Pregnancy-related pelvic girdle pain management

Tailored physiotherapy treatment strategies anchored in women's experiences and expectations

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What I love about science is that as you learn, you don't really get answers. You just get better questions.

John Greene

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ABSTRACT

Introduction: Pregnancy-related pelvic pain (PGP) affects over half of all pregnant women. This pain can significantly impact daily activities and limit the ability to move freely, leading to reduced physical activity, which negatively impacts overall health.

Aim: This thesis aimed to investigate physiotherapy for PGP in pregnancy, focusing on treatment expectations, satisfaction, and the impact of management strategies on functioning, physical activity level, and symptoms in both short- and long-term perspectives.

Methods: A randomized controlled trial comparing acupuncture and Transcutaneous electric nerve stimulation (TENS) for PGP during pregnancy (*Paper I*). *Paper II* was a qualitative interview exploring pregnant women's expectations and needs before a physiotherapy consultation for PGP. *Paper III* was a cross-sectional evaluation of women's satisfaction with physiotherapy for PGP in pregnancy, and their functional status 4 months postpartum. In *Paper IV* a long-term follow-up of the study in Paper I was performed, assessing functioning, physical activity level, and symptoms 4 months and 3 years postpartum.

Results: Both acupuncture and TENS were effective in reducing pain intensity and concern about pain. No differences between treatment groups were detected and the women maintained their physical activity level, which is typically reduced in PGP *(Paper I)*. Women with PGP experienced significant negative impacts on their daily lives, with a need for tailored advice and support from physiotherapists *(Paper II)*. Most women were satisfied with the tailored physiotherapy they received for PGP in pregnancy. 4 months postpartum, 125 of 164 women experienced pain and impact on functioning to some extent. Concern about pain seemed to have an association with the level of functioning *(Paper III)*. At 3 years postpartum, women who got physiotherapy for PGP in pregnancy still experienced limited functioning. No difference between treatment groups was detected. The level of functioning and concern about pain in pregnancy was associated with functioning 3 years postpartum *(Paper IV)*.

Conclusion: Pelvic girdle pain significantly affects women's lives during and after pregnancy. Early identification and tailored treatment can lead to reduced discomfort, improved functioning, maintained physical activity levels and high treatment satisfaction. Concern about pain seemed to impact functioning, thus it is important to address, to possibly lower the risk of persistent pain.

Keywords: Physiotherapy, Pregnancy, Pelvic girdle pain, Women’s health, Acupuncture, TENS, Phenomenology

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SAMMANFATTNING PÅ SVENSKA

Graviditetsrelaterad bäckensmärta är ett vanligt problem som drabbar mer än hälften av alla gravida kvinnor. Besvären kan starta när som helst under graviditeten eller inom tre veckor efter förlossningen. Smärtan är lokaliserad över de bakre bäckenlederna och/eller blygdbensfogen och kan även kännas ner i låren. Bäckensmärta kan få negativa konsekvenser för kvinnors vardagsliv eftersom smärtan ofta begränsar möjligheten att röra sig fritt på samma sätt som tidigare.

Bäckensmärta är en vanlig orsak till att kvinnor minskar sin fysiska aktivitetsnivå vilket kan ha negativ påverkan på den allmänna hälsan. Forskning visar att kvinnor som är aktiva under sin graviditet har en minskad risk för graviditetsrelaterade komplikationer som diabetes, högt blodtryck och havandeskapsförgiftning. De åtgärder som i dagsläget rekommenderas som behandling för graviditetsrelaterad bäckensmärta är bäckenbälte, akupunktur och träning för att stärka muskulaturen i bål- och höftregionen.

Syftet med denna avhandling var att undersöka fysioterapi för graviditetsrelaterad bäckensmärta: förväntningar på behandling, nöjdhet med behandling samt hur åtgärder med syfte att underlätta för kvinnorna att hantera sina besvär påverkar funktionstillstånd, fysisk aktivitetsnivå och symtom i ett kort-, respektive långtidsperspektiv.

Denna avhandling innehåller fyra delstudier. *Delstudie I* är en randomiserad kontrollerad studie som undersökt akupunktur jämfört med Transkutan elektrisk nervstimulering (TENS) för bäckensmärta i graviditet. Denna studie visade att fem veckors behandling för bäckensmärta i graviditet med antingen akupunktur eller TENS gav minskad smärtintensitet och minskad oro för smärta. Ingen skillnad mellan behandlingsgrupperna kunde identifieras. Kvinnorna som fick behandling upprätthöll också sin fysiska aktivitetsnivå, vilket inte brukar vara fallet vid bäckensmärta.

Delstudie II är en kvalitativ intervjustudie som utforskat gravida kvinnors förväntningar och behov inför att de träffar fysioterapeut på grund av sin bäckensmärta. Resultatet visade att kvinnor med bäckensmärta upplever att besvären har en stor negativ påverkan på deras vardagsliv. De beskriver hur de behöver anpassa aktiviteter, försöker hitta strategier för att minska smärta och att bäckensmärta var något de inte var förberedda på eller hade kunskap om. Inför besöket hos fysioterapeut beskriver de att de önskar träffa en expert som

ser dem som individer i en för dem unik situation, och som kan ge individanpassade råd för att hjälpa dem att hantera bäckensmärtan.

Delstudie III är en tvärsnittsstudie som utvärderat kvinnors nöjdhet med behandling för bäckensmärta i graviditet samt beskriver kvinnornas funktionstillstånd, fysiska aktivitetsnivå och symptom fyra månader efter förlossning. Majoriteten av deltagarna i denna delstudie var nöjda med den behandling de hade fått. Fyra månader efter förlossning upplevde 125 av de 164 deltagarna att de haft besvär av bäckensmärta under de senaste fyra veckorna. Av de 125 med smärta hade 50 kvinnor en måttlig till hög påverkan på sitt funktionstillstånd och omkring en tredjedel uppfyllde de allmänna rekommendationerna för fysisk aktivitet på minst 150 minuter/vecka. Oro för sina besvär visade sig vara en faktor som hade ett möjligt samband med kvinnans funktionstillstånd.

Delstudie IV är en uppföljning av delstudie I som utvärderat funktionstillstånd, fysisk aktivitetsnivå och eventuell kvarstående bäckensmärta fyra månader samt tre år efter förlossning. Studien har också undersökt möjliga samband mellan faktorer som kan påverka kvinnans funktionstillstånd tre år efter förlossning. Denna uppföljningsstudie visade att tre år efter förlossning så angav 34 av 57 kvinnor som fått behandling med antingen akupunktur eller TENS för bäckensmärta i graviditet att de hade kvarstående besvär med smärta i bäckenet. Kvinnor i båda behandlingsgrupperna förbättrade sitt funktionstillstånd över tid och ingen skillnad mellan grupperna identifierades, men deras funktionstillstånd och oro över besvären när de sökte vård för bäckensmärta verkar ha samband med deras funktionstillstånd 3 år efter förlossningen.

Bäckensmärta påverkar många kvinnors vardagsliv, både under graviditet och efter förlossning. Om kvinnor med besvär identifieras och får behandling tidigt i förloppet kan det innebära minskade besvär, oro över besvären och en ökad funktionsnivå med bibehållen fysisk aktivitetsnivå. Att erbjuda uppföljning hos fysioterapeut under och efter graviditet för dem som upplever bäckensmärta skulle kunna vara en strategi för att ytterligare minska oro och hjälpa kvinnor att bibehålla sin aktivitetsnivå.

LIST OF PAPERS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

I. Svahn Ekdahl A, Fagevik Olsén M, Jendman T, Gutke A. Maintenance of physical activity level, functioning and health after non-pharmacological treatment of pelvic girdle pain with either transcutaneous electrical nerve stimulation or acupuncture: a randomised controlled trial. BMJ Open. 2021;11(10):e046314.

II. Ekdahl AS, Gutke A, Olsén MF, Mannerkorpi K. Expertise and individually tailored interventions are expected by pregnant women with pelvic girdle pain who seek physical therapy: a qualitative study. Braz J Phys Ther. 2023;27(2):100494.

III. Svahn Ekdahl A, Fagevik Olsén M, Gutke A. Individually tailored physiotherapy interventions for pelvic girdle pain in pregnancy: treatment satisfaction, daily functioning and physical activity postpartum. A cross sectional study. (In manuscript)

IV. Svahn Ekdahl A, Fagevik Olsén M, Gutke A. From pregnancy to three years after – maintenance of functioning & physical activity level among women treated for pelvic girdle pain in pregnancy. (In manuscript)

CONTENTS

ABBREVIATIONS

ASLR	Active straight leg raise
BMI	Body mass index, kg/m^2
ICF	International Classification of Functioning, Disability and Health
NRS	Numeric Rating Scale
ODI	Oswestry Disability Index
PGP	Pelvic girdle pain
PGQ	Pelvic Girdle Questionnaire
PPGP	Postpartum pelvic girdle pain
PSFS	Patient-Specific Functional Scale
TENS	Transcutaneous electric nerve stimulation

DEFINITIONS IN SHORT

Disability	Defined by the World Health Organization (WHO) as impairments, activity limitations and participation restrictions. (1)
Exercise	A subset of physical activity that is planned, structured, and repetitive with the aim of improvement or maintenance of physical fitness (2)
Functioning	According to the WHO all bodily functions, activities and participation (1)
Low back pain	Pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without leg pain (3)
Pelvic girdle pain	An experience of pain localized between the posterior iliac crest and the gluteal fold, commonly in the area over the sacroiliac joints and/or the symphysis, with or without radiation into the posterior thigh/s, and further determined through positive pelvic pain provocation tests (4)
Physical activity	Bodily movements produced by skeletal muscles that results in an increase over the resting energy expenditure (2)
Postpartum	Described as the period that starts directly after delivery and lasts up to 6 months (5) In this thesis, 4 months and 3 years postpartum is used to describe different time periods.
Sensitivity	The ability of a test to correctly identify patients who have a certain disease.

Specificity	The ability of a test to correctly identify people who do not have a certain disease.

1 INTRODUCTION

A wanted pregnancy is for many women a time of anticipation and joy. For more than 50% though (6-9) , this period in their life is disrupted by pelvic girdle pain (PGP), a pain that they are unprepared for, something they have no idea of, and little knowledge about. These women feel limited by a pain that keeps them from work and social activities, affects their mood, and hinders them from being as physically active as they want to be (10, 11).

Historically, pregnancy and delivery have been tough and dangerous life events for women, but developed healthcare has largely reduced the risks. Today most women are working and can continue to do so as long as possible during an uncomplicated pregnancy (12). Societal demands such as an active social life and regular exercise should be balanced in everyday life. Women of today may experience pressure to take care of themselves, their work, home, and relations during pregnancy and to return to their usual life as soon as possible after delivery, which can be stressful (13).

Pain, tiredness, or other complaints are sometimes thought of as normal, something that comes with pregnancy and should just be endured. Women with PGP report that healthcare professionals as well as society in general lack knowledge about PGP and the women feel misunderstood and dismissed when they seek care (14). Pregnancy is not a disease but when PGP causes the women to struggle managing their everyday chores, to feel a need to adapt life according to pain, and to refrain from activities – then it becomes a condition that is not normal.

There is a further need for research on the topic and the Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU) has announced scientific evidence gaps regarding PGP (15). Prioritized research questions for PGP focus on care programs including collaboration between various health care professionals, the economic impact on society and the individual due to sick leave, and the role of education for clinicians in PGP care. Other prioritized areas are preventive measures, risk factors and follow-up strategies to prevent persistent PGP, the condition's impact on women's quality of life, as well as societal attitudes towards PGP, including possibilities for the women to receive adequate care (15).

This thesis fills some knowledge gaps but also raises some more questions on how PGP could be assessed and treated.

1.1 PELVIC GIRDLE PAIN

Pain is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage” (16, p. 1977). Pain is a subjective experience shaped by biological, psychological, and social factors, distinct from nociception, which is a mere sensory neuron activity. Individuals understand pain through life experiences, and their expressions of pain should be respected. Pain typically plays an adaptive role, as a function to help us respond to and avoid harmful stimuli, ultimately aiding in our survival, but it can also negatively impact function and psychological well-being (16).

Pelvic girdle pain is a musculoskeletal pain localized in the area between the superior iliac crest and the gluteal fold, and can involve the sacroiliac joints and the pubic symphysis (Figure 1), ligaments, fascia, and muscles surrounding the pelvic bone structure (4). The sacroiliac joints between the sacrum and iliac bones on either side are large axial joints which serve as a crucial connection between the spine and the pelvis, enabling load transfer from the lumbar spine to the legs. The sacroiliac joints have limited motion, on average about 2° in the three planes of the joint respectively (17).

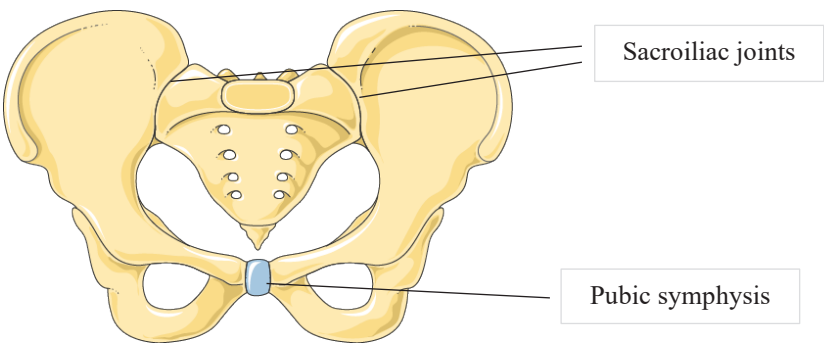

Figure 1. Female pelvis. (Figure modified with lines and text after adaptation of “Female pelvis” from Servier Medical Art by Servier, licensed under a Creative Commons Attribution 3.0 Unported License.)

The pubic symphysis is made up of a fibrocartilaginous disc positioned between the articulation surfaces of the pubic bones. Ligaments reinforce the structure as it should withstand tensile, shearing and compressive forces. The symphysis has limited range of movement, up to a 2 mm shift and 1° of rotation (18).

When a woman gets pregnant many physiological changes take place. The increased weight of the mother and changes in point of gravity due to the growing fetus alter the biomechanical demands on the pelvic area. For some women these alterations become symptomatic, but for others they do not. Pelvic girdle pain could debut at any time during pregnancy or within the first three weeks postpartum (4).The most common pain site is uni- or bilaterally in the lower back/gluteal area, more specifically over the sacroiliac joints, and/or the pubic symphysis. Sometimes pain is referred to one or both thighs, but seldom below the knee (6). Pain intensity varies, but pain is usually provoked by asymmetrical activities such as walking, climbing stairs, and standing on one leg. Prolonged standing or sitting may also aggravate the symptoms, and a catching sensation in the hip area when walking or moving the leg has been reported as a PGP-specific symptom (6). Women with pubic symphysis pain may report a shooting pain sensation in the symphysis and often have major difficulties with walking, uneven load such as standing on one leg, and/or rising from a chair or lifting (19).

For most women PGP resolves spontaneously within 3–4 months after delivery (6, 20, 21), but for some the symptoms remain and may become longstanding, and persistent PGP for up to 12 years postpartum has been reported (22, 23).

Which factors hinder a full recovery from PGP is not completely clear, but several risk factors for postpartum PGP have been identified. An increased number of childbirths (24, 25) and caesarian section deliveries (26, 27) have been linked to higher risk for PGP postpartum. In the study by Bjelland et al., the increased risk for PGP postpartum associated with caesarian section was seen for women with severe pain and in need of crutches. The authors discuss that women with severe PGP to a higher extent have a planned caesarian section (27), which is in line with Mogren et al. (26), who also discussed that women with increased symptom severity to a larger extent delivered by caesarian section and had a higher risk for lumbopelvic pain postpartum. The impact of maternal age on PGP shows varied findings: while some studies indicate that younger women are at greater risk (25, 28), others suggest higher maternal age as a factor (29, 30). Starzec-Proserpio et al. reported a 10%

increase in PGP risk for each additional year of maternal age (31). However, younger age in one study correlated with trunk flexor strength, suggesting age alone should not be the sole predictor of PGP (32).

Pre-pregnancy lumbopelvic pain (25, 28, 29, 31), a body mass index (BMI) over 25 (25), severe pain (33), pain in all pelvic girdle joints with multiple positive pain provocation tests (34), and combined PGP/lumbar pain (21) are all linked to increased risk of postpartum pain. The same goes for psychological factors such as fear-avoidance, catastrophic thinking, and depression, and negative expectations about recovery (22, 33, 35-37).

Other factors with impact in development of long-standing PGP include heavy workload during pregnancy (25, 36), low physical activity levels (25, 28, 38), and lower education (25). The connection between low educational levels and PGP is less certain, though low education is known to be a risk factor for low back pain (39, 40).

1.1.1 ETIOLOGY

To this date, it is still unclear what causes PGP, and several theories have been suggested (41, 42).

The concept of form-, and force closure of the pelvic joints is a possible biomechanical explanation of PGP. Form closure is the passive stability in the sacroiliac joints due to their shape, the position of sacrum like a wedge between the two iliac bones and the compressive forces of the pelvic ligaments (43). The form closure is not enough to withstand the shear forces through the sacroiliac joints in weightbearing position, and therefore, muscles in the hip are necessary for generating a compression force that further increases stability. An impairment in this force closure mechanism may increase shear force on the sacroiliac joints and this may in turn cause pain (43). Increased range of motion in the pelvic joints has been proposed to play a role in pregnancy-related lumbopelvic pain, but according to Mens et al. (44) there is a large overlap in measured motion between healthy controls and women with symptoms. Therefore, other possible factors must be identified as well.

In pregnancy, hormone levels change and when relaxin, estrogen, and progesterone levels change this may affect ligament laxity and joint stability in both the sacroiliac joints and the pubic symphysis, and therefore contribute

to PGP (45), although a previous study found no association between relaxin levels and PGP (46). There are other conditions such as hypermobility spectrum disorders that may result in a higher risk for developing PGP (47). The increased laxity in the ligaments and tendons supporting the joints due to the hypermobility spectrum disorder permits a greater range of motion, which in turn may increase load on the sacroiliac joints and thus cause pain (47). Research indicates that while women with generalized joint mobility might not be more likely to develop pregnancy-related PGP, they could experience more intense pain compared to women without generalized joint mobility (48). However, when this increased joint mobility is present alongside a BMI of 25 or higher, the risk of experiencing PGP increases (48).

Another theory is that PGP may start with microtrauma, small, repetitive injuries to tissues such as ligaments, tendons and muscles that accumulate over time. This microtrauma may not cause immediate pain, but it causes slight tissue damage, triggering the release of pro-inflammatory substances that increase blood flow and attract immune cells (42). These inflammatory mediators sensitize nociceptors, lowering their activation threshold and making them respond to stimuli that are normally not painful (42, 49). If microtrauma and inflammation persist, they can cause changes in the central nervous system, a phenomenon known as central sensitization, which increases pain sensitivity and can lead to an overreaction to various stimuli which in turn may lead to persistent pain (49). Over time, continuous inflammation can also alter peripheral nerves, increasing their ability to transmit nociceptive signals. Even after the initial injury heals, pain can persist due to lasting changes in the nervous system's pain pathways, which could explain why pain becomes longstanding (42). Psychological factors like stress, anxiety, and depression can further intensify the perception of pain and contribute to the development of PGP in pregnancy and postpartum (42, 50).

Neuromuscular adaptation and pain modulation may contribute to the development and perpetuation of pain (45). Altered muscle function, such as involuntary muscle tension in response to pain, can lead to increased fatigue and exacerbate pain, creating a cycle of dysfunction (51). Adaptations in motor control to avoid pain can result in imbalances and abnormal movement patterns, increasing stress on the pelvic joints (51, 52). Furthermore, chronic pain can lead to reduced muscle strength and endurance due to avoidance of movement, making muscles less capable of supporting joints and absorbing shocks, thereby increasing susceptibility to injury and pain (51). Impaired pain modulation, such as reduced efficacy of endogenous opioids or dysregulation

of pain-suppressing brain pathways, can exacerbate pain perception. Additionally, the psychological impact of anxiety, pain-related fear, and fear-avoidance behaviors (53), can lead to further neuromuscular deconditioning, perpetuating the cycle of pain.

A recent, observational study on prevalence of PGP indicates that both hereditary and environmental factors may contribute (54). The hazard ratios for PGP in this study were highest for full sisters, interpreted as doubling the odds for siblings to develop PGP compared to a reference group. Sisters may share environmental factors, but the authors state that this may not be the case for their whole life and thus, heredity may have more impact than environment on the development of PGP (54).

Pelvic girdle pain during pregnancy is a unique type of pain, because in most cases it has a natural endpoint – the delivery. Depending on when PGP debuts in pregnancy, women can experience it for varying amounts of time. Therefore, the time point for defining pain as chronic, 3 months (55), cannot be applied to this type of pain in pregnancy.

1.1.2 PREVALENCE

Due to inconsistency regarding what terminology is being used, if lumbar pain is included, which trimester PGP was measured in, the study design (prospective or retrospective), the recruitment procedure, and if PGP is clinically verified or not, prevalence differs largely between studies and countries with a range between 4 and 86 % in pregnancy (4, 6, 8, 9, 56-59). The prevalence of postpartum pain also varies, because of the previously mentioned factors and the time point at which postpartum PGP is measured (6, 21, 31, 57). According to the International Classification of Diseases (ICD–10), pregnancy-related PGP has no specific diagnostic code (60). This means that several codes may be used for the same symptoms, which in turn can make the prevalence hard to estimate (61).

Example of ICD-10 codes being used for pelvic girdle pain

- R10.2 Pelvic and perineal pain
- O26.7 Subluxation of symphysis pubis in pregnancy
- O26.9 Pregnancy-related condition, unspecified
- M53.3 Sacrococcygeal disorders not elsewhere specified
- M54.5 Low back pain

Figure 2. Example of ICD-10 codes used to classify PGP.

As pregnancy proceeds, every additional gestational week may increase the odds of having PGP (9). The strongest predictor for having PGP in pregnancy was having a history of lumbar pain/PGP (9, 25, 36).

1.1.3 DIAGNOSING PELVIC GIRDLE PAIN

To diagnose pregnancy-related PGP, a thorough examination is important to differentiate between PGP, lumbar pain, and hip joint pathology. Other possible causes of pain, such as trauma, inflammatory disease, neurologic symptoms, and so-called "red flags" pointing towards a more serious pathology, need to be ruled out (7). For a precise diagnosis of PGP, and to differentiate it from lumbar pain, PGP should be reproducible through pain provocation tests. Various tests are available, but the most commonly used and recommended ones for diagnosing PGP, according to the European guidelines (4) and the Swedish profession-specific guidelines for physiotherapists (62), are displayed in Table 1.

The pain provocation tests can be used to assess symptom severity (number of positive tests) and to classify symptoms into subgroups of PGP; Isolated symphyseal pain, unilateral sacroiliac pain, bilateral sacroiliac pain, or pelvic girdle syndrome (pain in all three joints of the pelvis) (63). A positive outcome for the pain provocation tests for posterior and anterior PGP is if the test reproduces a familiar pain in the area of the sacroiliac joints or the pubic symphysis. The 4-P has the highest sensitivity and specificity among the tests for posterior pain (Table 1).

Table 1. Clinical tests used for diagnosing PGP

Test	Performance	Sensitivity	Specificity
Posterior pain			
Posterior pain provocation test (4-P) (63-65)	Patient supine with the tested leg in 90 hip- and knee flexion. PT stabilizes ASIS on the opposite side. A downward (dorsal) light pressure is applied to the knee.	0.81–0.93	0.80–0.98
SIJ compression test (63)	Patient supine, PT places hands with crossed arms on ASIS bilaterally and applies a dorsolateral pressure.	0.04–0.40*	1.00
SIJ distraction test (63)	Patient side-lying, hip flexion 45°, knee flexion 90°. PT places both hands on the upper ilium and applies a downward pressure.	0.24–0.70*	1.00
Sacral thrust (66), *not evaluated in pregnancy*	Patient prone (side-lying in pregnancy), PT applies a downward (ventral) pressure on sacrum.	0.63	0.75
Palpation LDL (67)	Palpation of the ligament below the posterior iliac spine.	0.76	–
Patrick's test (63)	Patient supine with one foot on the opposite knee, the leg in flexion, abduction and external rotation.	0.40–0.70*	0.99
Anterior pain			
Pulling-a-mat (MAT) test (68)	Patient standing, one straight leg is abducted and then adducted with constant contact with the floor.	0.85	0.89
Modified Trendelenburg (63)	Standing on one leg, the other leg held at 90° hip- and knee flexion.	0.60, 0.62**	0.99
Pain drawing (68)	Patients mark their painful area(s) on a body-chart.	0.96	0.85
Palpation symphysis (63)	Palpation of the pubic symphysis.	0.60, 0.81**	0.99
Functional tests			
Active straight leg raise test (ASLR) (69)	Patient supine, raises one leg 20 cm from the examination table and grades the difficulty 0–5 per leg.	0.54 0.68***	0.88

PT, Physiotherapist; ASIS, Anterior superior iliac spine; SIJ, Sacroiliac joints; LDL, Long dorsal ligament
* different values depending on classification group (one sided/double sided SIJ syndrome, pelvic girdle syndrome)
** for classification groups pelvic girdle syndrome, and symphysiolysis respectively
*** sensitivity for ASLR is higher when combined with 4-P

To increase the accuracy of the diagnosis of sacroiliac joint pain it is recommended that the 4-P, compression-, distraction-, and sacral thrust tests are clustered with a cut-off point for diagnosing PGP of ≥2 positive tests (66, 70). On the contrary, a systematic review suggests that clusters of tests are better for ruling out sacroiliac joint pain than diagnosing it (71). The ASLR could be added to the test cluster as a test to assess muscular function in the trunk and pelvic area in pregnant women (69). The woman grades the difficulty of her lifting one leg from the treatment table (0 = no difficulties to 5 = unable to lift the leg), and the score of each leg is combined into a summary score. In pregnancy, the recommended cut-off for the ASLR is 0–1. The test has moderate sensitivity, but combined with 4-P the sensitivity gets higher for posterior PGP (69).

Patrick's test is not only a test for the compression/distraction of the sacroiliac joint, but there is also stress on its anterior ligaments and the hip joint. Depending on where pain is felt during the test, it may indicate that either the sacroiliac joint or the hip joint is affected (63). The thigh thrust is another test used for diagnosing PGP (66). It is similar to the 4-P, performed in the same position but with the tested leg in adduction and the force applied by the physiotherapist as 3–5 high velocity thrusts instead of a continuous light pressure. The test has lower sensitivity/specificity than 4-P (64, 66) and may be more painful and harder to perform in pregnancy due to the growing belly; thus, 4-P is a better choice in pregnancy. For anterior pain, palpation of the pubic symphysis has high sensitivity and specificity (Table 1) but may be very painful, and thus could be considered to be avoided. The MAT-test, a pain drawing, and the Trendelenburg test could be a proper cluster for diagnosing symphyseal pain (63, 68). Overall, these pelvic pain provocation tests show a moderate to high sensitivity (Table 1). The inter-examiner reliability, evaluated by Cohen's kappa, ranged between 0.34–0.89 for the pain provocation tests in the study by Albert et al. (63). The lowest kappa coefficients were detected for palpation of LDL (0.34) and Patrick's test (0.54), and the highest for palpation of the pubic symphysis in anterior pelvic pain (0.89). Albert et al. considered values of 0.41–0.60 as moderate strength of agreement, 0.61–0.80 as substantial, and 0.81–1.0 as almost perfect (63).

Previous studies have evaluated the pelvic pain provocation tests, used individually or in different combinations, in cohorts of pregnant women in order to classify pregnancy-related lumbopelvic pain (63, 72). Albert et al (63) evaluated 15 individual tests, used to classify different types of pregnancy-

related PGP. The tests were found to be easy to use, precise for pain localization, and they had high sensitivity and specificity (63).

In pregnancy, the only tested clinical procedure for diagnosing PGP is by Gutke et al (73), who evaluated a classification system to differentiate between lumbar pain and PGP among pregnant women and this procedure is often used in clinical work and research today. The procedure is based on the recommended test cluster by Laslett et al (66), and were further adapted by the authors to fit pregnant women (73). It includes assessment of hip range of motion, a neurological examination (L4–S1 levels), pelvic pain provocation tests, a mechanical lumbar spine assessment, and the ASLR. This test procedure shows substantial inter-rater agreement, with a kappa coefficient of 0.79 for differentiating between lumbar pain and PGP in pregnant women (73).

1.1.4 IMPACT ON WOMEN'S EVERYDAY LIFE

The impact of PGP on women's everyday life can be structured according to the International Classification of Functioning, Disability and Health (ICF) (1). This model has been developed by the World Health Organization for assessing functioning and is based on the bio-psycho-social model developed by Engel (74) to cover all aspects of a health condition. Functioning, and its counterpart, disability, is the result of interactions between all components included in the ICF model. Health conditions such as PGP may affect function of the body (e.g., pain, concern), limit the ability to be active (e.g., walking difficulties), and result in difficulties in participating in social activities and work (75) (Figure 3). Pregnant women have a higher rate of sick leave than women in general (76), and PGP is one of the most common causes for sick leave (77, 78). Being on sick leave may lead to a feeling of exclusion from professional life and its social interactions, which can cause distress and have impact on the woman's health (79).

Personal factors, such as previous pregnancies or prior experience with any type of pain, may influence the individual woman's perception of PGP. Environmental factors, such as living in a house without an elevator, the presence or absence of support from family and friends, and prevailing attitudes towards pain in their surroundings, may influence the experience of pain (Figure. 3). ICF provides a framework for a holistic view of PGP that enlightens the individual woman's experience of pain, limitations, and the

aspects that are most important to her, which is important to address when designing physiotherapy treatment.

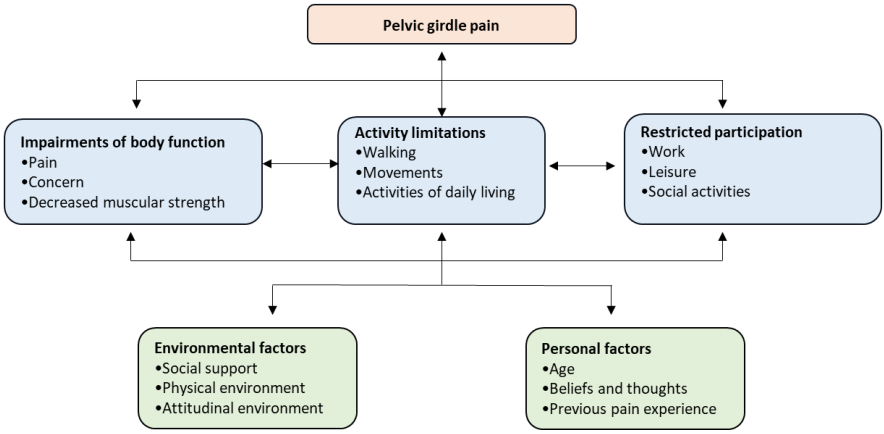

Figure 3. PGP structured according to the framework of the International Classification of Functioning, Disability and Health (ICF) (1). Impairments, limitations and factors that may affect the experience of PGP (75, 80).

Women report that PGP limits their functioning in various ways and that they cannot be as physically active as they want to be due to their symptoms (75, 80). Regular physical activity is known to have health benefits for people of all ages (81, 82). Pregnant and postpartum women are recommended to follow general guidelines for physical activity; to reduce sedentary time, and to be physically active at least 150 minutes per week on a moderate intensity level (81). Few pregnant women reach this recommendation; a decreased physical activity level is common during pregnancy (83), and this decrease remains after delivery (84, 85). For pregnant women who stay active there is a lower risk for complications such as diabetes, hypertension, and preeclampsia (86). Tiredness, lack of time, PGP, uncertainty about safe exercise and lack of social support are common reasons for not being active during pregnancy (87-90). Among postpartum women, the adaptation to life as a new mother including fatigue, lack of time and motivation, and poor knowledge about suitable activities are barriers for physical activity (90-92).

Physiotherapists have an important role in education about PGP and in promoting physical activity for both pregnant and postpartum women. To help women find safe ways to be physically active, and to find alternatives for

painful working positions or tasks, may reduce sick-leave and promote overall health both in pregnancy and postpartum.

1.1.5 PHYSIOTHERAPY FOR PELVIC GIRDLE PAIN

There is currently limited evidence regarding effective treatment for PGP (4, 93-95), but acupuncture, muscle strengthening exercises for the trunk and pelvic/hip area, and a pelvic belt are interventions that could be used.

The physiology behind the pain-relieving effect of acupuncture is not completely clear. Needles are inserted in different traditional acupuncture points, distributed along meridians over the whole body. The meridians do not correspond with any specific anatomic structures, but the acupoints are located over areas with high concentration of A-delta and C fibres (96). The needles are stimulated manually to create a deep feeling of numbness, aching, or stinging, "de qi." Also, electrical stimulation can be applied to the needles, giving a different response than with manual stimulation. The pain-relieving effect of acupuncture is suggested to result from increased blood circulation, release of endogenous opioids. Pain relief is also explained by the gate-control theory and through activation of descendent pain inhibitory pathways (96). Acupuncture is considered a safe treatment method with few and minor adverse effects and could be recommended as treatment for musculoskeletal pain including PGP. It is also considered safe to administer in pregnancy; no negative effect on delivery outcomes has been shown among women treated with acupuncture during pregnancy (97, 98).

Previous research has reported that reduced muscle function in the trunk and hip could affect severity of PGP (99). Exercise could be a way of preventing PGP (100), and women who exercised before pregnancy may have a reduced risk for PGP in pregnancy (101). Today there is limited evidence regarding stabilizing exercise for treating PGP (102). Previous studies are heterogeneous when it comes to type of exercises and dosages, which makes it difficult to draw conclusions (103).

A stabilizing pelvic belt could relieve PGP through increasing the force closure mechanism of the pelvis via the external force applied by the belt (104). The proprioceptive input given by the belt may enhance muscular control and have effect on pain via the gate-control theory (105, 106). Transcutaneous electric nerve stimulation (TENS) is another common method used by physiotherapists for treating PGP, but there is limited evidence for its effectiveness (107, 108). TENS is a non-invasive method of pain relief where electrodes, connected to

an electronic portable device, are placed over the painful area (96). The electric stimulation could be of high (80 Hz), or low (2 Hz) frequency. High frequency stimulation should result in a tingling, non-painful sensation in the area of stimulation, while low frequency TENS induces muscle contractions. Pain relief is explained by the gate-control theory, activation of descending pain-inhibitory pathways, and release of endogenous opioids (109). TENS has few adverse effects, mostly soreness or skin irritation under the electrodes (110), and is considered safe to use during pregnancy (107, 111).

1.1.6 PELVIC GIRDLE PAIN AND HEALTHCARE

Research shows that women's knowledge about PGP is often sparse and women describe experiences of healthcare providers also lacking knowledge and understanding (75). Feelings of being misunderstood, rejected, and told that PGP is something that is normal in pregnancy, as well as difficulties in achieving proper treatment are expressed by pregnant women with PGP (75).

When women with PGP seek care for their symptoms, the midwife is often the first and natural contact as almost all pregnant women in Sweden are enlisted at a maternity health-care center. A report from the Swedish National Board of Health and Welfare (112) highlights the important role of midwives in supporting women during and after pregnancy. It was found that a significant majority (85%) of women experienced worries during pregnancy, predominantly concerning their child's health, the childbirth process, and potential perineal tears. Postpartum concerns shifted towards the child's well-being, their own recovery process, and overall health. Engaging with healthcare providers, including midwives, physiotherapists, or psychologists, was reported to increase women's sense of security. However, the report also points out a notable uncertainty among women, especially those born outside the Nordic countries, about where to seek help for physical or mental health issues. To address specific challenges like PGP, urinary incontinence, and diastasis recti, women expressed a need for easier access to physiotherapy services, both during pregnancy and after delivery (112). This suggests a gap in the healthcare system's ability to adequately guide and support women through pregnancy and postpartum, indicating a need for improved communication and referral processes as well as a need for marketing the competence of physiotherapists in the field of women's health.

2 RATIONALE OF THIS THESIS

About half of all pregnant women experience PGP to some extent and one can argue that this makes PGP a public health issue, even if it is not classified as a disease. The cause of PGP is not completely clear and evidence for current interventions and/or prevention is limited. This thesis is based on questions about how PGP should be managed in clinical practice to be able to provide adequate management for PGP

Evidence-based treatment for PGP includes acupuncture, but TENS is widely used in physiotherapy practice, even though evidence is lacking (107, 108). The pain-relieving mechanisms of acupuncture and TENS are similar, with release of endogenous opioids and decreased pain explained by the gate-control theory (96), but it is unknown whether either one is superior in PGP. Knowledge is also sparse about long-term effects of physiotherapy for PGP with the aim of managing pain and its effect on functioning, physical activity level and symptoms.

There are guidelines for treating PGP (4, 62), but whether they thoroughly address the issues women experience in pregnancy or postpartum is not yet known. Knowledge about what expectations and needs women have when they seek physiotherapy for PGP is lacking, and thus, physiotherapists may fail to offer adequate treatment.

Because PGP can debut in different gestational weeks or early postpartum, and has a complex nature affecting women in various ways (75), no standard treatment can be provided, and thus individually tailored interventions are needed. It is unknown whether women are satisfied with received physiotherapy treatment based on treatment guidelines and tailored to their individual needs.

There is also a lack of knowledge regarding possible factors, identifiable in pregnancy, that may be associated with the level of functioning postpartum.

3 AIMS

This project aimed to investigate physiotherapy for PGP in pregnancy: expectations for treatment, treatment satisfaction, and how treatment aimed to improve pain management affects functioning, physical activity level, and symptoms in short- and long-term perspectives.

3.1 SPECIFIC AIMS

- To investigate if there are differences between acupuncture and transcutaneous electric nerve stimulation (TENS) as treatment for PGP in pregnancy in order to manage pain and thus maintain health and functioning in daily activities and physical activity. *(Paper I)*

- To explore pregnant women's lived experience of PGP and what needs and expectations they express prior to a physical therapy consultation. *(Paper II)*

- To describe current levels of functioning, physical activity, pain, and treatment satisfaction in women who received individually tailored physiotherapy based on treatment guidelines for PGP in their latest pregnancy. Another objective was to investigate relationships between factors that could impact disability resulting from PGP postpartum. *(Paper III)*

- To investigate functioning, physical activity level, and possible remaining PGP at 4 months and 3 years postpartum, respectively, and investigate relationships between factors that could impact functioning 3 years postpartum. *(Paper IV)*

4 METHODS

The basis for this thesis is four studies with different designs: one randomized controlled trial (RCT) with a long-term follow-up, one qualitative study, and one cross-sectional study (Table 2). The different designs provide a broad perspective on PGP, both in pregnancy and postpartum, and give an important insight into women's needs and expectations when they seek physiotherapy. Altogether, these studies add to the existing knowledge regarding physiotherapy for PGP.

Table 2. Overview of Papers I-IV

	Paper I	Paper II	Paper III	Paper IV
Design	Randomized controlled trial	Qualitative study; phenomenological approach	Cross-sectional study	Long-term follow-up of Paper I
Time point	In pregnancy	In pregnancy	4 months postpartum	4 months and 3 years postpartum
Participants	Pregnant women with clinically verified PGP (n = 113)	Pregnant women seeking physiotherapy due to PGP (n = 15)	Women who received physiotherapy for PGP in pregnancy (n = 164)	Participants in initial RCT (n = 77 at 4 months, n = 57 at 3 years)
Recruitment	Two maternity health care centers in western Sweden	One primary-care rehabilitation center in Gothenburg	One primary-care rehabilitation center in Gothenburg	See Paper I
Intervention	Five weeks of either acupuncture or TENS	–	Tailored physiotherapy based on current guidelines	–
Data collection	PROM and CA at baseline and post treatment	Individual face-to-face interviews	PROM via questionnaire	PROM + CA at 4 months pp + PROM 3 years pp
Trial registration	VGFOUREG–127261	VGFOUREG–220091	VGFOUREG–220091	VGFOUREG–127261
Ethical approval	No. 308–13	No. 105–16	No. 105–6	No. 308–13

RCT, Randomized controlled trial; PROM, Patient-reported outcome measures; CA, Clinical assessment; pp, postpartum.

Ethical approval was granted for all studies by the regional ethical review board in Gothenburg, Sweden. Informed consent was obtained from all participants, and procedures were conducted according to the Declaration of Helsinki.

4.1 OUTCOME MEASUREMENTS

The following instruments (Table 3) were used in the different studies with the aim of covering all aspects of the ICF in each of the studies.

Table 3. Overviews of the outcome measures used in Papers I, III, and IV

Construct	Instrument	Paper I	Paper III	Paper IV	
				4 months	*3 years*
Functioning	PSFS	X	X	X	X
Functioning	PGQ	X	X	X	X
Disability	ODI	X		X	
Physical Activity	Two single questions	X	X	X	X
Work Ability	WAI, one question	X	X	X	X
Pain intensity	NRS	X	X	X	X
Pain-related concern	NRS	X	X	X	X
Health	EQ-5D	X		X	X
Health	EQ-VAS	X		X	X
Health	NRS		X	X	
Depressive symptoms	EDPS	X		X	
Catastrophizing	CSQ-CAT	X			
Depression/anxiety	HADS				X
Urinary incontinence	Yes/no	X		X	
Urinary incontinence	ICIQ-UI				X
Recovery	GRC			X	X

PSFS, Patient-Specific Functional Scale; ODI, Oswestry Disability Index; WAI, Work Ability Index; NRS, Numeric Rating Scale; EQ-5D, EuroQoL 5 dimensions; EQ-VAS; EuroQoL Visual Analogue Scale; EDPS, Edinburgh Postnatal Depression Scale; CSQ-CAT, Coping Strategies Questionnaire, subscale "Catastrophizing"; HADS, Hospital Anxiety and Depression Scale; ICIQ-UI, International Consultation on Incontinence Questionnaire; GRC, Global Rating of Change Scale

** After data collection was completed, the research group was informed that PGQsve differs from the original questionnaire (113) regarding one item. In the Swedish version, the timeframe in item 8 is 10 minutes compared to 60 minutes in the original version.*

The Patient-Specific Functional Scale (PSFS) is an instrument where the participant chooses two activities they experienced as difficult due to PGP and rate the difficulty in performing those activities on an NRS 0–10, where 10 = can perform the activity unrestrictedly or as before the onset of PGP. The PSFS measures functioning based mostly on the "Activities" and Participation" components of the ICF, and the activities chosen by the participants are often very specific to the individual, in contrast to more condition-specific measurements which include the most commonly troublesome activities for the participants. A recent systematic review showed insufficient construct validity for measuring physical function, sufficient test-retest reliability, and insufficient responsiveness for patients with back problems (114). According to Abbott et al., minimum important difference (MID) for PSFS ranged from 1.3 (small/medium change), to 2.7 (large change) in a sample of patients with back pain (115), and Pathak et al. reported a minimum important change (MIC) of median 2.0 (range 0.8–2.9) (114).

The Pelvic Girdle Questionnaire (PGQ) (113) is a recommended instrument for measuring pain frequency/intensity/severity and functioning/disability in PGP (116), and it includes specific activities often reported as painful by women with PGP. This corresponds to the components of body function and activity according to the ICF. The instrument consists of 25 questions and a total score (questions 1–25), and two scores for the subscales of "Activity" (question 1–20), and "Symptoms" (questions 21–25) are calculated. A score of 0% = no disability. The PGQ is translated into several languages and pooled evidence from a systematic review showed PGQ to have sufficient internal consistency, construct validity, reliability, and responsiveness. The instrument is recommended for assessing pain intensity, symptomatic activities and activity limitations in PGQ (116, 117). A general MIC for PGQ is 25, but when analyzed for subgroups of low (<28), moderate (28–62), and high (>62) baseline PGQ scores, the MIC values were 6, 32, and 33 for the subgroups, respectively (117).

The Oswestry Disability Index (ODI) was initially developed for use in lumbar pain (118). It is a 10-item questionnaire, in which each item (pain intensity, personal care, lifting, walking, sitting, standing, sleep, sex, social life, travelling) is graded on a scale 0–5, where 5 = severe disability. The scores are summarized, divided by the maximum score, and then multiplied by 100 to calculate a percentage score. Scores of 21–40 indicates moderate disability, 41–60 severe disability, 61–80 incapacitating disability, and >80 indicates that

the patient is bed-bound (118). The ODI measures disability according to body function and activity on the ICF. For PGP the ODI shows inconsistent content validity, sufficient internal consistency and sufficient reliability (116). Abbott et al. reported a MID as -12 (115), and Ogollah identified a MIC of 3.1 for pregnant women with PGQ (119).

For measuring the women's physical activity level, two single-item questions were used (120), inspired by a Norwegian study (121). The participants reported how many days per week they were active on a moderate intensity level for at least 30 minutes and/or active on a high intensity level for at least 20 minutes. Based on each individual woman's answers, a calculation was made to see if she met the general recommendations for physical activity of at least 150 minutes/week (81). Single-item questions show strong test-retest reliability and moderate concurrent validity (120).

The measure of work ability was made using a single-item question from the Work Ability Index, WAI (122, 123) The participants were asked to grade their current work ability on an Numeric Rating Scale (NRS) 0-10, where 10 = work ability at its best. The single-item question is responsive to change and has acceptable reliability and construct validity. The minimum clinical important change (MCIC) was 1.5–2 points (124, 125).

For measurement of pain intensity, an NRS 0–10 was used, 0 = no pain, which is considered as a valid measurement for pain intensity (119, 126) with good responsiveness. MID for the NRS was identified as -1.5 (small change), -3.0 (medium change) to -3.5 (large change) for a variety of musculoskeletal disorders (115), and for pregnant women with PGQ, a MIC of 1.3 is described (119).

Pain-related concern was measured by an NRS 0–10, 0 = no concern (127). This instrument has not been previously evaluated in PGP, but it is considered a valid and sensitive measurement of anxiety in patients before surgery (127)

Edinburgh Post-natal Depression Scale (EPDS) is a valid instrument for detecting depression (128, 129), both in pregnancy and postpartum. The participant answers 10 questions, scored 0–3, and a total score of ≥13 indicates symptoms of depression which need to be further investigated (129). The instrument shows high test-retest reliability and moderate concurrent validity (130).

Coping strategies were measured by the Coping Strategies Questionnaire (CSQ), a 50-item questionnaire (48 items divided into eight subscales and two concluding questions about control of pain and ability to relieve pain). The participants range each item on a scale from 0–6 where 0 indicates "never use this strategy" and 6 "always use this strategy". The item scores are summed to create a total score for each subscale (131). The Swedish version of CSQ shows high internal consistency and moderate test-retest reliability (132). The subscale of Catastrophizing (CSQ-CAT) (133) was used in *Paper I*, as catastrophizing is a factor that can be associated with lumbopelvic pain and postpartum functioning (35). This subscale ranges from 0 to 48 with 0 = no catastrophizing beliefs.

Because of the long interval since pregnancy and delivery, the Hospital Anxiety and Depression Scale (HADS), an instrument suitable for screening for symptoms of anxiety and or depression (134, 135) was used instead of the EPDS in the three-year follow up of the RCT *(Paper IV)*. The scale ranges 0–21 for the subscales Anxiety (HADS-A), and Depression (HADS-D), respectively. A cut-off score of ≥8 for each scale is used to detect a possible anxiety/depressive disorder. The instrument has moderate internal consistency and high construct validity (136)

Health was measured by EuroQol 5 dimensions (EQ-5D), which includes five items (movement, hygiene, daily activities, pain/complaints, and worries/depressive symptoms) (137), including the EuroQoL Vertical Analogue Scale (EQ-VAS), a vertical scale of 0–100 mm where the participant marks their current health status. The EQ-5D is an instrument with high construct-, content-, and convergent validity, and it also have a high test-retest reliability (138).

In addition to EQ 5D, overall health was also measured by an NRS in *Paper III* and as a single measurement of overall health in *Paper IV* at 4 months. The women graded their perceived current health on an NRS 0–10 where 0 = best imaginable health. This reversed NRS may be less common than the scale where 10 describes the best imaginable state.

Urinary incontinence was assessed briefly in the initial RCT *(Paper I)* and at the 4-month follow-up *(Paper IV)* by asking if the participant experienced any urinary incontinence. If yes, one question about frequency and one about volume followed.

At the 3-year term follow up *(Paper IV)*, the short form of the International Consultation on Incontinence Questionnaire (ICIQ-UI) (139, 140) was included to get a more detailed picture of possible remaining incontinence symptoms. The ICIQ-UI consists of four questions; assessing frequency, severity, the impact incontinence has on quality of life, and the situations in which incontinence occurs. The scores are summarized, and 0 = no incontinence symptoms, 1–5 = slight, 6–12 = moderate, 13–18 = severe, 19–21 = very severe symptoms (140).

Postpartum recovery was measured by the Global Rating of Change Scale (GRC) (141), an NRS where the participants grade their current state in comparison to when they received treatment for PGP; 10 = completely recovered. This instrument shows excellent test-retest reliability but varying convergent validity among studies (142). MID is estimated to -7 to +7 (115).

To be able to describe the study population, demographic information was collected through the questionnaires at all time-points, about the participants' age, gestational week (in pregnancy), height, weight, highest completed education, financial status, marital status, possible previous diagnoses, and possible side effects of treatment. In questionnaires postpartum, additional information on delivery mode and possible complications was collected.

4.2 CLINICAL ASSESSMENT

To verify PGP and exclude the hip joint or lumbar spine as the origin of pain, the participants included in *Papers I–IV* were assessed by a physiotherapist. In the papers included in this thesis, all clinical assessments were made in the same way, based on a procedure developed after recommendation in guidelines emphasizing the importance of differentiating lumbar pain from PGP (73) (Table 4). This procedure could be performed throughout pregnancy and shows substantial ability to distinguish between PGP, lumbar pain or a combination of both (73). The original procedure was adapted, based on clinical reasoning, and Gaenslen's test was excluded due to the clinical experience of the test being too provocative for pregnant women, and its lower sensitivity (0.52) and specificity (0.74) than the other tests included. According to Laslett et al., Gaenslen's test could be removed from a cluster of tests without compromising the diagnostic properties of the test cluster (66). The sacral thrust was added instead but was performed with the woman in side-lying position due to the pregnant abdomen and with a continuous pressure applied perpendicular to the

sacrum (73). The MAT test was included to be able to detect symphyseal pain (68).

Table 4. Tests included in the clinical assessment

Test	Paper I	Paper II	Paper III	Paper IV, at 4 months postpartum
ROM hip joints	X	X	X	X
Neurological assessment L4-S1	X	X	X	X
Pulling-a-mat (MAT) test	X	X	X	X
Posterior pelvic pain provocation test (4P)	X	X	X	X
SIJ compression test	X	X	X	X
SIJ distraction test	X	X	X	X
Sacral thrust	X	X	X	X
Active straight leg raise (ASLR)	X	X	X	X
Lumbar assessment (flexion, extension)	X	X	X	X
Unipedal balance test	X	(X)*	-	X
Biering-Sörensen test	-		-	X
Back flexor test	-		-	X

ROM, Range of motion; SIJ, Sacroiliac joint
** A Trendelenburg test was performed*

The assessments contained a neurological examination (sensitivity, isometric strength, and reflexes corresponding to L4–S1 levels), hip range of motion, pelvic pain provocation tests, a brief mechanical lumbar spine assessment, the active straight leg test (ASLR) and a unipedal stance test (73, 143). At the 4-month follow-up in *Paper IV*, assessment of endurance in back extensors (Biering-Sörensen test) and back flexors was added to the procedure (73, 99, 144) (Table 4).

4.3 PARTICIPANTS AND PROCEDURES

Data (Table 5) were collected through questionnaires *for Papers I, III, and IV* and for *Paper II* before recording of the face-to-face interviews took place.

Inclusion criteria for participants in the studies included in this thesis are displayed in Table 5. A common criterion in all the studies was that the participants should be able to understand Swedish in speech and writing.

Table 5. Inclusion- and exclusion criteria for studies presented in Papers I to IV

Inclusion criteria	• Singleton pregnancy *(Paper I)* • PGP or combined PGP/lumbar pain in gestational weeks 12–28 *(Paper I)* • Pain over sacroiliac joints, and/or pubic bone, verified by ≥2 positive pain provocation tests or a positive ASLR *(Paper I)* • ODI score ≥20% and/or ≤6 in one activity of the PSFS *(Paper I)* • PGP with debut in pregnancy, clinically verified *(Papers II & III)* • Received physiotherapy for their complaints *(Paper III)*
Exclusion criteria	• Previous fracture, surgery, or malignant disease in the back, pelvis, or hips *(Papers I–IV)* • Any systemic disease or obstetric complication that contraindicates treatment or tests *(Papers I-IV)* • Contraindications for TENS; pacemaker; decreased sensation in the treatment area *(Paper I)* • Contraindications for acupuncture; treatment with anticoagulants *(Paper I)* • Start of other treatment during the study period *(Paper I)*

PGP, Pelvic girdle pain; ASLR, Active straight leg test; ODI, Oswestry Disability Index, TENS, Transcutaneous electric nerve stimulation

The study presented in *Paper I* was conducted in two Swedish cities between 2014 and 2018. Participants were recruited through midwives at maternity health and if a woman mentioned to the midwife that she had pain in the pelvic region, the midwife briefly informed her about the ongoing study and provided contact information and the study e-mail address. Women who were interested sent their contact information to the study e-mail and the test leader called back to provide more information, and a screening for inclusion, and to book an appointment for baseline tests. After baseline tests to verify PGP and completion of the first questionnaire, those who fulfilled the inclusion criteria were referred to the treating physiotherapist for start of treatment. Before treatment started, participants were randomized 1:1 into the two intervention groups.

Recruitment of participants for *Paper II*, was done through a primary-care rehabilitation center in Gothenburg, Sweden, between February 2017 and October 2019. When a pregnant woman called to book an appointment due to PGP, she was briefly informed about the study and asked if a researcher could call her for further information. The ones who accepted were contacted and the

interview was scheduled prior to the first physiotherapy visit. In total 16 women were interviewed, face-to-face, at a location chosen by the individual woman. One interview was excluded, due to the woman having a rheumatic disease, leaving 15 for analysis. Participants were married/cohabiting, with full-/part-time jobs; four were on sick leave during interviews. In the semi-structured interviews, an open-ended question guide was used that focused on living with PGP; its impact on daily, social, and working life; and expectations of physiotherapy treatment. All women were asked the same opening question about seeking physiotherapy for lumbar pain/PGP. Follow-up questions ensured rich descriptions. Interviews were audio-recorded and transcribed verbatim, and a pilot interview helped refine the guide. The interviews lasted 25–40 minutes each and provided rich narratives on experiences, needs, and expectations.

For *Paper III*, participants were recruited via a physiotherapist specialized in women's health at a primary health care center in western Sweden. The recruitment, spanning from 2017 to 2021, relied on the clinic's regular patient flow, without any external advertising. Due to the Covid-19 pandemic in 2020–21, the patient flow decreased, which prolonged the inclusion period. A first round of questionnaires was sent to 302 women who received physiotherapy for PGP during their latest pregnancy. Non-responders received a reminder after three weeks, followed by a second reminder, if necessary. The questionnaire was returned by 164 women.

Paper IV is a follow-up study; for the recruitment, see *Paper I.* The women who completed the initial RCT were invited to a follow up visit 4 months postpartum, which included a clinical assessment and a questionnaire. Those who attended the visit were invited via mail to fill in a questionnaire that constituted the final follow-up 3 years postpartum (Figure 4).

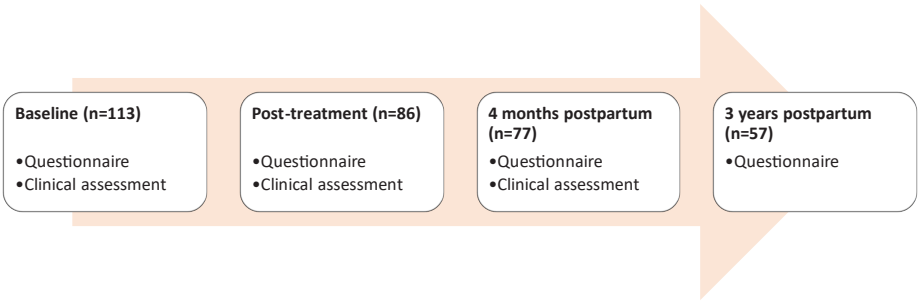

Figure 4. Timeline of inclusion Papers I and IV.

Twelve women (3 acupuncture/9 TENS) had subsequent pregnancies during the period between the initial RCT and the 3-year follow up, and 4 women (3 acupuncture/1 TENS) reported that they were pregnant at the 3-year follow-up. Two women were on sick leave at each time point, respectively. Baseline characteristics for the participants in *Papers I to III* are displayed in Table 6.

Table 6. Demographic characteristics at inclusion for participants in Papers I–III. Paper IV is a follow-up and includes participants from Paper I

Variable	**Paper I n = 113**		**Paper II n= 15**	**Paper III n = 164**
	Acupuncture n = 56	*TENS n = 57*		
Maternal age, mean (SD) min; max	30.5 20.0; 38.0	31.1 22.0; 43.0	31.4 26.0; 37.0	32.6 (4.06) 20.0; 44.0
Gestational week, mean (SD) min; max	20.9 11.0; 28.0	20.8 10.0; 28.0	23.4 9.0; 37.0	n.a.
BMI, mean (SD) min; max	25.6 (4.53) 19.5; 41.8	26.4 (3.87) 19.7; 35.0	–	25.6 (4.84) 17.6; 40.3
Parity, n (%) 0 1 ≥2	 21 (37.5) 30 (53.6) 5 (8.9)	 22 (38.6) 28 (49.1) 7 (12.3)	 7 (47.0) 6 (40.0) 2 (13.0)	 n.a. 85 (52.1) 78 (47.9) *n = 163*
Living with partner	–	–	15 (100)	162 (99.4) *n = 164*
Sick leave; yes, n (%)	9 (16.1)	7 (12.3)	4 (26.6)	–
Educational level, n (%) Elementary/high school College/university	 13 (23.2) 46 (76.8)	 22 (38.6) 35 (61.4)	 3 (20.0) 12 (80.0)	 33 (20.1) 131 (79.9)
Manage financially; yes (%)	52 (92.9)	56 (96.5)	*	145 (88.4)

TENS, Transcutaneous electric nerve stimulation; BMI, Body mass index; n.a., not applicable
** All participants had a full/part-time occupation at the time of inclusion*

4.4 INTERVENTIONS PAPERS I AND III

The interventions in *Paper I* lasted five weeks for both groups, all women received general written advice on managing PGP in addition to their specific treatment.

The acupuncture treatment involved 10 acupuncture sessions administered by a physiotherapist and scheduled twice a week for the first three weeks, and once a week for the remaining two weeks. For ethical reasons, the treatment was not extended beyond the point where any participant experienced adequate pain relief, even if this occurred before completing all ten sessions. The acupuncture points selected for each woman were tailored to her specific symptoms and clinical condition, following a protocol detailed in a prior study (145). Once the needles were inserted and manually stimulated to induce de Qi, a sensation of spreading or heaviness from the insertion point, they remained in place for 30 minutes. During this time, they were manually stimulated again at 10 and 20 minutes. Participants received written information about acupuncture at the beginning of the treatment and were advised to report any side effects they noticed to the physiotherapist.

A physiotherapist customized the placement of TENS electrodes based on each woman's specific symptoms. This placement was either uni- or bilaterally over the sacroiliac joint and gluteal muscles for posterior PGP, or in the groin area for symphyseal pain. The participants used the TENS device at home for at least 30 minutes, twice a day, during five weeks, following personalized oral and written instructions. The device was set to high frequency stimulation (80 Hz), and the intensity was adjusted to a level that was strong yet not painful for the area being treated. The women were advised to gradually increase the intensity during each session to maintain this sensation. After one week, a follow-up visit with the physiotherapist was scheduled to evaluate and possibly adjust the treatment. If there was no noticeable effect after the first week, the stimulation could be switched to a low frequency (2 Hz) for better pain relief. Three weeks into the intervention, a follow-up phone call was made to each woman to check on the progress. Finally, after five weeks, there was a concluding session with the physiotherapist.

The interventions in the study presented in *Paper III* followed current guidelines (4, 62, 93) and were tailored to each woman's unique needs through clinical reasoning and joint decision-making between the physiotherapist and the patient, resulting in varying session numbers. A minimum of two visits

were ensured for all, with some women receiving extra sessions for specific treatments. Participants received guidance on managing daily tasks and work, finding pain-free ways to stay active. They were offered to try a pelvic belt for help with pain management and activity, along with pelvic floor muscle training and basic exercises for the trunk and hip muscles. For those requiring more targeted interventions, options like acupuncture or TENS, and/or exercises (with or without resistance such as elastic bands or weights) to strengthen muscles in the affected area were available.

4.5 ANALYSIS PAPER II

4.5.1 THEORETICAL FRAMEWORK

The study that preceded *Paper II* had a phenomenological approach. Modern phenomenology has its roots in philosophy, and Edmund Husserl (1859–1938) is described as its founder. Husserl's phenomenology is descriptive in its form and aims to explore the meaning of a phenomenon.

In the field of applied phenomenology, the researcher's goal is to explore phenomena characterized by their inherent meaning. Rather than seeking logical or causal explanations, the focus is on understanding the form and significance embedded in the research material. The objective is to reveal, enlighten, or demonstrate by examining expressions, whether verbal or non-verbal, emanating from lived experiences (146). The participation of individuals in sharing their personal experiences of a phenomenon is crucial. However, the researcher's main focus should be on understanding the phenomenon itself rather than the personal experiences described by the participants (147). To effectively uncover the underlying meaning and structure of the phenomenon, the researcher needs to engage in ongoing reflective analysis throughout the research process. This requires adopting a phenomenological approach known as *epoché*, which involves temporarily setting aside everyday assumptions to more deeply understand how an individual experiences a particular phenomenon in their own lifeworld (148). *Bridling* or *bracketing* are other terms for this concept, as we bridle our previous understanding or put it within brackets, so we do not jump to conclusions (149, 150).

In everyday life, we tend to accept our perceptions of the world without question, but in research, it is important to embrace a more questioning and doubtful attitude. Using *epoché/bridling* helps researchers become aware of

how their own experiences and biases might influence their understanding of the phenomenon. This shift from a personal to a more theoretical and analytical perspective is essential, and it involves a process called *eidetic- or phenomenological reduction,* where the researcher uses their imagination to rethink their perception of the phenomenon, aiming to view it from a new angle. This deep and critical reflection can lead to a clearer understanding of the phenomenon's core meaning and structure, making these insights relevant and applicable beyond the specific group in which the phenomenon was initially studied (148, 149).

In physiotherapy research, a phenomenological approach can be useful for exploring lived experiences, and there are several phenomenological philosophies with different foci that could be used to elucidate different parts of lived experiences (150). In this thesis, Husserl's descriptive phenomenology is the basis for an objective description of the lived experience and meaning of seeking physiotherapy for PGP.

4.5.2 DATA ANALYSIS

The descriptive phenomenological psychological method by Giorgi (151) guided the analysis, with the aim of describing lived experiences and their meaning among women seeking physiotherapy for PGP. To ensure an unbiased exploration of the phenomenon, the researchers applied the concepts of phenomenological reduction and bracketing, setting aside their existing knowledge and preconceptions. This process was facilitated by continuous reflection and collaborative discussions among the research team.

The process of analysis started with listening to the recorded interviews and reading the transcripts to get a sense of the whole. The process of analysis is described in detail in *Paper II*, and an overview is displayed in Figure 5.

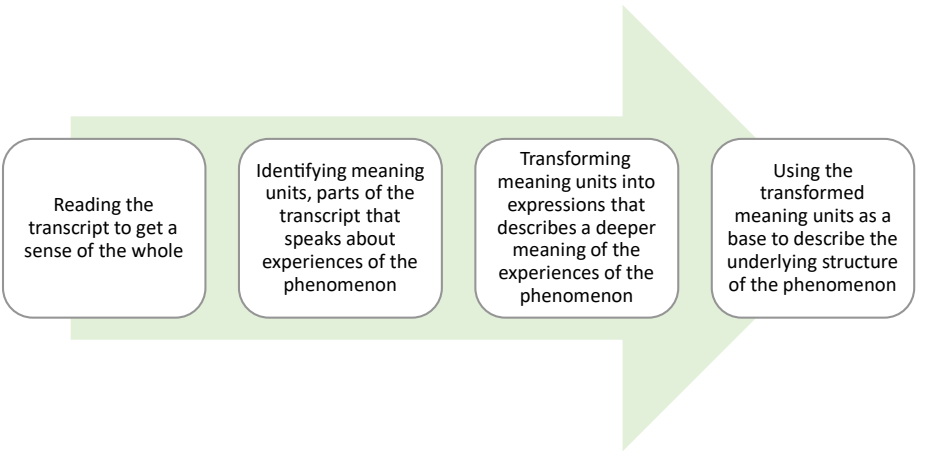

Figure 5. Process of analysis according to Giorgi et al (151).

4.6 STATISTICAL ANALYSIS PAPER I, III, AND IV

The analyses in *Paper I* were made using IBM SPSS Statistics v. 24 and SAS v. 9.4 (SAS Institute Inc., Cary, NC, USA) In *Papers III and IV* IBM SPSS Statistics v. 27 (IBM Corp., Armonk, NY, USA) was used. Demographic variables were displayed as mean (SD) and median (min;max) or frequency (percentage) depending on the type of variable. When comparing groups, t-test was used for independent continuous variables and chi-squared test for dichotomous variables. An overview of statistical tests used is displayed in Table 7.

Table 7. Overview of statistical tests used in Papers I, III, and IV

Statistics	Paper I	Paper III	Paper IV
T-test	X	X	X
Chi-squared test	X	X	X
Fisher's non-parametric permutation test	X		
Multiple linear regression		X	
Repeated linear regression			X

SD, Standard deviation

In *paper I*, analyses of differences both between and within the intervention groups were made. Data were analyzed according to the principle of intention to treat (ITT). Because of dropouts and missing data, multiple imputation in the ITT analysis was necessary, with 50 datasets generated and individual analyses conducted for each dataset. Subsequently, a pooled analysis of the 50 tests was performed. Fully conditional specifications were used for imputation. In addition to the ITT-analysis, a full analysis set (FAS), employing Fisher's non-parametric permutation test, was performed and this analysis included only women who completed the intervention.

In *paper III*, a multiple linear regression analysis with the PGQ-T as a continuous dependent variable was used to explore the level of disability due to PGP 4 months postpartum. Unlike previous studies focusing on prevalence and risk factors, this analysis included previously known risk factors for postpartum PGP as independent variables to be able to explore possible associations with the level of functioning. Additionally, a separate analysis with the PGQ-Activity subscale (PGQ-A) as the dependent variable was performed. Subgroup analyses were performed using the described regression models for all participants (n = 164) and those who reported having pain in the pelvic region during the last four weeks (n = 125). The respective models' residuals were checked for normal distribution, consistent variance, and independence from the predicted values. Additionally, the independent variables were checked for any signs of multicollinearity. No problems were detected by these evaluations, therefore, the necessary assumptions for the multiple linear regression models were satisfactorily met.

A repeated linear regression model with an unstructured covariance structure was used in *paper IV* to analyze temporal changes within and between intervention groups. This model, suitable for datasets with repeated measures and missing data, utilized all available data, with the PSFS as a continuous dependent variable. Independent variables, chosen based on clinical reasoning and previously identified factors known to impact functioning due to PGP during pregnancy. The fixed factors were treatment group, time point, concern about pain, and PGQ-T. Interaction between treatment and timepoint, and concern and PGQ-T was added. No issues of multicollinearity were observed among the selected variables. Additionally, checks for linearity, homoscedasticity, and normal distribution of residuals were conducted, confirming that the model's assumptions were satisfactorily met.

5 SUMMARY OF RESULTS

5.1 PAPER I

A total of 113 women were randomized into two treatments groups, with no statistically significant baseline differences between the groups. Both groups reported pelvic/lumbar pain affecting daily activities, with the sacroiliac joint as the predominant pain location (93%). Women in both groups reported decreased work ability, mean 6.5 on an NRS where 10 marked work ability at its best. Few women (mean 24 %) met the recommendations of at least 150 minutes of moderate physical activity per week. Analgesic use was low in both groups. Nine women in the acupuncture group and six in the TENS group reported minor side effects of the interventions at follow-up, such as tiredness, nausea or initially aggravated symptoms. One woman reported discomfort from the TENS electrodes, and two women experienced increased activity of the baby when using the TENS device. Women in the acupuncture group reported higher positive effect of the treatment (82.5%) compared to TENS (60%) ($p=0.032$).

Between groups, no statistically significant changes were detected in ODI or PA levels from baseline to follow-up. However, both groups exhibited a decrease in work ability at follow-up, which was expected as pregnancy proceeded. Within groups, the results showed a significant reduction in pain intensity for those who received acupuncture (average decrease of 1.26, $p=0.0052$) and those who used TENS (average decrease of 1.27, $p=0.0002$). Concerns related to pain also significantly decreased in both the acupuncture group (average decrease of 1.45, $p=0.0007$) and the TENS group (average decrease of 2.00, $p<0.0001$). Additionally, there was an improvement in functioning for the acupuncture group, with an average increase of 0.89 in PSFS score, which is a statistically significant change ($p=0.025$) compared to the TENS group (Figure 6).

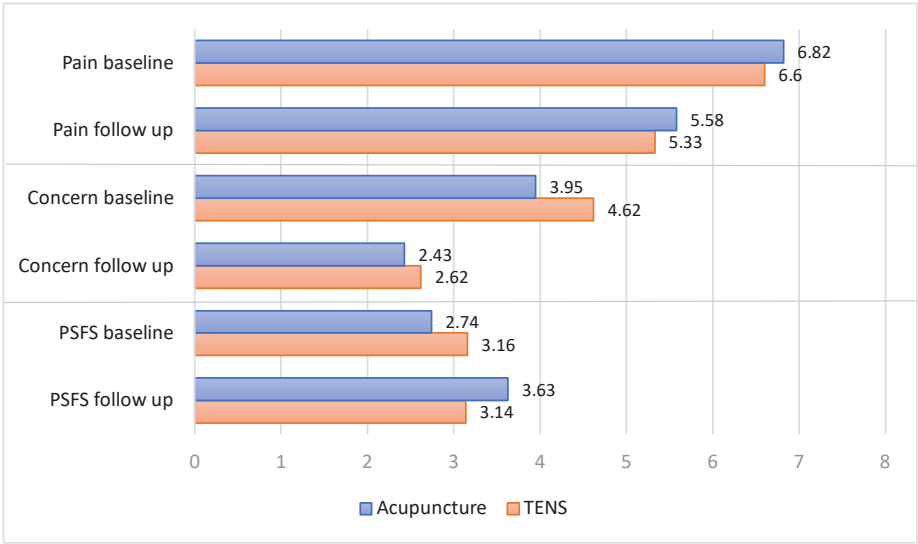

Figure 6. Values of pain intensity, concern about pain, and PSFS at baseline and after treatment (FAS-analysis). For concern and pain intensity, lower numbers indicate less concern/pain. For PSFS, higher numbers indicate higher functioning.

There were some minor differences between the results of the ITT analysis and the FAS. In the FAS analysis, the group using TENS showed an increase in disability measured by ODI, with an average increase of 3.87 (p=0.043). However, this was not observed in the ITT analysis, where the average increase was 3.53 (p=0.11).

In the acupuncture group, there was a significant reduction in catastrophizing beliefs, CSQ-CAT, observed in the FAS analysis, with an average decrease of -2.60 (p=0.010), which differed from the ITT analysis, where the average decrease was -2.50 and not statistically significant (p=0.095).

5.2 PAPER II

The individual interviews resulted in rich narratives and the women spoke freely and sometimes got emotional about their complaints and struggle to make the everyday life work. The women provided detailed accounts of their everyday life, highlighting their challenges, needs, and perspectives. They

disclosed how PGP profoundly affected them, altering their self-image and maternal identity, and they struggled to balance daily activities, professional responsibilities, and social interactions. When these efforts faltered, they felt overwhelmed and sought support.

The variations in the women's descriptions, forming the structure of the phenomenon, are displayed as four themes and their respective constituents (Figure 7).

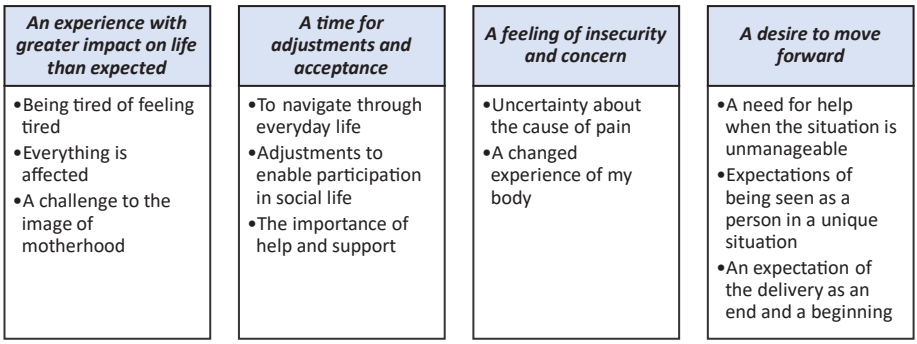

Figure 7. The lived experience, needs and expectations of pregnant women seeking physiotherapy for PGP: Themes and constituents derived from the phenomenological analysis according to Giorgi (151).

The women described PGP as a distressing pain that limited their movement, affecting daily activities and their roles as partners and mothers. They struggled with sleep due to discomfort, leading to daytime fatigue, decreased work ability, and distress about managing daily tasks. Their dependence on others for help made them feel a loss of independence and control, challenging their lifestyle and causing worry about worsening pain. This situation affected their relationships and led to feelings of frustration, anger, and guilt towards their partners and children. For those with older children, the inability to fulfill their own expectations of motherhood caused concern, fear of inadequacy, and guilt, for not being able to participate in activities as they wanted.

Yes, I don't do anything anymore ... No, because I... it feels so, it's so exhausting and ... and to do anything at all because I need to stop all the time, sit down, stand up, I don't know how to sit. Standing, that's tough too ... uh so it's ... I actually don't do much at all. It's really boring but that's how it is. (participant F)

The women tried to find solutions to cope with pain and tiredness, which consumed their energy and impacted their social roles. They saw this as a temporary phase, but when they failed to find effective strategies for functioning, they felt despair and inadequacy. They adjusted daily activities, transportation, and work to manage pain, sometimes taking time off to handle household and childcare tasks. However, they often felt sadness for not functioning as usual.

To maintain social participation, they adapted activities to avoid pain or accepted their limited social life, hoping that their life would go back to normal after delivery. At home, roles shifted, with partners and children taking on more responsibilities. The women expressed that they were grateful for having support at home and work and stated that PGP would have been even harder to handle without this support. Despite the challenges, they endured the pain, viewing it as a temporary part of life, and remained positive, believing that the pain would end after childbirth.

> *Then there is this thing that you are waiting for something good ... as they say ... so ... but I think that there is a lot of pain to endure. (participant H)*

Experiencing PGP significantly impacted women's independence, self-image, and body perception, leading to feelings of concern, frustration, and disappointment. They were uncertain about the cause of PGP, its consequences, and possible ways to relieve it. This lack of knowledge about their symptoms and how to manage them led to fear and avoidance of activity, as they worried it could worsen their condition or lead to disability. Pain and fear of pain also became barriers to an active lifestyle and exercise, causing self-blame and concern that inactivity might contribute to the pain or a weaker body for pregnancy and childbirth. This led to feelings of resignation and despair.

The women also experienced a change in how they viewed their bodies, describing them as old, tired or worn-out. This negative perception challenged their idea of the "beautiful, glowing pregnant woman" and sometimes led to a disappointment which made it difficult to enjoy the pregnancy.

When will it go away, how long will it last, is it dangerous? That's what you think about mostly, is it dangerous for me, is it dangerous for the baby? (participant F)

A feeling of inadequacy and a need to find solutions to an almost unbearable situation made the women seek help. It appeared that they refrained from seeking help until they could not manage PGP on their own, but they did not want to be seen as weak or complaining.

The women expected the physiotherapist to be an expert who could understand, explain, and give individual advice about their current situation so that their everyday life during the rest of their pregnancy would be easier. Reflecting on their personal experiences, they expressed a need for thorough medical assessments, deeper understanding of PGP, and tailored solutions fitting their specific circumstances. Some women expressed that they had negative experiences with questioning and mistrust from previous healthcare visits, which made them have low expectations for the physiotherapy consultation. They viewed childbirth not only as an end to their pain but also as a beginning of a new phase, where they could rebuild their bodies and return to their desired level of activity. While most women mentally prepared for various scenarios for the rest of their pregnancy, some focused solely on managing daily life, apprehensive about the future.

No, but the most important thing is to be taken seriously and to be able to leave feeling that the person I have met now has really examined or checked where the pain is … and taken into consideration what I have said and told about myself, and not just assume that it's like with everyone else. (participant K)

5.3 PAPER III

This cross-sectional study had the aim of gaining information about treatment satisfaction, and describing daily functioning, physical activity level and possible remaining PGP 4 months postpartum among women who received physiotherapy for PGP in pregnancy at a primary care rehabilitation clinic.

Of the 164 women who answered the questionnaire, 125 reported having pain in the pelvic region during the most recent four weeks. The responses were divided into subgroups of women with low disability (PGQ-T <28, n=73, two questionnaires were excluded due to missing values on PGQ), and moderate to high disability (PGQ-T ≥28, n=50). No statistically significant differences between the subgroups were detected for any variables except for the women's ratings of recovery, measured by Global Rating of Change Scale (GRC). Women with PGQ-T <28 (low disability) reported better recovery ($p<0.001$) than the subgroup with moderate to high disability.

There was no difference between subgroups regarding treatment satisfaction, on an NRS 0–10, women with low disability (PGQ-T <28) rated mean 8.2 (SD 2.39), and the group of women with PGQ-T ≥28 mean 7.9 (SD 2.67), $p=0.562$. An option to add free text comments about treatment was provided in the questionnaire and 94 women added information about treatment satisfaction. Most of them stated that they got the help that they needed, even though some reported that they did not follow the instructions they got from the physiotherapist. Some women requested other treatment, such as aquatic physiotherapy, massage, treatment for vaginal prolapse, and referral to a psychologist (Figure 8).

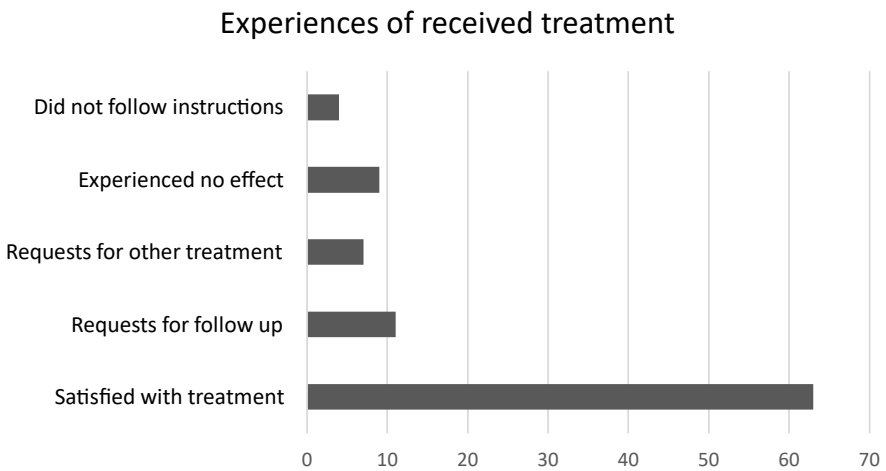

Figure 8. Experiences of received treatment provided by 94 women in free text comments.

About 30% of the 125 women who reported pain during the last four weeks reached the recommendations for physical activity of at least 150 minutes/week, regardless of the level of disability. No difference between subgroups was detected. The women reported various reasons for not being as active as they wanted, with lack of time and pain as the most common ones (Figure 9).

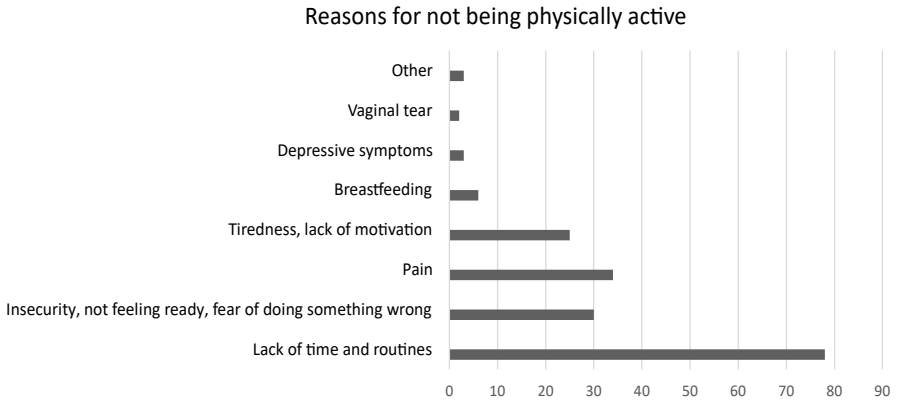

Figure 9. Reasons for not being physically active, all participants (n=164). Each participant could give more than one reason.

The uni-variate linear regression analysis indicated that pain-related concern was the sole variable significantly linked ($p < 0.001$) with PGQ-T across all study participants (n = 164). Further exploration using a multiple linear regression model demonstrated that the group of independent variables correlated with PGQ-T at 4 months postpartum, with R^2 value of 0.309 ($p < 0.001$) for all participants. Among these variables, concern about pain emerged as the only one with a significant contribution to PGQ-T, with a B value of 3.436 ($p < 0.001$).

5.4 PAPER IV

This long-term follow up of the randomized controlled trial (Paper I) was made to evaluate if the initial treatment had any impact on women's functioning, physical activity levels and possible remaining pain at 4 months and 3 years postpartum. No significant differences were found for descriptive variables between the two intervention groups at any of the follow-ups.

In this follow up PSFS was chosen as the main outcome for functioning 4 months and 3 years postpartum. PSFS scores revealed that women regained functioning according to their rating of the individually chosen activities over time and PGQ-T scores at both 4 months, and 3 years postpartum indicated low disability, with no significant difference between groups.

A statistically significant difference in PGQ-S scores was noted at 4 months postpartum, where women in the acupuncture group had a higher mean symptoms-score than the TENS-group (p=0.034). This difference was not present at 3 years. (Table 8).

Table 8. Mean scores (SD) of PSFS and the total score plus subscales of activity and symptoms of PGQ for the two intervention groups at 4 months, and 3 years postpartum.

	4 months postpartum (n = 77)			
	Acupuncture (n = 38)	**TENS** (n = 39)	***Mean difference*** *(95 % CI)*	***p-value***
PSFS	7.81 (2.60) *(n = 35)*	8.53 (1.87)	*-0.71 (-1.75 to 0.33)*	*0.177*
PGQ-T	12.65 (13.59)	7.71 (11.17)	*4.94 (-0.69 to 10.58)*	*0.085*
PGQ-A	12.29 (13.60)	7.93 (11.13)	*4.37 (-1.27 to 10.00)*	*0.127*
PGQ-S	14.04 (16.61)	6.84 (12.28)	*7.20 (-0.58 to 13.82)*	*0.034*
	3 years postpartum (n = 57)			
	Acupuncture (n = 26)	**TENS** (n = 31)	***Mean difference*** *(95 % CI)*	***p-value***
PSFS	8.25 (2.31)	8.65 (2.39)	*-0.40 (-1.67 to 0.87)*	*0.529*
PGQ-T	12.69 (17.38)	7.16 (10.65)	*5.53 (-1.99 to 13.05)*	*0.146*
PGQ-A	12.35 (17.41)	7.02 (10.57)	*5.32 (-2.19 to 12.83)*	*0.161*
PGQ-S	13.85 (18.94)	7.53 (13.31)	*6.31 (-2.27 to 14.91)*	*0.146*

SD, Standard deviation; CI, Confidence interval; PSFS, Patient-Specific Functional Scale; PGQ, Pelvic Girdle Questionnaire (T, Total score; A, Activity subscale; S, Symptoms subscale)

Figure 10 displays a grouping of the activities on the PSFS, chosen by the individual women at inclusion for the initial RCT.

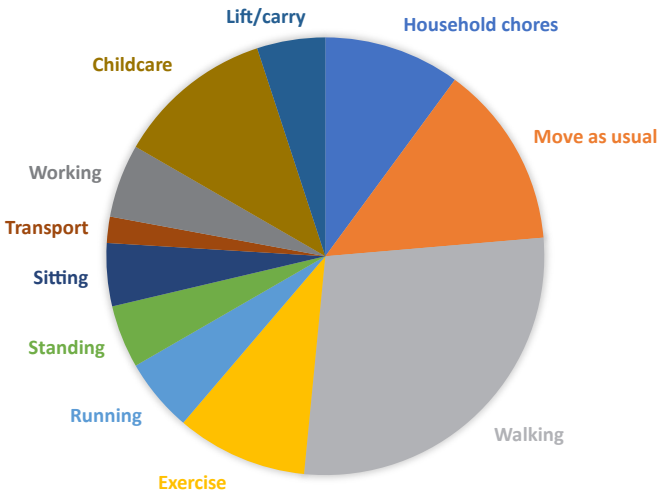

Figure 10. Grouping and distribution of PSFS activities chosen by participants in the randomized controlled trial, at inclusion.

The repeated linear regression model demonstrated how the PSFS scores increased over time, indicating higher functioning, with no significant differences between intervention groups (Figure 11). The result of this analysis showed that the type of treatment and the combined effect of treatment type and time point did not significantly influence the average PSFS scores.

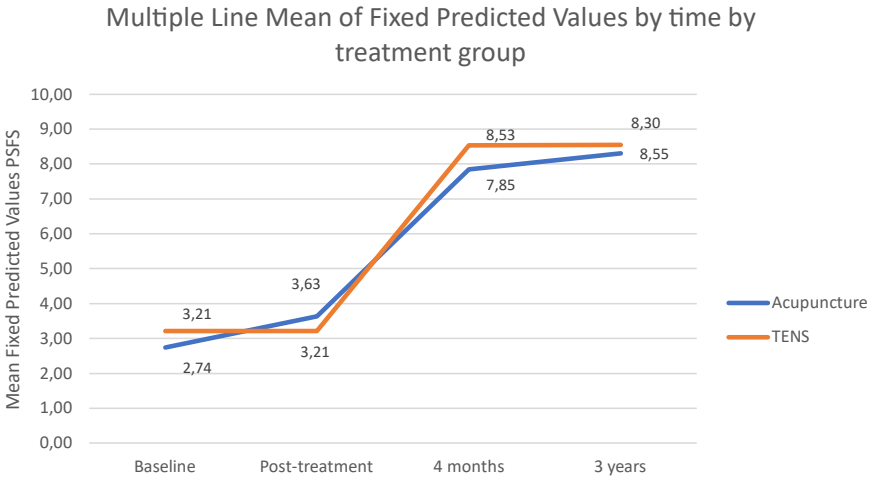

Figure 11. Estimated means for PSFS from the repeated linear regression analysis at four different time points.

However, the PGQ-T, pain-related concern, and the interaction between these two factors had a statistically significant effect on the average PSFS scores 3 years after childbirth (Table 9). Nevertheless, these changes are small and may not be clinically important.

Table 9. Results from the repeated linear regression analysis. Dependent variable: mean PSFS.

Fixed effects	Estimate	95 % CI	p-value
Intercept	9.16	8.45 to 9.87	<0.001
[Treatment=Acupuncture]	0.09	-0.91 to 1.09	0.854
[Treatment=TENS]	0	.	.
Concern	-0.21	-0.39 to -0.04	0.019
PGQ-T	-0.06	-0.08 to -0.05	<0.001
Concern * PGQ-T	0.004	0.00 to 0.007	0.034

PSFS, Patient specific functional scale; CI, Confidence interval; TENS, Transcutaneous electric nerve stimulation; PGQ-T, Pelvic girdle questionnaire total score

6 DISCUSSION

This thesis adds knowledge about physiotherapy to enhance pain management in pregnancy-related PGP and emphasizes the importance of tailoring interventions based on the individual woman's thoughts and beliefs about the complaints and her expectations and needs for treatment.

Most women refrain from analgesics during pregnancy and therefore a nonpharmacological alternative for pain-relief is needed. TENS is such a method which is easy to use and could be used according to the individual woman's needs according to the results of *Paper I*. The use of TENS is considered as a safe method for relieving PGP in pregnancy (107, 111). The initial hypothesis when the study presented in *Paper I* was designed, suggested that early pain-relief treatment, like acupuncture or TENS, helps women stay active and maintain muscle activity, which has been shown to be reduced in PGP (99) The study compared the effectiveness of clinic-based acupuncture, which requires clinic visits, with home-based TENS treatment, offering continuous use but less therapist interaction. The aim was to prevent worsening of the PGP, which often is the case as pregnancy proceeds (152). The results of *Paper I* show that an intervention for PGP in pregnancy, either acupuncture or TENS plus general information about how to manage PGP, resulted in decreased pain intensity and pain-related concern and the women maintained their physical activity level. The positive effect of TENS confirm the result of Kestin et al. (107), which to this date is the only identified previous study that evaluated TENS as a method for pain relief for lumbopelvic pain. The interventions of the study presented in paper I was not tailored, as women were randomized into treatment groups and got the same advice, but the women in the TENS group could choose the timing, duration and intensity of the treatment. This gave them control over the treatment and this might have increased empowerment. The women in the acupuncture group had the possibility of asking questions of the physiotherapist, as they met regularly during the intervention period; thus, the interaction between physiotherapist and patient may have had impact on the treatment outcomes (153).

Nevertheless, no difference between the two interventions in *Paper I* was detected, indicating that either one could be chosen based on clinical reasoning and the individual woman's preferences. An intervention early when women start to experience PGP that limits their everyday activities, could, by reducing pain intensity and pain-related concern, and promoting physical activity, lead

to more women taking the "green path" in the fear-avoidance model (53, 154), displayed in Figure 12.

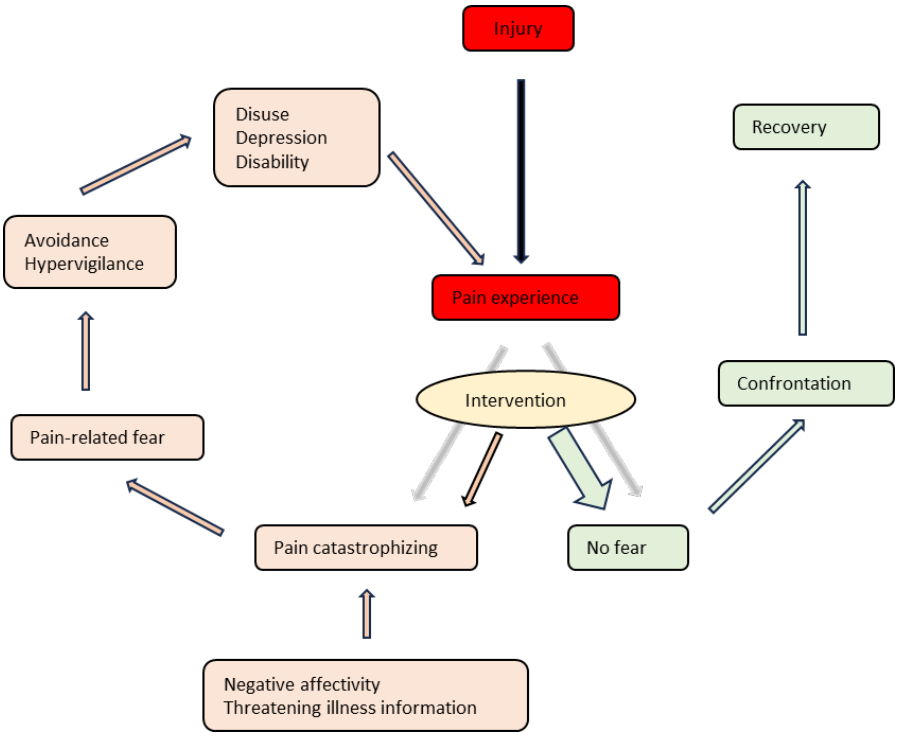

Figure 12. Possible effect of physiotherapy interventions for PGP, based on the fear-avoidance model by Vlaeyen et al. (53, 154).

Pain is a warning signal about a present tissue damage or risk for damage. This warning may lead one to take action and change behavior to decrease the risk of further injury (16). If a pregnant woman experiences a pain that she doesn't know much about, which makes her feel insecure for her baby's safety, and uncertain which activities are safe, her everyday life could be affected to a large extent. If fear and concern continue, it may lead to her refraining from her usual activities, which in turn could cause depressive symptoms. If no adequate information is provided about her complaints, and she gets no reassurance – this may lead to further fear and catastrophizing about pain. This chain of events could be a factor in the development of persistent PGP, according to the fear-avoidance model (Figure 12). Reassurance means to relieve concern and fear about pain. For patients with acute lumbar pain, there is evidence that education about the complaints, delivered by health care

personnel in primary care, can increase reassurance and also reduce care-seeking due to lumbar pain (155).

Concern about pain seems to be an important factor that may have impact on the level of functioning as seen in *Papers II, III and IV*. One observation from the research for this thesis is that women with PGP are concerned about something specific about their pain such as insecurity regarding exercise and possibilities for pain relief. Identifying women experiencing concern is crucial to preventing the escalation into anxiety, as research by Dunkel Schetter et al. (156) suggests that anxiety in the third trimester may predict an earlier delivery. Acknowledging and addressing these psychological aspects are important components of comprehensive care for pregnant women with PGP, and physiotherapists are an important resource in delivering reassurance, information and advice for pain management.

A lack of knowledge about PGP was seen in the result of *Paper II,* where women experienced PGP as a surprise, and the cause and course of the symptoms were something they knew little about. Similar results are reported in a Dutch study (157), which shows that first-time mothers express different beliefs and uncertainty regarding the cause and symptoms of PGP. Consulting a physiotherapist provided them with reassurance, as it offered both confirmation and an understanding of their symptoms (157). Pain education has not been evaluated for PGP, but previous studies on lumbar pain show that it may provide benefits regarding decreasing pain intensity and increasing quality of life; however, due to heterogeneity among interventions and measurements, conclusions may be uncertain (155, 158). A recent systematic review (159) that evaluated a minimal intervention of patient education for lumbar pain showed that this intervention alone did not reduce disability or pain intensity. The authors suggest that tailored interventions or patient education in combination with other treatment is needed for the management of lumbar pain (159). Patients with musculoskeletal disorders value education about their complaints and want to understand and share their thoughts with the physiotherapist (153). Physiotherapists may be more focused on delivering a specific intervention more than listening and thus not prioritizing education tailored to the patient's needs (153). The interaction between patient and therapist is important for treatment outcomes, and organizational factors, the physiotherapist's clinical experience and competence, and practical and/or communicational skills may be both barriers and facilitators for an optimal interaction (160).

The multifaceted nature of PGP, with its varying onset during gestation and diverse impact on individual women, underscores the need for personalized interventions tailored to the unique etiology and circumstances of each patient (108). A one-size-fits-all approach may not be effective, given the heterogeneous nature of PGP and the different limitations that women experience in everyday life.

Stucki et al. (161) advocate for measuring the lived experience of health, not single outcomes; thus, the PSFS is a suitable instrument, which aligns with activities personally meaningful to women. In *Paper I*, the women chose specific activities, for example "walking my dogs," "sitting on a chair without a backrest," "getting up from the floor after playing with my child," "exercise at the gym," and the chosen activities followed the individual woman through the different questionnaires. This procedure gives an individual-specific measurement that could be followed over time and a bigger picture than provided by standardized questionnaires of the limitations in functioning that women experience. In *Paper IV*, the result showed that the women regained functioning postpartum according to PSFS. Not everyone stated that they could perform the activities as they had before they got PGP, and the reason for this is not known. PSFS is an appropriate measure to include in the clinical work for physiotherapists; it is easy to administer and easy to re-test and is responsive for detecting change in functioning (114).

Understanding pregnant women's goals when they seek physiotherapy is important to be able to tailor interventions and the results of *Paper II* reveals that women express frustration about not being able to move as usual. Their desire to be able to move as usual is closely tied to independence, and the inability to perform routine activities because of PGP can significantly impact their overall health. To be able to move freely is something many of us take for granted. (162) Movement is a means of independence; it is related to our basic needs and relations to others and makes it possible for us to participate in activities that we find meaningful (162). Women with PGP describe how they feel limited and restricted in all components of the ICF, and also have a different experience of their bodies, as the body becomes more noticeable to them than before the onset of PGP. This can be understood according to Leder (163), who describes how the body normally *dis-appears* – we take it for granted and do not think about it in our daily activities. If we experience pain, the body instead *dys-appears* – it takes place in the foreground of our consciousness and our attention. We then notice changes and symptoms which cause disruptions in our everyday life, and we might have to make adaptations

to be able to manage pain (163). As a physiotherapist I must be able to acknowledge the patient's subjective perceptions and thoughts about her body and pain, add my objective assessments, and thereafter communicate with the patient in a way that includes both the subjective and objective perspectives of the symptoms (164).

As seen in *Paper II*, women's expectations for physiotherapy range from neutral to positive or negative, often influenced by their prior experiences or knowledge. Some women, unfamiliar with physiotherapy's role, entered treatment without clear expectations. Others, having benefited from previous physiotherapy for different issues, approached with confidence. Recommendations from friends or family who had positive experiences also shaped expectations positively. However, women who have had previous negative encounters with healthcare, particularly when seeking care for PGP, were hesitant to expect positive outcomes as they had experienced disappointment before. Experiences of a lack of knowledge regarding PGP among healthcare professionals has been reported by participants in previous research (75, 80). This could contribute to disparities in recognizing and addressing PGP effectively. Regardless of their initial outlook, the results of *Paper II* showed that women sought personalized care and advice, expecting the physiotherapist to possess deep knowledge of their symptoms, conduct a comprehensive assessment, and provide clear explanations for their pain. This is in line with previous physiotherapy research among patients with various musculoskeletal disorders (165, 166). Using empathy, building strong therapeutic alliances with patients, being culturally sensitive, and creating treatments that align with patients' beliefs and perceptions can enhance treatment effectiveness via placebo effects (167). When healthcare professionals actively participate, they can assist patients in changing their mindset and expectations, activating both conscious and subconscious coping strategies. This approach can help to reduce symptoms and improve patient satisfaction (167). Perhaps a close collaboration between midwives and physiotherapists may provide the best care for women who experience their everyday life being disrupted due to PGP. In *Paper III*, tailored physiotherapy was provided to women with PGP during pregnancy. At 4 months postpartum, a majority of women were satisfied with the received treatment which indicated that tailored interventions could meet the needs and expectations among women seeking care for pregnancy-related PGP. Treatment satisfaction has not been previously evaluated regarding physiotherapy for PGP. In other musculoskeletal disorders, treatment satisfaction is reported to be high when

physiotherapists provide education and have a person-centered approach which includes shared decision making (168, 169).

Measurements of pain intensity is common in clinical work and research, but it may not reveal the whole picture of PGP. PGP is most commonly a movement-evoked pain (170). Women often describe how pain diminishes at rest. Instead of investigating whether women have pain or not and the intensity of pain, it is more interesting to evaluate what effect pain has on the woman's ability to move and on her daily functioning (170). All activities chosen by the individual women on PSFS, presented in *Paper IV*, contains some kind of body movements, except for one category, sitting.

A recent core outcome set (COS) (171) for measuring PGP recommends five outcome measures to be used in clinical practice and reported in research on PGP. This COS includes pain frequency/intensity/severity, limitations of functioning/activity, health-related quality of life, and fear avoidance beliefs (171). The focus of this thesis was functioning, and therefore, the measures of pain intensity were not included in the analyses, other than as descriptive variables. Pain intensity is also included in the PGQ (113), which is symptom specific and includes activities known to provoke symptoms in PGP as well as measures of pain intensity and severity.

After the data collection for the different studies in this thesis was concluded, the research group was informed about an error in the Swedish version of PGQ (PGQsve) (172). Item no. 8 in the original version is, *"How problematic is it for you because of your pelvic girdle pain to: Walk for more than 60 minutes?"* but in the Swedish version the question regards walking for more than 10 minutes. This means that PGQsve has a different threshold for symptoms during walking than the original, and it is thereby possible that more women with walking difficulties have been detected by using the Swedish version. Because of this discrepancy, the PGQ scores were recalculated with and without item no 8. This did not significantly alter any of our results and therefore the scores were kept in their original form. One could argue that walking for more than 60 minutes is a long time when having PGP, as walking often is the most troublesome activity (75).

Why PGP becomes longstanding for some women is not completely understood. Identifying risk factors for postpartum PGP is challenging due to variations in measurement methods, terminology, and diagnostic criteria across studies. Wuytack et al. (25) noted in a scoping review that among 24

studies, 148 different outcomes were measured, but only 14 were common across more than one study. Additionally, clinical examinations were conducted in only three of the 24 studies, raising concerns about diagnostic accuracy (25). It is important to clinically differentiate between lumbar pain and PGP and between women with different symptom severity, as a higher number of positive pelvic pain provocation tests may increase the risk for persistent pain (23, 34, 63).

In *Paper IV* the scores on PSFS, PGQ and the physical activity level were similar at 4 months and 3 years postpartum. Aota et al. (38) describes how sedentary behavior at 4 months postpartum was associated with lumbopelvic pain at 10 months postpartum in first-time mothers. For women who had given birth before, the intensity of lumbopelvic pain at 4 months postpartum had impact on the risk for persistent lumbopelvic pain (38). These results indicate that might be possible to identify women at risk for persistent pain based on an assessment 4 months postpartum, but this needs to be further investigated.

In *paper IV*, a discrepancy was detected between the number of women who reported PGP and the ones verified by clinical assessment. According to Wu (6) this kind of discrepancy between patients' and clinicians' reports on symptoms, is likely due to patients reporting even mild pain in questionnaires. These could be symptoms they would not normally seek medical help for. In contrast, physiotherapists in clinical work diagnose symptoms only when they are serious enough for the woman to seek care.

Defining the complaints that could be considered as "normal" symptoms in pregnancy becomes a nuanced challenge, particularly when considering the diverse onset and impact of PGP. Mild pain in the lumbopelvic region can perhaps be considered as something that could arise due to physiological changes that occur during pregnancy but when pain limits functioning, it becomes an issue that women may need help to manage. To offer adequate treatment and advice for PGP is crucial, as women with PGP have a lower health-related quality of life in pregnancy (173), and because non-optimal treatment of PGP may be one factor impacting the risk for longstanding pain (174).

6.1 METHODOLOGICAL CONSIDERATIONS

There are several strengths of the papers included in this thesis. First, the research closely aligns with the everyday clinical work of physiotherapists in primary care. For *Papers II and III*, participants were recruited directly from the clinic's consecutive flow, without the need for advertising. In *Paper I*, midwives assisted in the recruitment process.

A significant aspect of *Papers I and IV* is the long-term follow-up, which is relatively rare in research on PGP. All participants in the included papers had clinically verified PGP, which makes the results reliable for this specific diagnosis.

Furthermore, the phenomenological analysis presented in P*aper II* contributes by adding the women's voices regarding expectations and needs for physiotherapy treatment. This gives another perspective that further enlightens the findings of the other studies.

However, the thesis also acknowledges certain limitations. A notable limitation is that most participants across *Papers I–IV* had a higher education, which may influence the generalizability of the findings. Earlier research linked lower education levels to increased risk for lumbar pain (39, 40), though this association is less clear for pregnancy-related PGP (25).

For *Paper I*, it is possible that the study design, requiring women to visit a specific clinic for tests, acupuncture, and follow-ups, may have prevented those with severe complaints from participating. Participants in both intervention groups were lost to follow-up for various reasons, for example difficulty finding time for treatment, or dropping out without giving any reason, and thus, study power was not maintained at the 3-years postpartum follow-up *(Paper IV)*.

Another limitation in *Paper I* was the self-administration of TENS at home. Without direct monitoring, it is uncertain whether participants correctly followed the instructions regarding dose, despite recording their sessions in a diary. Past studies suggest a risk of tolerance to the pain-relieving effects of TENS, recommending changes in electrode placement or stimulation mode to counter this (175, 176). Although the physiotherapist could modify the TENS use after a week if the participant experienced insufficient pain relief, no such adjustments were needed.

In the RCT *(Paper I)*, the study's sample size calculation was based on the ODI, an instrument primarily developed for lumbar pain (118). At the time when the RCT was designed, PGQ was not available, and therefore ODI was used. However, subsequent research indicates that ODI may not effectively capture the specific symptoms and limitations of PGP (119, 177), and it is possible that the sample size calculation would have been different if PGQ could have been used instead.

The recruitment of participants for *Papers II and III* was made through a single clinic, and in the case of *Paper III*, treatment was provided by a single physiotherapist. While this approach ensured consistency in treatment based on guidelines and allowed for tailored interventions, it also presents a limitation in terms of diversity and generalizability. The qualitative research results in *Paper II* are context specific and thus cannot be generalized. This is due to their dependence on the unique experiences the participants had regarding the phenomenon of interest. Nevertheless, the thoroughness of the interviews and analysis, along with the transparency regarding the researchers' backgrounds, adds credibility to these findings.

Paper III had a cross-sectional design to evaluate satisfaction with individually tailored physiotherapy for PGP in pregnancy, which has not been studied before. Due to the design, no causal conclusions could be drawn but the results regarding treatment satisfaction and the description of women's functioning 4 months postpartum will serve as a basis for more in-depth experimental research, such as a randomized controlled trial, in this area.

6.2 ETHICAL CONSIDERATIONS

The studies included in this thesis were conducted according to the declaration of Helsinki (178). All participants received verbal and written information and gave informed consent before data collection started for the respective study. They were informed that they could withdraw from participation in the studies at any time, without giving any reason, and without any consequences for future care.

The European Code of Conduct for Research Integrity (179) states that all research should be conducted according to the following principles: reliability, honesty, respect and accountability. Regarding the research of this thesis, reliability and quality were ensured by carefully selecting design, methodology and analytical methods. The whole research process from development to

reporting for each study was conducted in a transparent and fair way with respect for the women participating in the studies, colleagues, and with accountability for the management and organization of the respective studies from research question to publication (179). Several measures were employed to ensure participant confidentiality and data integrity. Participant data was anonymized and encoded, with the code key stored separately to maintain confidentiality. Physical questionnaire data was securely stored in a fire-proof safe, while electronic databases were password-protected for added security. To prevent data bias, various strategies were used: the test leader in paper I was unaware of the treatment received by participants, an independent person transcribed half of the interviews for *Paper II*, and an independent person handled part of the data entry for *Papers I, III, and IV*. Additionally, one of the authors of *Paper II*, who was also the treating physiotherapist, did not participate in data analysis to avoid conflict of interest. A statistician was consulted to verify the methods and calculations in *Papers I, III, and IV*, ensuring statistical accuracy.

In *Paper I*, TENS was compared to acupuncture, which is a recommended treatment option for pain relief in PGP (4, 62). It was decided that it would be unethical to have a control group that did not get any active treatment when acupuncture was available. The study design consisted of baseline testing and three additional follow-ups *(Papers I and IV)* that encompassed both clinical tests and questionnaires. The questionnaires took about 10−15 minutes to complete, which was not considered too time-consuming for the women, and the clinical tests were performed in a manner as to not provoke excessive pain.

During the interviews for *Paper II* two women got emotional when describing their situation and started crying. The interviews were paused but were able to be resumed after a short break. These women were asked if they wanted to end the interviews, but neither one chose this alternative; they stated that it was important for others to know about their struggles. It was possible to refer participants to a counselor at the rehabilitation clinic where recruitment was made if needed, but this was not necessary for any of the participants.

In the study presented in *Paper III* the women eligible for the study were informed by the treating physiotherapist about the questionnaire they would get 4 months postpartum. For some patients this information was missing, so perhaps they got the questionnaire as a surprise. Together with the questionnaire they received written information about the study and provided

written consent when they returned it, so the lack of prior information in some cases should not have had any ethical impact on the study.

7 CONCLUSION

Based on the results presented in this thesis, it was found that PGP has a significant impact on women's everyday life. For many women, PGP results in concern about pain and limited functioning. Treatment early in the course of pain with the aim of facilitating pain management and physical activity resulted in less pain and concern about pain and this can be a way to prevent development of fear-avoidance behavior. No difference between acupuncture or TENS was detected, which indicates that either one could be chosen according to the individual woman's needs and expectations. At 4 months, and 3 years postpartum, the groups reported improved, and similar levels of functioning and remaining symptoms, and about half of the women reached the recommended levels of physical activity. Concern about pain and in-pregnancy levels of functioning seemed to be associated with postpartum functioning three years postpartum.

Women with PGP who seek physiotherapy expect to gain more knowledge about their symptoms, and interventions and advice tailored to their unique situation, provided by an expert physiotherapist. When physiotherapy is tailored to the individual woman, treatment satisfaction is high among women treated for PGP in pregnancy. Four months after delivery, remaining PGP and limited functioning was reported, but despite this, a third of the women reached the recommended levels of physical activity. Concern about pain was once again associated with the level of functioning, a result that further highlights the importance of addressing this when treating women with PGP. If the woman gets more knowledge about her symptoms, gets more confident in how to manage pain and find alternatives to stay active, concern about pain may be reduced. Such management may reduce fear avoidance and/or catastrophizing thoughts, which in turn may increase the risk of longstanding pain if they are left unaddressed. This kind of management strategy would be possible for physiotherapists to incorporate when designing tailored treatment for PGP.

8 CLINICAL IMPLICATIONS & FUTURE PERSPECTIVES

The clinical implications and future perspectives highlighted in this research encompass a comprehensive approach to managing PGP, focusing on education, early detection, and tailored interventions.

This approach aims to increase knowledge about PGP among women and healthcare providers, emphasizing awareness for early detection and intervention, and promoting self-care. A basic level of education, information for self-care and promotion of physical activity for those with low risk of PGP could be a first step to investigate in future research. When self-care is not enough, proper referral to a physiotherapist with knowledge and interest in treating pregnant and postpartum women, should be made for more tailored interventions. Women experience PGP in different ways and at different time points during pregnancy and postpartum; thus, individualized physiotherapy management need to be further explored. It may not be necessary to treat every woman who experiences PGP, but if maternity healthcare centers had a close collaboration with physiotherapists, it would be possible to assess and identify women at risk of persistent PGP, ensuring prompt recognition and treatment of early signs. As research about treatment satisfaction regarding physiotherapy for PGP is lacking, this is also an area that needs further exploration.

This thesis also underscores the need for future research involving more diverse study populations to enhance generalizability. The women included in the studies for this thesis were mostly highly educated, and a challenge for future physiotherapy research is to include women with different educational backgrounds.

Furthermore, the thesis proposes that TENS could be chosen as a patient-tailored method for pain relief, but it needs further evaluation. I Sweden, TENS-devices are free to buy without prescriptions from health care personnel and thus, women may use it differently. Which type of stimulation, electrode placement and dosage that is optimal for PGP, or if women could use it as they want is not yet known.

Additionally, measuring functioning due to PGP in an individually tailored way is important in the clinical physiotherapy setting in order to be able to

tailor interventions. The PSFS could be a valuable instrument for this purpose, but its application and effectiveness in measuring PGP need further exploration.

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REFERENCES

1. World Health Organisation WHO. How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF). Exposure draft for comment. Geneva: WHO; 2013.
2. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 1985;100(2):126-31.
3. van Tulder M, Becker A, Bekkering T, Breen A, del Real MT, Hutchinson A, et al. Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. Eur Spine J. 2006;15(Suppl 2):S169-91 DOI: 10.1007/s00586-006-1071-2.
4. Vleeming A, Albert HB, Ostgaard HC, Sturesson B, Stuge B. European guidelines for the diagnosis and treatment of pelvic girdle pain. Eur Spine J. 2008;17(6):794-819 DOI: 10.1007/s00586-008-0602-4.
5. Romano M, Cacciatore A, Giordano R, La Rosa B. Postpartum period: three distinct but continuous phases. J Prenat Med. 2010;4(2):22-5.
6. Wu WH, Meijer OG, Uegaki K, Mens JM, van Dieen JH, Wuisman PI, et al. Pregnancy-related pelvic girdle pain (PPP), I: Terminology, clinical presentation, and prevalence. Eur Spine J. 2004;13(7):575-89 DOI: 10.1007/s00586-003-0615-y.
7. Vermani E, Mittal R, Weeks A. Pelvic girdle pain and low back pain in pregnancy: a review. Pain Pract. 2010;10(1):60-71 DOI: 10.1111/j.1533-2500.2009.00327.x.
8. Gutke A, Boissonnault J, Brook G, Stuge B. The Severity and Impact of Pelvic Girdle Pain and Low-Back Pain in Pregnancy: A Multinational Study. J Womens Health (Larchmt). 2018;27(4):510-7 DOI: 10.1089/jwh.2017.6342.
9. Ceprnja D, Chipchase L, Fahey P, Liamputtong P, Gupta A. Prevalence and Factors Associated With Pelvic Girdle Pain During Pregnancy in Australian Women: A Cross-Sectional Study. Spine (Phila Pa 1976). 2021;46:944-9 DOI: 10.1097/brs.0000000000003954.
10. Mackenzie J, Murray E, Lusher J. Women's experiences of pregnancy related pelvic girdle pain: A systematic review. Midwifery. 2018;56:102-11 DOI: 10.1016/j.midw.2017.10.011.
11. Varley M, Hunter L. How does pelvic girdle pain impact on a woman's experience of her pregnancy and the puerperium? Evid Based Midwifery. 2019;17(2):60-70.

12. Selboe ST, Skogas AK. Working fulltime throughout pregnancy - The Norwegian women's perspectives. A qualitative approach. Midwifery. 2017;50:193-200 DOI: 10.1016/j.midw.2017.04.012.
13. Bondas T, Eriksson K. Women's lived experiences of pregnancy: a tapestry of joy and suffering. Qual Health Res. 2001;11(6):824-40 DOI: 10.1177/104973201129119415.
14. Fredriksen EH, Harris J, Moland KM, Sundby J. "They ask whether this is real or fake": a qualitative norwegian study of pregnancy complaints and access to social benefits. Health Care Women Int. 2014;35(3):266-84 DOI: 10.1080/07399332.2013.794463.
15. Elden H, Gutke A, Naurin E, Domeij H, Rydin K, Åberg I, et al. Prioritized research questions regarding pregnancy-related pelvic girdle pain. Stockholm: Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU), 2022 356.
16. Raja SN, Carr DB, Cohen M, Finnerup NB, Flor H, Gibson S, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. Pain. 2020;161(9):1976-82 DOI: 10.1097/j.pain.0000000000001939.
17. Vleeming A, Schuenke MD, Masi AT, Carreiro JE, Danneels L, Willard FH. The sacroiliac joint: an overview of its anatomy, function and potential clinical implications. J Anat. 2012;221(6):537-67 DOI: 10.1111/j.1469-7580.2012.01564.x.
18. Becker I, Woodley SJ, Stringer MD. The adult human pubic symphysis: a systematic review. J Anat. 2010;217(5):475-87 DOI: 10.1111/j.1469-7580.2010.01300.x.
19. Leadbetter RE, Mawer D, Lindow SW. Symphysis pubis dysfunction: a review of the literature. J Matern Fetal Neonatal Med. 2004;16(6):349-54 DOI: 10.1080/14767050400018247.
20. Gausel AM, Malmqvist S, Andersen K, Kjaermann I, Larsen JP, Dalen I, et al. Subjective recovery from pregnancy-related pelvic girdle pain the first 6 weeks after delivery: a prospective longitudinal cohort study. Eur Spine J. 2020;29(3):556-63 DOI: 10.1007/s00586-020-06288-9.
21. Tavares P, Barrett J, Hogg-Johnson S, Ho S, Corso M, Batley S, et al. Prevalence of Low Back Pain, Pelvic Girdle Pain, and Combination Pain in a Postpartum Ontario Population. J Obstet Gynaecol Can. 2020;42(4):473-80 DOI: 10.1016/j.jogc.2019.08.030.
22. Bergstrom C, Persson M, Nergard KA, Mogren I. Prevalence and predictors of persistent pelvic girdle pain 12 years postpartum. BMC Musculoskelet Disord. 2017;18(1):399 DOI: 10.1186/s12891-017-1760-5.
23. Elden H, Gutke A, Kjellby-Wendt G, Fagevik-Olsen M, Ostgaard HC. Predictors and consequences of long-term pregnancy-related pelvic

girdle pain: a longitudinal follow-up study. BMC Musculoskelet Disord. 2016;17:276 DOI: 10.1186/s12891-016-1154-0.
24. Bjelland EK, Eskild A, Johansen R, Eberhard-Gran M. Pelvic girdle pain in pregnancy: the impact of parity. Am J Obstet Gynecol. 2010;203(2):146.e1-6 DOI: 10.1016/j.ajog.2010.03.040.
25. Wuytack F, Begley C, Daly D. Risk factors for pregnancy-related pelvic girdle pain: a scoping review. BMC Pregnancy Childbirth. 2020;20(1):739 DOI: 10.1186/s12884-020-03442-5.
26. Mogren IM. Does caesarean section negatively influence the post-partum prognosis of low back pain and pelvic pain during pregnancy? Eur Spine J. 2007;16(1):115-21 DOI: 10.1007/s00586-006-0098-8.
27. Bjelland EK, Stuge B, Vangen S, Stray-Pedersen B, Eberhard-Gran M. Mode of delivery and persistence of pelvic girdle syndrome 6 months postpartum. Am J Obstet Gynecol. 2013;208(4):298.e1-7 DOI: 10.1016/j.ajog.2012.12.002.
28. Bryndal A, Majchrzycki M, Grochulska A, Glowinski S, Seremak-Mrozikiewicz A. Risk Factors Associated with Low Back Pain among A Group of 1510 Pregnant Women. J Pers Med. 2020;10(2) DOI: 10.3390/jpm10020051.
29. Ertmann RK, Nicolaisdottir DR, Siersma V, Overbeck G, Strøyer de Voss S, Modin FA, et al. Factors in early pregnancy predicting pregnancy-related pain in the second and third trimester. Acta Obstet Gynecol Scand. 2023;102(10):1269-80 DOI: 10.1111/aogs.14670.
30. Gausel AM, Kjærmann I, Malmqvist S, Dalen I, Larsen JP, Økland I. Pelvic girdle pain 3-6 months after delivery in an unselected cohort of Norwegian women. Eur Spine J. 2016;25(6):1953-9 DOI: 10.1007/s00586-015-3959-1.
31. Starzec-Proserpio M, Węgrzynowska M, Sys D, Kajdy A, Rongies W, Baranowska B. Prevalence and factors associated with postpartum pelvic girdle pain among women in Poland: a prospective, observational study. BMC Musculoskelet Disord. 2022;23(1):928 DOI: 10.1186/s12891-022-05864-y.
32. Sjodahl J, Gutke A, Oberg B. Predictors for long-term disability in women with persistent postpartum pelvic girdle pain. Eur Spine J. 2013;22(7):1665-73 DOI: 10.1007/s00586-013-2716-6.
33. Bjelland EK, Stuge B, Engdahl B, Eberhard-Gran M. The effect of emotional distress on persistent pelvic girdle pain after delivery: a longitudinal population study. BJOG. 2013;120(1):32-40 DOI: 10.1111/1471-0528.12029.
34. Robinson HS, Mengshoel AM, Veierød MB, Vøllestad N. Pelvic girdle pain: potential risk factors in pregnancy in relation to disability and pain intensity three months postpartum. Man Ther. 2010;15(6):522-8 DOI: 10.1016/j.math.2010.05.007.

35. Olsson CB, Grooten WJ, Nilsson-Wikmar L, Harms-Ringdahl K, Lundberg M. Catastrophizing during and after pregnancy: associations with lumbopelvic pain and postpartum physical ability. Phys Ther. 2012;92(1):49-57 DOI: 10.2522/ptj.20100293.
36. Wiezer M, Hage-Fransen MAH, Otto A, Wieffer-Platvoet MS, Slotman MH, Nijhuis-van der Sanden MWG, et al. Risk factors for pelvic girdle pain postpartum and pregnancy related low back pain postpartum; a systematic review and meta-analysis. Musculoskelet Sci Pract. 2020;48:102154 DOI: 10.1016/j.msksp.2020.102154.
37. Fernando M, Nilsson-Wikmar L, Olsson CB. Fear-avoidance beliefs: A predictor for postpartum lumbopelvic pain. Physiother Res Int. 2020:e1861 DOI: 10.1002/pri.1861.
38. Aota E, Kitagaki K, Tanaka K, Tsuboi Y, Matsuda N, Horibe K, et al. The Impact of Sedentary Behavior After Childbirth on Postpartum Lumbopelvic Pain Prolongation: A Follow-Up Cohort Study. J Womens Health (Larchmt). 2021;30(12):1804-11 DOI: 10.1089/jwh.2020.8695.
39. Dionne CE, Von Korff M, Koepsell TD, Deyo RA, Barlow WE, Checkoway H. Formal education and back pain: a review. J Epidemiol Community Health. 2001;55(7):455-68 DOI: 10.1136/jech.55.7.455.
40. Großschädl F, Stolz E, Mayerl H, Rásky É, Freidl W, Stronegger W. Educational inequality as a predictor of rising back pain prevalence in Austria-sex differences. Eur J Public Health. 2016;26(2):248-53 DOI: 10.1093/eurpub/ckv163.
41. Meijer OG, Hu H, Wu WH, Prins MR. The pelvic girdle pain deadlock: 1. Would 'deconstruction' help? Musculoskelet Sci Pract. 2020;48:102169 DOI: 10.1016/j.msksp.2020.102169.
42. Meijer OG, Barbe MF, Prins MR, Schipholt IJL, Hu H, Daffertshofer A. The Pelvic Girdle Pain deadlock: 2. Topics that, so far, have remained out of focus. Musculoskelet Sci Pract. 2020;48:102166 DOI: 10.1016/j.msksp.2020.102166.
43. Vleeming A, Schuenke M. Form and Force Closure of the Sacroiliac Joints. PM R. 2019;11 Suppl 1:S24-s31 DOI: 10.1002/pmrj.12205.
44. Mens JM, Pool-Goudzwaard A, Stam HJ. Mobility of the pelvic joints in pregnancy-related lumbopelvic pain: a systematic review. Obstet Gynecol Surv. 2009;64(3):200-8 DOI: 10.1097/OGX.0b013e3181950f1b.
45. Daneau C, Abboud J, Marchand AA, Houle M, Pasquier M, Ruchat SM, et al. Mechanisms Underlying Lumbopelvic Pain During Pregnancy: A Proposed Model. Front Pain Res (Lausanne). 2021;2:773988 DOI: 10.3389/fpain.2021.773988.
46. Aldabe D, Ribeiro DC, Milosavljevic S, Dawn Bussey M. Pregnancy-related pelvic girdle pain and its relationship with relaxin levels during

pregnancy: a systematic review. Eur Spine J. 2012;21(9):1769-76 DOI: 10.1007/s00586-012-2162-x.
47. Ali A, Andrzejowski P, Kanakaris NK, Giannoudis PV. Pelvic Girdle Pain, Hypermobility Spectrum Disorder and Hypermobility-Type Ehlers-Danlos Syndrome: A Narrative Literature Review. J Clin Med. 2020;9(12) DOI: 10.3390/jcm9123992.
48. Ahlqvist K, Bjelland EK, Pingel R, Schlager A, Peterson M, Olsson CB, et al. Generalized joint hypermobility and the risk of pregnancy-related pelvic girdle pain: Is body mass index of importance?-A prospective cohort study. Acta Obstet Gynecol Scand. 2023;102(10):1259-68 DOI: 10.1111/aogs.14664.
49. Woolf CJ. Central sensitization: implications for the diagnosis and treatment of pain. Pain. 2011;152(3 Suppl):S2-s15 DOI: 10.1016/j.pain.2010.09.030.
50. Algård T, Kalliokoski P, Ahlqvist K, Schlager A, Kristiansson P. Role of depressive symptoms on the development of pelvic girdle pain in pregnancy: A prospective inception cohort study. Acta Obstet Gynecol Scand. 2023 DOI: 10.1111/aogs.14562.
51. O'Sullivan PB, Beales DJ. Diagnosis and classification of pelvic girdle pain disorders--Part 1: a mechanism based approach within a biopsychosocial framework. Man Ther. 2007;12(2):86-97 DOI: 10.1016/j.math.2007.02.001.
52. Hodges PW, Tucker K. Moving differently in pain: a new theory to explain the adaptation to pain. Pain. 2011;152(3 Suppl):S90-s8 DOI: 10.1016/j.pain.2010.10.020.
53. Vlaeyen JWS, Linton SJ. Fear-avoidance model of chronic musculoskeletal pain: 12 years on. Pain. 2012;153(6):1144-7 DOI: 10.1016/j.pain.2011.12.009.
54. Kristiansson P, Zöller B, Dahl N, Kalliokoski P, Hallqvist J, Li X. Heredity of pregnancy-related pelvic girdle pain in Sweden. Acta Obstet Gynecol Scand. 2023;102(10):1250-8 DOI: 10.1111/aogs.14646.
55. Nicholas M, Vlaeyen JWS, Rief W, Barke A, Aziz Q, Benoliel R, et al. The IASP classification of chronic pain for ICD-11: chronic primary pain. Pain. 2019;160(1):28-37 DOI: 10.1097/j.pain.0000000000001390.
56. Sward L, Manning N, Murchison AB, Ghahremani T, McCaulley JA, Magann EF. Pelvic Girdle Pain in Pregnancy: A Review. Obstet Gynecol Surv. 2023;78(6):349-57 DOI: 10.1097/ogx.0000000000001140.
57. Dunn G, Egger MJ, Shaw JM, Yang J, Bardsley T, Powers E, et al. Trajectories of lower back, upper back, and pelvic girdle pain during pregnancy and early postpartum in primiparous women. Womens

Health (Lond). 2019;15:1745506519842757 DOI: 10.1177/1745506519842757.
58. Shijagurumayum Acharya R, Tveter AT, Grotle M, Eberhard-Gran M, Stuge B. Prevalence and severity of low back- and pelvic girdle pain in pregnant Nepalese women. BMC Pregnancy Childbirth. 2019;19(1):247 DOI: 10.1186/s12884-019-2398-0.
59. Shi Z, Yan F, Lu Y, Liu W, Wang Z, Zhang H. Pregnancy-related low back/pelvic girdle pain: Prevalence, severity, and risk factors in Zhengzhou, China. J Back Musculoskelet Rehabil. 2023;36(4):895-902 DOI: 10.3233/bmr-220147.
60. World Health Organisation W. International Classification of Diseases (ICD-10), version 2019 Switzerland2019 [updated 2020 Feb 01; cited 2023 Nov 14]. Available from: https://icd.who.int/browse10/2019/en.
61. Clinton SC, Newell A, Downey PA, Ferreira K. Pelvic Girdle Pain in the Antepartum Population: Physical Therapy Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health From the Section on Women's Health and the Orthopaedic Section of the American Physical Therapy Association. J Womens Health Phys Therap. 2017;41(2):102-25 DOI: 10.1097/jwh.0000000000000081.
62. Gutke A, Betten C, Degerskar K, Fagevik Olsen M, Pousette S. Riktlinjer för behandling av patienter med graviditetsrelaterad ländryggs- och bäckensmärta. Stockholm: Fysioterapeuterna, 2016.
63. Albert H, Godskesen M, Westergaard J. Evaluation of clinical tests used in classification procedures in pregnancy-related pelvic joint pain. Eur Spine J. 2000;9(2):161-6 DOI: 10.1007/s005860050228.
64. Ostgaard HC, Zetherstrom G, Roos-Hansson E. The posterior pelvic pain provocation test in pregnant women. Eur Spine J. 1994;3(5):258-60.
65. Gutke A, Hansson ER, Zetherstrom G, Ostgaard HC. Posterior pelvic pain provocation test is negative in patients with lumbar herniated discs. Eur Spine J. 2009;18(7):1008-12 DOI: 10.1007/s00586-009-1003-z.
66. Laslett M, Aprill CN, McDonald B, Young SB. Diagnosis of sacroiliac joint pain: validity of individual provocation tests and composites of tests. Man Ther. 2005;10(3):207-18 DOI: 10.1016/j.math.2005.01.003.
67. Vleeming A, de Vries HJ, Mens JM, van Wingerden JP. Possible role of the long dorsal sacroiliac ligament in women with peripartum pelvic pain. Acta Obstet Gynecol Scand. 2002;81(5):430-6 DOI: 10.1034/j.1600-0412.2002.810510.x.
68. Fagevik Olsen M, Gutke A, Elden H, Nordenman C, Fabricius L, Gravesen M, et al. Self-administered tests as a screening procedure for

pregnancy-related pelvic girdle pain. Eur Spine J. 2009;18(8):1121-9 DOI: 10.1007/s00586-009-0948-2.
69. Mens JM, Huis In 't Veld YH, Pool-Goudzwaard A. The Active Straight Leg Raise test in lumbopelvic pain during pregnancy. Man Ther. 2012;17(4):364-8 DOI: 10.1016/j.math.2012.01.007.
70. Robinson HS, Brox JI, Robinson R, Bjelland E, Solem S, Telje T. The reliability of selected motion- and pain provocation tests for the sacroiliac joint. Man Ther. 2007;12(1):72-9 DOI: 10.1016/j.math.2005.09.004.
71. Saueressig T, Owen PJ, Diemer F, Zebisch J, Belavy DL. Diagnostic Accuracy of Clusters of Pain Provocation Tests for Detecting Sacroiliac Joint Pain: Systematic Review With Meta-analysis. J Orthop Sports Phys Ther. 2021;51(9):422-31 DOI: 10.2519/jospt.2021.10469.
72. Kristiansson P, Svardsudd K. Discriminatory power of tests applied in back pain during pregnancy. Spine (Phila Pa 1976). 1996;21(20):2337-43; discussion 43-4.
73. Gutke A, Kjellby-Wendt G, Oberg B. The inter-rater reliability of a standardised classification system for pregnancy-related lumbopelvic pain. Man Ther. 2010;15(1):13-8 DOI: 10.1016/j.math.2009.05.005.
74. Engel GL. The need for a new medical model: a challenge for biomedicine. Science. 1977;196(4286):129-36 DOI: 10.1126/science.847460.
75. Buin L, Joaquim R, Strong J, Robinson K. The Experience of Pregnancy-Related Lumbopelvic Pain: A Qualitative Evidence Synthesis. Can J Occup Ther. 2023:84174231172037 DOI: 10.1177/00084174231172037.
76. Sydsjo A, Sydsjo G, Alexanderson K. Influence of pregnancy-related diagnoses on sick-leave data in women aged 16-44. J Womens Health Gend Based Med. 2001;10(7):707-14 DOI: 10.1089/15246090152563597.
77. Backhausen M, Damm P, Bendix J, Tabor A, Hegaard H. The prevalence of sick leave: Reasons and associated predictors - A survey among employed pregnant women. Sex Reprod Healthc. 2018;15:54-61 DOI: 10.1016/j.srhc.2017.11.005.
78. Dorheim SK, Bjorvatn B, Eberhard-Gran M. Sick leave during pregnancy: a longitudinal study of rates and risk factors in a Norwegian population. BJOG. 2013;120(5):521-30 DOI: 10.1111/1471-0528.12035.
79. Severinsen A, Midtgaard J, Backhausen MG, Broberg L, Hegaard HK. Pregnant women's experiences with sick leave caused by low back pain. A qualitative study. Work. 2019;64(2):271-81 DOI: 10.3233/wor-192991.

80. Ceprnja D, Chipchase L, Liamputtong P, Gupta A. "This is hard to cope with": the lived experience and coping strategies adopted amongst Australian women with pelvic girdle pain in pregnancy. BMC Pregnancy Childbirth. 2022;22(1):96 DOI: 10.1186/s12884-022-04426-3.
81. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451-62 DOI: 10.1136/bjsports-2020-102955.
82. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. CMAJ. 2006;174(6):801-9 DOI: 10.1503/cmaj.051351.
83. Hegaard HK, Damm P, Hedegaard M, Henriksen TB, Ottesen B, Dykes AK, et al. Sports and leisure time physical activity during pregnancy in nulliparous women. Matern Child Health J. 2011;15(6):806-13 DOI: 10.1007/s10995-010-0647-y.
84. Brown WJ, Heesch KC, Miller YD. Life events and changing physical activity patterns in women at different life stages. Ann Behav Med. 2009;37(3):294-305 DOI: 10.1007/s12160-009-9099-2.
85. Coll CV, Domingues MR, Hallal PC, da Silva IC, Bassani DG, Matijasevich A, et al. Changes in leisure-time physical activity among Brazilian pregnant women: comparison between two birth cohort studies (2004 - 2015). BMC Public Health. 2017;17(1):119 DOI: 10.1186/s12889-017-4036-y.
86. Davenport MH, Ruchat SM, Poitras VJ, Jaramillo Garcia A, Gray CE, Barrowman N, et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: a systematic review and meta-analysis. Br J Sports Med. 2018;52(21):1367-75 DOI: 10.1136/bjsports-2018-099355.
87. Haakstad LA, Voldner N, Henriksen T, Bo K. Why do pregnant women stop exercising in the third trimester? Acta Obstet Gynecol Scand. 2009;88(11):1267-75 DOI: 10.3109/00016340903284901.
88. Coll CV, Domingues MR, Goncalves H, Bertoldi AD. Perceived barriers to leisure-time physical activity during pregnancy: A literature review of quantitative and qualitative evidence. J Sci Med Sport. 2017;20(1):17-25 DOI: 10.1016/j.jsams.2016.06.007.
89. Evenson KR, Moos MK, Carrier K, Siega-Riz AM. Perceived barriers to physical activity among pregnant women. Matern Child Health J. 2009;13(3):364-75 DOI: 10.1007/s10995-008-0359-8.
90. McKeough R, Blanchard C, Piccinini-Vallis H. Pregnant and Postpartum Women's Perceptions of Barriers to and Enablers of Physical Activity During Pregnancy: A Qualitative Systematic

Review. J Midwifery Womens Health. 2022;67(4):448-62 DOI: 10.1111/jmwh.13375.
91. Saligheh M, McNamara B, Rooney R. Perceived barriers and enablers of physical activity in postpartum women: a qualitative approach. BMC Pregnancy Childbirth. 2016;16(1):131 DOI: 10.1186/s12884-016-0908-x.
92. Baattaiah BA, Zedan HS, Almasaudi AS, Alashmali S, Aldhahi MI. Physical activity patterns among women during the postpartum period: an insight into the potential impact of perceived fatigue. BMC Pregnancy Childbirth. 2022;22(1):678 DOI: 10.1186/s12884-022-05015-0.
93. Liddle SD, Pennick V. Interventions for preventing and treating low-back and pelvic pain during pregnancy. Cochrane Database Syst Rev. 2015(9):Cd001139 DOI: 10.1002/14651858.CD001139.pub4.
94. Gutke A, Betten C, Degeskär K, Pousette S, Fagevik-Olsén M. Behandling av graviditetsrelaterad ländryggs- och bäckensmärta. Fysioterapi. 2016;7:38-45.
95. Gutke A, Betten C, Degerskar K, Pousette S, Fagevik Olsen M. Treatments for pregnancy-related lumbopelvic pain: a systematic review of physiotherapy modalities. Acta Obstet Gynecol Scand. 2015;94(11):1156-67 DOI: 10.1111/aogs.12681.
96. Coutaux A. Non-pharmacological treatments for pain relief: TENS and acupuncture. Joint Bone Spine. 2017;84(6):657-61 DOI: 10.1016/j.jbspin.2017.02.005.
97. Moon HY, Kim MR, Hwang DS, Jang JB, Lee J, Shin JS, et al. Safety of acupuncture during pregnancy: a retrospective cohort study in Korea. BJOG 2020;127(1):79-86 DOI: 10.1111/1471-0528.15925.
98. Li R, Chen L, Ren Y, Huang J, Xu Y, Lin X, et al. Efficacy and safety of acupuncture for pregnancy-related low back pain: A systematic review and meta-analysis. Heliyon. 2023;9(8):e18439 DOI: 10.1016/j.heliyon.2023.e18439.
99. Gutke A, Ostgaard HC, Oberg B. Association between muscle function and low back pain in relation to pregnancy. J Rehabil Med. 2008;40(4):304-11 DOI: 10.2340/16501977-0170.
100. Santos FF, Lourenço BM, Souza MB, Maia LB, Oliveira VC, Oliveira MX. Prevention of low back and pelvic girdle pain during pregnancy: a systematic review and meta-analysis of randomised controlled trials with GRADE recommendations. Physiotherapy. 2023;118:1-11 DOI: 10.1016/j.physio.2022.09.004.
101. Owe KM, Bjelland EK, Stuge B, Orsini N, Eberhard-Gran M, Vangen S. Exercise level before pregnancy and engaging in high-impact sports reduce the risk of pelvic girdle pain: a population-based cohort study

of 39 184 women. Br J Sports Med. 2015 DOI: 10.1136/bjsports-2015-094921.
102. Shiri R, Coggon D, Falah-Hassani K. Exercise for the prevention of low back and pelvic girdle pain in pregnancy: A meta-analysis of randomized controlled trials. Eur J Pain. 2018;22(1):19-27 DOI: 10.1002/ejp.1096.
103. Almousa S, Lamprianidou E, Kitsoulis G. The effectiveness of stabilising exercises in pelvic girdle pain during pregnancy and after delivery: A systematic review. Physiother Res Int. 2018;23(1) DOI: 10.1002/pri.1699.
104. Mens JM, Damen L, Snijders CJ, Stam HJ. The mechanical effect of a pelvic belt in patients with pregnancy-related pelvic pain. Clin Biomech (Bristol, Avon). 2006;21(2):122-7 DOI: 10.1016/j.clinbiomech.2005.08.016.
105. Arumugam A, Milosavljevic S, Woodley S, Sole G. Effects of external pelvic compression on form closure, force closure, and neuromotor control of the lumbopelvic spine--a systematic review. Man Ther. 2012;17(4):275-84 DOI: 10.1016/j.math.2012.01.010.
106. Bertuit J, Van Lint CE, Rooze M, Feipel V. Pregnancy and pelvic girdle pain: Analysis of pelvic belt on pain. J Clin Nurs. 2018;27(1-2):e129-e37 DOI: 10.1111/jocn.13888.
107. Keskin EA, Onur O, Keskin HL, Gumus, II, Kafali H, Turhan N. Transcutaneous electrical nerve stimulation improves low back pain during pregnancy. Gynecol Obstet Invest. 2012;74(1):76-83 DOI: 10.1159/000337720.
108. Verstraete EH, Vanderstraeten G, Parewijck W. Pelvic Girdle Pain during or after Pregnancy: a review of recent evidence and a clinical care path proposal. Facts Views Vis Obgyn. 2013;5(1):33-43.
109. Johnson M. Transcutaneous Electrical Nerve Stimulation: Mechanisms, Clinical Application and Evidence. Rev Pain. 2007;1(1):7-11 DOI: 10.1177/204946370700100103.
110. Johnson MI, Paley CA, Jones G, Mulvey MR, Wittkopf PG. Efficacy and safety of transcutaneous electrical nerve stimulation (TENS) for acute and chronic pain in adults: a systematic review and meta-analysis of 381 studies (the meta-TENS study). BMJ Open. 2022;12(2):e051073 DOI: 10.1136/bmjopen-2021-051073.
111. Quittan M, Bily W, Crevenna R, Fialka-Moser V, Grestenberger W, Hofer C, et al. Transcutaneous Electrical Nerve Stimulation (TENS) in Patients with Pregnancy-Induced Low Back Pain and/or Pelvic Girdle Pain. Phys Med Rehab Kuror. 2016;26(02):91-5 DOI: 10.1055/s-0035-1565058.
112. Swedish national board of health and welfare. Gravida och nyförlösta kvinnors situation och behov. En enkätundersökning och

fokusgruppssamtal om hälsofrågor, oro, information, uppföljning och stöd. Stockholm: Swedish National Board of Health and Welfare; 2019 [updated 2020 Nov 09; cited 2023 Nov 17]. Available from: https://www.socialstyrelsen.se/meranbaramamma/undersakning/.

113. Stuge B, Garratt A, Krogstad Jenssen H, Grotle M. The pelvic girdle questionnaire: a condition-specific instrument for assessing activity limitations and symptoms in people with pelvic girdle pain. Phys Ther. 2011;91(7):1096-108 DOI: 10.2522/ptj.20100357.
114. Pathak A, Wilson R, Sharma S, Pryymachenko Y, Ribeiro DC, Chua J, et al. Measurement Properties of the Patient-Specific Functional Scale and Its Current Uses: An Updated Systematic Review of 57 Studies Using COSMIN Guidelines. J Orthop Sports Phys Ther. 2022;52(5):262-75 DOI: 10.2519/jospt.2022.10727.
115. Abbott JH, Schmitt J. Minimum important differences for the patient-specific functional scale, 4 region-specific outcome measures, and the numeric pain rating scale. J Orthop Sports Phys Ther. 2014;44(8):560-4 DOI: 10.2519/jospt.2014.5248.
116. Remus A, Lempke AFD, Wuytack F, Smith V. Outcome Measurement Instruments and Evidence-based Recommendations for Measurement of the Pelvic Girdle Pain Core Outcome Set (PGP-COS): A Systematic Review and Consensus Process. J Pain. 2022;23(12):2052-69 DOI: 10.1016/j.jpain.2022.08.003.
117. Stuge B, Jenssen HK, Grotle M. The Pelvic Girdle Questionnaire: Responsiveness and Minimal Important Change in Women With Pregnancy-Related Pelvic Girdle Pain, Low Back Pain, or Both. Phys Ther. 2017;97(11):1103-13 DOI: 10.1093/ptj/pzx078.
118. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine (Phila Pa 1976). 2000;25(22):2940-52; discussion 52 DOI: 10.1097/00007632-200011150-00017.
119. Ogollah R, Bishop A, Lewis M, Grotle M, Foster NE. Responsiveness and Minimal Important Change for Pain and Disability Outcome Measures in Pregnancy-Related Low Back and Pelvic Girdle Pain. Phys Ther. 2019;99(11):1551-61 DOI: 10.1093/ptj/pzz107.
120. Milton K, Bull FC, Bauman A. Reliability and validity testing of a single-item physical activity measure. Br J Sports Med. 2011;45(3):203-8 DOI: 10.1136/bjsm.2009.068395.
121. Haakstad LA, Voldner N, Henriksen T, Bo K. Physical activity level and weight gain in a cohort of pregnant Norwegian women. Acta Obstet Gynecol Scand. 2007;86(5):559-64 DOI: 10.1080/00016340601185301.
122. de Zwart BC, Frings-Dresen MH, van Duivenbooden JC. Test-retest reliability of the Work Ability Index questionnaire. Occup Med (Lond). 2002;52(4):177-81 DOI: 10.1093/occmed/52.4.177.

123. Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health--a prospective study of women on long-term sick leave. Scand J Work Environ Health. 2010;36(5):404-12 DOI: 10.5271/sjweh.2917.
124. Boekel I, Dutmer AL, Schiphorst Preuper HR, Reneman MF. Validation of the work ability index-single item and the pain disability index-work item in patients with chronic low back pain. Eur Spine J. 2022;31(4):943-52 DOI: 10.1007/s00586-022-07109-x.
125. Stienstra M, Edelaar MJA, Fritz B, Reneman MF. Measurement Properties of the Work Ability Score in Sick-Listed Workers with Chronic Musculoskeletal Pain. J Occup Rehabil. 2022;32(1):103-13 DOI: 10.1007/s10926-021-09982-7.
126. Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH, et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. J Pain Symptom Manage. 2011;41(6):1073-93 DOI: 10.1016/j.jpainsymman.2010.08.016.
127. Elkins G, Staniunas R, Rajab MH, Marcus J, Snyder T. Use of a numeric visual analog anxiety scale among patients undergoing colorectal surgery. Clin Nurs Res. 2004;13(3):237-44 DOI: 10.1177/1054773803262222.
128. Kozinszky Z, Dudas RB. Validation studies of the Edinburgh Postnatal Depression Scale for the antenatal period. J Affect Disord. 2015;176:95-105 DOI: 10.1016/j.jad.2015.01.044.
129. Rubertsson C, Borjesson K, Berglund A, Josefsson A, Sydsjo G. The Swedish validation of Edinburgh Postnatal Depression Scale (EPDS) during pregnancy. Nord J Psychiatry. 2011;65(6):414-8 DOI: 10.3109/08039488.2011.590606.
130. Bergink V, Kooistra L, Lambregtse-van den Berg MP, Wijnen H, Bunevicius R, van Baar A, et al. Validation of the Edinburgh Depression Scale during pregnancy. J Psychosom Res. 2011;70(4):385-9 DOI: 10.1016/j.jpsychores.2010.07.008.
131. Rosenstiel AK, Keefe FJ. The use of coping strategies in chronic low back pain patients: Relationship to patient characteristics and current adjustment. Pain. 1983;17(1):33-44 DOI: http://dx.doi.org/10.1016/0304-3959(83)90125-2.
132. Jensen I, Linton S. Coping Strategies Questionnaire (CSQ): Reliability of the Swedish version of the CSQ. Scand J Behav Therap. 1993;22:139-45 DOI: 10.1080/16506079309455940.
133. Hirsh AT, George SZ, Riley JL, 3rd, Robinson ME. An evaluation of the measurement of pain catastrophizing by the coping strategies

questionnaire. Eur J Pain. 2007;11(1):75-81 DOI: 10.1016/j.ejpain.2005.12.010.
134. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361-70 DOI: 10.1111/j.1600-0447.1983.tb09716.x.
135. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J Psychosom Res. 2002;52(2):69-77 DOI: 10.1016/s0022-3999(01)00296-3.
136. Lisspers J, Nygren A, Söderman E. Hospital Anxiety and Depression Scale (HAD): some psychometric data for a Swedish sample. Acta Psychiatr Scand. 1997;96(4):281-6 DOI: 10.1111/j.1600-0447.1997.tb10164.x.
137. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001;33(5):337-43 DOI: 10.3109/07853890109002087.
138. Feng YS, Kohlmann T, Janssen MF, Buchholz I. Psychometric properties of the EQ-5D-5L: a systematic review of the literature. Qual Life Res. 2021;30(3):647-73 DOI: 10.1007/s11136-020-02688-y.
139. Avery K, Donovan J, Peters TJ, Shaw C, Gotoh M, Abrams P. ICIQ: a brief and robust measure for evaluating the symptoms and impact of urinary incontinence. Neurourol Urodyn. 2004;23(4):322-30 DOI: 10.1002/nau.20041.
140. Klovning A, Avery K, Sandvik H, Hunskaar S. Comparison of two questionnaires for assessing the severity of urinary incontinence: The ICIQ-UI SF versus the incontinence severity index. Neurourol Urodyn. 2009;28(5):411-5 DOI: 10.1002/nau.20674.
141. Kamper SJ, Maher CG, Mackay G. Global rating of change scales: a review of strengths and weaknesses and considerations for design. J Man Manip Ther. 2009;17(3):163-70 DOI: 10.1179/jmt.2009.17.3.163.
142. Bobos P, Ziebart C, Furtado R, Lu Z, MacDermid JC. Psychometric properties of the global rating of change scales in patients with low back pain, upper and lower extremity disorders. A systematic review with meta-analysis. J Orthop. 2020;21:40-8 DOI: 10.1016/j.jor.2020.01.047.
143. Springer BA, Marin R, Cyhan T, Roberts H, Gill NW. Normative values for the unipedal stance test with eyes open and closed. J Geriatr Phys Ther. 2007;30(1):8-15 DOI: 10.1519/00139143-200704000-00003.
144. Latimer J, Maher CG, Refshauge K, Colaco I. The reliability and validity of the Biering-Sorensen test in asymptomatic subjects and subjects reporting current or previous nonspecific low back pain.

Spine (Phila Pa 1976). 1999;24(20):2085-9; discussion 90 DOI: 10.1097/00007632-199910150-00004.
145. Elden H, Ladfors L, Olsen MF, Ostgaard HC, Hagberg H. Effects of acupuncture and stabilising exercises as adjunct to standard treatment in pregnant women with pelvic girdle pain: randomised single blind controlled trial. BMJ. 2005;330(7494):761 DOI: 10.1136/bmj.38397.507014.E0.
146. Zahavi D. Phenomenology, the basics. London: Routledge; 2019.
147. Englander M. The interview: Data collection in descriptive phenomenological human scientific research. J Phenomenol Psychol. 2012;43(1):13-35 DOI: 10.1163/156916212X632943.
148. Englander M. The phenomenological method in qualitative psychology and psychiatry. Int J Qual Stud Health Well-being. 2016;11:30682 DOI: 10.3402/qhw.v11.30682.
149. Dahlberg K. The essence of essences – the search for meaning structures in phenomenological analysis of lifeworld phenomena. Int J of Qual Stud Health Well-being. 2006;1(1):11-9 DOI: 10.1080/17482620500478405.
150. Shaw JA, Connelly DM. Phenomenology and physiotherapy: meaning in research and practice. Phys Ther Rev. 2012;17(6):398-408 DOI: 10.1179/1743288X12Y.0000000043.
151. Giorgi A, Giorgi B, Morley J. The Descriptive Phenomenological Psychological Method. In: Willig W, Rogers W, editors. The Sage Handbook of Qualitative Research in Psychology. 2nd ed: Sage; 2017. p. 176-92.
152. Lardon E, St-Laurent A, Babineau V, Descarreaux M, Ruchat SM. Lumbopelvic pain, anxiety, physical activity and mode of conception: a prospective cohort study of pregnant women. BMJ Open. 2018;8(11):e022508 DOI: 10.1136/bmjopen-2018-022508.
153. O'Keeffe M, Cullinane P, Hurley J, Leahy I, Bunzli S, O'Sullivan PB, et al. What Influences Patient-Therapist Interactions in Musculoskeletal Physical Therapy? Qualitative Systematic Review and Meta-Synthesis. Phys Ther. 2016;96(5):609-22 DOI: 10.2522/ptj.20150240.
154. Vlaeyen JW, Kole-Snijders AM, Rotteveel AM, Ruesink R, Heuts PH. The role of fear of movement/(re)injury in pain disability. J Occup Rehabil. 1995;5(4):235-52 DOI: 10.1007/bf02109988.
155. Traeger AC, Hübscher M, Henschke N, Moseley GL, Lee H, McAuley JH. Effect of Primary Care-Based Education on Reassurance in Patients With Acute Low Back Pain: Systematic Review and Meta-analysis. JAMA Intern Med. 2015;175(5):733-43 DOI: 10.1001/jamainternmed.2015.0217.

156. Dunkel Schetter C, Rahal D, Ponting C, Julian M, Ramos I, Hobel CJ, et al. Anxiety in pregnancy and length of gestation: Findings from the healthy babies before birth study. Health Psychol. 2022;41(12):894-903 DOI: 10.1037/hea0001210.
157. van Benten E, de Kruif A, Kiers H, Coppieters MW, Pool-Goudzwaard AL. Exploring health and illness perceptions to identify the perceived cause of pregnancy-related pelvic girdle pain. A mixed-methods study among primiparous women in The Netherlands. Midwifery. 2023;129:103892 DOI: 10.1016/j.midw.2023.103892.
158. Furlong B, Etchegary H, Aubrey-Bassler K, Swab M, Pike A, Hall A. Patient education materials for non-specific low back pain and sciatica: A systematic review and meta-analysis. PLoS One. 2022;17(10):e0274527 DOI: 10.1371/journal.pone.0274527.
159. Gomes LA, Rodrigues AM, Windt D, Pires D, Afreixo V, Canhão H, et al. Minimal Intervention of Patient Education for Low Back Pain: A Systematic Review with Meta-Analysis. J Orthop Sports Phys Ther. 2023:1-39 DOI: 10.2519/jospt.2023.11865.
160. Ceprnja D, Chipchase L, Liamputtong P, Gupta A. "We are not there yet": perceptions, beliefs and experiences of healthcare professionals caring for women with pregnancy-related pelvic girdle pain in Australia. BMC Pregnancy Childbirth. 2023;23(1):682 DOI: 10.1186/s12884-023-06000-x.
161. Stucki G, Rubinelli S, Bickenbach J. We need an operationalisation, not a definition of health. Disabil Rehabil. 2018:1-3 DOI: 10.1080/09638288.2018.1503730.
162. Wikstrom-Grotell C, Eriksson K. Movement as a basic concept in physiotherapy--a human science approach. Physiother Theory Pract. 2012;28(6):428-38 DOI: 10.3109/09593985.2012.692582.
163. Leder D. The Absent Body. Chicago: The University of Chicago Press; 1990.
164. Dahlberg H. Beyond the absent body-A phenomenological contribution to the understanding of body awareness in health and illness. Nurs Philos. 2019;20(2):e12235 DOI: 10.1111/nup.12235.
165. Calner T, Isaksson G, Michaelson P. "I know what I want but I'm not sure how to get it"-Expectations of physiotherapy treatment of persons with persistent pain. Physiother Theory Pract. 2017;33(3):198-205 DOI: 10.1080/09593985.2017.1283000.
166. Bernhardsson S, Larsson MEH, Johansson K, Öberg B. "In the physio we trust": A qualitative study on patients' preferences for physiotherapy. Physiother Theory Pract. 2017;33(7):535-49 DOI: 10.1080/09593985.2017.1328720.

167. Blasini M, Peiris N, Wright T, Colloca L. The Role of Patient-Practitioner Relationships in Placebo and Nocebo Phenomena. Int Rev Neurobiol. 2018;139:211-31 DOI: 10.1016/bs.irn.2018.07.033.
168. Nicholson V, Tuttle N, Papinniemi A, Evans K. Patients report being satisfied with private musculoskeletal physical therapy when therapists educate effectively and facilitate shared decision making. Braz J Phys Ther. 2023;27(2):100501 DOI: 10.1016/j.bjpt.2023.100501.
169. Hush JM, Yung V, Mackey M, Adams R, Wand BM, Nelson R, et al. Patient satisfaction with musculoskeletal physiotherapy care in Australia: an international comparison. J Man Manip Ther. 2012;20(4):201-8 DOI: 10.1179/2042618612y.0000000009.
170. Corbett DB, Simon CB, Manini TM, George SZ, Riley JL, 3rd, Fillingim RB. Movement-evoked pain: transforming the way we understand and measure pain. Pain. 2019;160(4):757-61 DOI: 10.1097/j.pain.0000000000001431.
171. Remus A, Smith V, Gutke A, Mena JJS, Mørkved S, Wikmar LN, et al. A core outcome set for research and clinical practice in women with pelvic girdle pain: PGP-COS. PLoS One. 2021;16(2):e0247466 DOI: 10.1371/journal.pone.0247466.
172. Gutke A, Stuge B, Elden H, Sandell C, Asplin G, Fagevik Olsen M. The Swedish version of the pelvic girdle questionnaire, cross-cultural adaptation and validation. Disabil Rehabil. 2019:1-8 DOI: 10.1080/09638288.2018.1515991.
173. Bai G, Raat H, Jaddoe VWV, Mautner E, Korfage IJ. Trajectories and predictors of women's health-related quality of life during pregnancy: A large longitudinal cohort study. PLoS One. 2018;13(4):e0194999 DOI: 10.1371/journal.pone.0194999.
174. Gutke A, Sundfeldt K, De Baets L. Lifestyle and Chronic Pain in the Pelvis: State of the Art and Future Directions. J Clin Med. 2021;10(22) DOI: 10.3390/jcm10225397.
175. Liebano RE, Rakel B, Vance CGT, Walsh DM, Sluka KA. An investigation of the development of analgesic tolerance to TENS in humans. Pain. 2011;152(2):335-42 DOI: 10.1016/j.pain.2010.10.040.
176. Pantaleão MA, Laurino MF, Gallego NL, Cabral CM, Rakel B, Vance C, et al. Adjusting pulse amplitude during transcutaneous electrical nerve stimulation (TENS) application produces greater hypoalgesia. J Pain. 2011;12(5):581-90 DOI: 10.1016/j.jpain.2010.11.001.
177. Grotle M, Garratt AM, Krogstad Jenssen H, Stuge B. Reliability and construct validity of self-report questionnaires for patients with pelvic girdle pain. Phys Ther. 2012;92(1):111-23 DOI: 10.2522/ptj.20110076.

178. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4 DOI: 10.1001/jama.2013.281053.
179. ALLEA. All European Academies. The European Code of Conduct for Research Integrity – Revised Edition 2023. Berlin: 2023.