure the correct execution of exercises seems essential.

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