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Aspects of Catastrophizing, Fear-Avoidance Beliefs, Physical Ability and Health-Related Quality of Life

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Nog finns det mål och mening i vår färd –
men det är vägen som är mödan värd.
Karin Boye, från dikten "I rörelse"

There is probably purpose and meaning in our journey
but it is the pathway there, which is worth our while
Karin Boye, from the poem "On the Move", translation by Jenny Nunn in "To a friend"

ABSTRACT

Background: Every second pregnant woman suffers from lumbopelvic pain, and many report remaining pain postpartum. Lumbopelvic pain affects the woman's life in many ways and it is the main reason for sick leave during pregnancy. Lumbopelvic pain has mainly been studied from a biomedical perspective, but to fully explain the experience and its consequences a biopsychosocial approach is needed.

Aim: To study aspects of pain, catastrophizing, fear-avoidance beliefs, physical ability, and health related quality of life during and after pregnancy, among women with and without lumbopelvic pain.

Methods: Self-report questionnaires were used in two different samples. In S*tudy I* women at weeks 34–37 of pregnancy rated pain intensity, physical ability and health-related quality of life. In addition, in s*tudies II-IV* the women also rated catastrophizing and fear-avoidance beliefs on three occasions; at weeks 19–21 and weeks 34–37 of pregnancy, and 6 months postpartum. In s*tudies I* (n=136) and *II* (n=324), comparisons were made between women with and women without lumbopelvic pain. In S*tudy III* (n=273) determinants for postpartum lumbopelvic pain were investigated. In S*tudy IV* (n=242) catastrophizing was followed over time and the associations between catastrophizing and lumbopelvic pain and level of physical ability postpartum were studied. Non-parametric analyses were used in *studies I-IV* and the Cox proportional hazards model was used in S*tudy III*.

Results: Women with lumbopelvic pain (44%) in weeks 19–21 of pregnancy had higher levels of catastrophizing and fear-avoidance beliefs, limited physical ability and lower health-related quality of life compared with women without lumbopelvic pain *(Study II).* Women with lumbopelvic pain (51%) in weeks 34–37 of pregnancy had limited physical ability and lower health-related quality of life compared with women without lumbopelvic pain *(Study I).* High levels of catastrophizing and more limited physical ability, in combination with lumbopelvic pain during pregnancy, doubled the risk for postpartum lumbopelvic pain *(Study III).* Most women did not report catastrophizing on any of the three measurement occasions, while 10% reported catastrophizing in all three occasions. For 32% catastrophizing varied over time *(Study IV).* Women who catastrophized on any occasion had limited physical ability postpartum compared with non-catastrophizing women.

Conclusion: Pregnancy adversely affects physical ability and health-related quality of life, and in these studies, pregnant women with lumbopelvic pain reported the most negative consequences. They also had higher levels of catastrophizing and fear-avoidance beliefs compared with pain-free women. Catastrophizing seems important in this context of lumbopelvic pain and pregnancy. One-tenth of the women reported catastrophizing on all of the measurement occasions and, surprisingly, catastrophizing varied over time in one-third of the women. The results imply that a broad perspective is necessary when meeting pregnant women both with and without lumbopelvic pain since, apart from biological factors, also psychosocial factors seem relevant.

SAMMANFATTNING

Varannan kvinna får ländrygg/bäckensmärta någon gång under graviditeten och många har kvarstående problem efter förlossningen. Smärtan påverkar många aspekter av livet och är den vanligaste orsaken till sjukskrivning under graviditet. Framför allt har ländrygg/bäckensmärta studerats ur ett biomedicinskt perspektiv men för att fullt ut kunna förklara smärtupplevelsen och de påföljande konsekvenserna är en biopsyko-social ansats nödvändig.

Syfte: Att studera aspekter av smärta, katastroftankar, rädsla-undvikande tankar, fysisk förmåga och hälsorelaterad livskvalitet under och efter graviditeten hos kvinnor med och utan ländrygg/ bäckensmärta.

Metod: Självrapporterade frågeformulär användes i två olika sample. I S*tudie I* skattade kvinnor i graviditetsvecka 34–37 smärta, fysisk förmåga och hälsorelaterad livskvalitet. Även i *Studie II-IV* skattade kvinnorna smärta, fysisk förmåga och hälsorelaterad livskvalitet men också katastroftankar och rädsla-undvikande tankar. Skattningarna gjordes vid tre tillfällen, i graviditetsvecka 19–21, 34–37 och sex månader efter förlossningen. I S*tudie I* (n=136) och *II* (n=324) jämfördes kvinnor med och utan smärta. I S*tudie III* (n=273) undersöktes faktorer som påverkade uppkomsten av ländrygg/bäckensmärta efter graviditeten. I S*tudie IV* (n=242) följdes utvecklingen av katastroftankar över tid och sambandet med ländrygg/ bäckensmärta, och fysisk förmåga efter graviditeten undersöktes. Icke parametriska analyser användes i S*tudie I-IV* och Cox regressions analys i S*tudie III*.

Resultat: I vecka 19–21 hade kvinnor med ländrygg/bäckensmärta (44%) mer katastroftankar och rädsla-undvikande tankar samt sämre fysisk förmåga och lägre hälsorelaterad livskvalitet, jämfört med de som var smärtfria *(Studie II)*. Även i vecka 34–37 hade kvinnor med ländrygg/bäckensmärta (51%) sämre fysisk förmåga och lägre livskvalitet än de som inte hade smärta *(Studie I)*. Hög andel katastroftankar och sämre fysisk förmåga i kombination med smärta under graviditeten fördubblade risken för ländrygg/ bäcken smärta efter graviditeten *(Studie III)*. De flesta kvinnorna angav låg andel katastroftankar vid alla tre mättillfällena, hos 32% varierade andelen katastroftankar över tid medan 10% uppgav hög andel katastroftankar vid alla tillfällena *(Studie IV)*. Kvinnorna som angav hög andel katastroftankar vid ett eller flera av frågetillfällena hade en lägre fysisk förmåga efter graviditeten jämfört med de som hade låg andel katastroftankar.

Konklusion: Fysisk förmåga och hälsorelaterad livskvalitet påverkas negativt under graviditeten, fr.a. hos de kvinnor som har ländrygg/ bäckensmärta. Kvinnorna med smärta hade också mer katastroftankar och rädsla-undvikande tankar än smärtfria kvinnor. Överdrivna negativa tankar, katastroftankar, verkar spela en viktig roll i det här sammanhanget. Att ha många sådana tankar fördubblade risken för smärta efter graviditeten. Vidare hade kvinnorna med katastroftankar, vid ett eller flera av frågetillfällena, en lägre fysisk förmåga efter graviditeten. Andelen katastroftankar varierad över tid hos var tredje kvinna, vilket inte var väntat. Eftersom det verkar som att många olika faktorer påverkar kvinnans liv, både under och efter graviditeten, kan ett biopsychosocialt synsätt vara nödvändigt för att kunna möta och hjälpa dessa kvinnor.

LIST OF PUBLICATIONS

This thesis is based on the following papers, which will be referred to in the text by their Roman numerals (I–IV).

I. **Olsson C**, Nilsson-Wikmar L.
Health-related quality of life and physical ability among pregnant women with and without back pain in late pregnancy.
Acta Obstet Gynecol Scand 2004;83:351–7

II. **Olsson C**, Buer N, Holm K, Nilsson-Wikmar L.
Lumbopelvic pain associated with catastrophizing and fear-avoidance beliefs in early pregnancy.
Acta Obstet Gynecol Scand 2009;88:378–85

III. **Olsson C**, Nilsson-Wikmar L, Grooten W.
Determinants for lumbopelvic pain six months postpartum.
Submitted

IV. **Olsson C**, Grooten W, Nilsson-Wikmar L, Harms-Ringdahl K, Lundberg M.
Catastrophizing during and after pregnancy – associations with lumbopelvic pain, and physical ability postpartum.
Manuscript

Additional data and analyses, not previously published, are added.

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Studies III and IV. These may not be the final versions before publication.

CONTENTS

LIST OF ABBREVIATIONS

BMI	body mass index
CI	confidence interval
CSQ	Coping Strategies Questionnaire
DRI	Disability Rating Index
EQ-5D	Euroquol-5 Dimension (quality-of-life questionnaire)
FABQ	Fear-Avoidance Beliefs Questionnaire
HR	hazard ratio
IASP	International Association for the Study of Pain
ICF	International Classification of Functioning, Disability and Health
IQR	interquartile range
LP	with lumbopelvic pain
NHP	Nottingham Health Profile
NLP	without lumbopelvic pain
PCS	Pain Catastrophizing Scale
PGP	pelvic girdle pain
PH	proportional hazards
QoL	quality of life
SD	standard deviation
SF-36	short form 36 (quality-of-life questionnaire)
SIJ	sacroiliac joints
TSK	Tampa Scale for Kinesiophobia
VAS	visual analogue scale
WHO	World Health Organization

1 INTRODUCTION

Pregnancy and becoming a mother affect a woman in many ways both at an individual and at a family and society level. It is important to enhance the understanding of lumbopelvic pain and related negative consequences during this period. Studies in this area are relatively few considering that women constitute about half of the world's population, as well as considering that on average every second woman reports lumbopelvic pain when pregnant and a considerable number of women also report remaining lumbopelvic pain problems postpartum.

Working as a physiotherapist in primary health care, I once met a woman with lumbopelvic pain that had started during pregnancy. She walked backwards, leaning on crutches that were far too low, followed by her husband carrying their 3-week old baby. The results from the clinical tests performed as part of my examination could not explain the way she walked, nor did they explain her decrease in daily activities that I learnt from the patient's history. This led me to the question of what other factors may be involved in the pain experience and in the reduction of physical ability. I also became interested to know more about how lumbopelvic pain, during and after pregnancy, affects a woman's life and daily activities.

Pain has been defined by the International Association for the Study of Pain as *"an unpleasant and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"* [127]. For a long time, pain has been regarded as a complex experience including both a sensory-discriminatory aspect (pain intensity, duration and localization) and affective-motivational (emotional colouring, behavioural aspects) and cognitive-evaluative (previous experiences, thoughts and ideas) dimensions [122-123]. Depending on individual and stage-of-pain process, the dimensions of pain interact in various ways. In the acute phase the sensory-discriminative dimension is the most prominent aspect of pain, while the other dimensions become more pronounced in the long-term phase. The complexity of pain is supported in more recent research where biological factors cannot entirely explain the pain experience and where pain itself does not adequately explain disability [1, 112]. Medical findings acquired through physical examinations and imaging do not seem to reliably predict reported symptoms and functioning [25, 57]. Furthermore, it is clear that psychological factors are important moderators and determinants of the pain experience [93, 113].

According to the biomedical model, there is a direct link between the actual pathophysiology of tissue damage and musculoskeletal pain [247]. It is assumed that the pain will be cured when the nociceptive stimulus is found and treated. However, this model does not fully explain the complex experience of pain and the development of disability and chronic pain. Hence, in an attempt to explain back pain a biopsychosocial model has been proposed and is frequently used [2, 219, 227]. This model considers the complex impact of biological, psychological, cultural, and social variables in the pain experience [1]. According to Vranceanu et al. [247] treatment for back pain based on the biopsychosocial model is more effective than biomedical treatment alone.

Women seem more likely to report pain than men [109]. There are also gender differences in the perception of pain and women report more negative pain experiences [94] and more intense pain [78], as well as showing more pain behaviour [204] compared with men.

1.1 LUMBOPELVIC PAIN DURING AND AFTER PREGNANCY

1.1.1 Pain in pregnancy and postpartum

It seems that pelvic girdle pain is the most common diagnosis among women with lumbopelvic pain in pregnancy, compared to lumbopelvic pain alone or combined low back and pelvic pain [72, 249]. Pelvic pain, from one or both of the sacroiliac joints and/or from the symphysis may appear separately or in combination with low back pain, which also may appear separately [5, 72, 101, 151]. Pelvic pain is commonly localized in the sacral and in gluteal regions [154]or in the area of the symphysis [125]. It may also radiate down the posterior part of one or both thighs [151]. Pelvic pain has been described as a stabbing, shooting pain [148, 196] while the lumbar pain has been described as a dull ache [196].

Use of a visual analogue scale (VAS) is common for estimating pain intensity and VASs have been applied both during [101, 149, 196] and after pregnancy [101, 154]. Comparisons of pain intensity between studies are, however, difficult since the questions vary about what pain intensity to rate (e.g. pain at present, morning pain, evening pain, worst pain during last week). In one study of pregnant women with lumbopelvic pain, 9% stated that they were totally disabled by pain while 61% claimed the pain was at least moderately severe [190]. The intensity for lumbopelvic pain has been shown to increase with time, both during the day [43] and during the course of pregnancy [101, 153]. Moreover, the pain intensity seems to peak around pregnancy week 36 [101, 153] and to be higher during pregnancy than postpartum [43, 101].

To select and apply targeted interventions a wide understanding is required, not only of pathology and physiology, but also of the psychosocial contexts, and their interactions. There is a lack of knowledge about the role of psychological factors and their possible effects on the pain experience and any negative consequences due to lumbopelvic pain in pregnancy and postpartum.

1.1.1.1 Terminology

The following definitions have been proposed for general back/pelvic pain:

- "low back pain" has been defined as "*pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without leg pain"* [226].

- "lumbar pain" has been defined as *"pain perceived as arising from anywhere within a region bounded superiorly by an imaginary transverse line through the tip of the last thoracic spinous process, inferiorly by an imaginary transverse line through the tip of the first sacral spinous process, and laterally by vertical lines tangential to the lateral borders of the lumbar erector spinae"* [128].

A European committee [244] working on guidelines for diagnosing and treating musculoskeletal pelvic pain have collaborated on the following definition:

> ”*Pelvic girdle pain (PGP) generally arises in relation to pregnancy, trauma, osteo-arthrosis and arthritis. Pain is experienced between the posterior iliac crest and the gluteal fold, particularly in the vicinity of the sacroiliac joints (SIJ). The pain may radiate in the posterior thigh and can also occur in conjunction with/or separately in the symphysis. The endurance capacity for standing, walking, and sitting is diminished. The diagnosis of PGP can be reached after exclusion of lumbar causes. The pain or functional disturbances in relation to PGP must be reproducible by specific clinical tests.”*

There is a lack of consensus regarding the terminology for lower back and pelvic pain in relation to pregnancy, and numerous different terms are being used. It is unclear whether all terms refer to pain with the same pathology and origin. The majority of the literature does not distinguish between low back and pelvic pain. This has prevented comparisons between studies and it has also hindered the understanding of the phenomenon [8, 249]. In a review article, Wu et al. [249] propose using of the terms “pregnancy-related low back pain” and “pregnancy-related pelvic girdle pain”. These terms focus on location of pain and symptoms instead of on the in largely unknown pathology. In the presence of both low back and pelvic pain, the term “pregnancy-related lumbopelvic pain” is suggested.

1.1.1.2 Prevalence of back pain and pregnancy-related lumbopelvic pain

Back pain may be the main cause of disability and sick leave worldwide and about 70–85 % of all people suffer from back pain at some time during their life [6]. Research suggests that women have a higher prevalence of back pain than men [109]. Among women in general the point prevalence of low back pain has been reported to be 26% for those between 25 and 44 years of age [160] and 20% for those between 16 and 44 years [217]. Of all women with persistent low back pain about 10–25 % refer the onset of back pain to pregnancy [13, 206].

It has been discussed whether pregnancy-related lumbopelvic pain is more common in Scandinavia than in other countries, but studies indicate that complaints are common across all continents and independent of socio-economic conditions [9, 15, 43, 102, 142, 205, 212, 214]. Prevalence rates of 24-90% of low back and/or pelvic pain in pregnancy have been reported [3, 72, 101, 151, 168]. The large variation in reported rates is due to use of different criteria, different study periods and use of different methodologies. A review study concluded that on average about 45% of all pregnant women suffer from lumbopelvic pain in pregnancy, and of these approximately 20% have pelvic girdle pain [249]. However, when clinical examinations were performed during weeks 12–18 of pregnancy, 62% of the women were classified as having lumbopelvic pain, of whom 54% had pelvic girdle pain, 17% lumbar pain and 29% combined lumbar and pelvic pain [72]. Lumbopelvic pain may occur already before the 12th week of pregnancy [101, 151] but the onset of pain is more common around week 18 [249] and the highest incidence is seen in months 5–7 [101]. The number of women with lumbopelvic pain increases during the course of pregnancy [101, 134, 151].

In most cases the pain disappears by itself during the months after delivery. However, improvement generally levels off at about three months post partum [101, 153], which is why women still having pain after this time point may have a poor prognosis. Recurrent pain episodes have been reported as being fairly common during the year after delivery [10]. Of 200 women who reported having lumbopelvic pain 6 months postpartum, 84% had recurrent pain and 16% had continuous pain [133]. Of women with lumbopelvic pain during pregnancy, 43% reported having lumbopelvic pain also at 6 months postpartum [214] and studies show a prevalence of about 20% for lumbopelvic pain 2–3 years after delivery [140, 212]. Six years after delivery 16% of all women reported lumbopelvic pain [153]. A review study found an average prevalence of postpartum lumbopelvic pain to be 25%, and of those women about 5% had problems severe enough to consult health professionals [249].

1.1.1.3 Aetiology of pregnancy-related lumbopelvic pain

The cause of pregnancy-related lumbopelvic pain is not clear. Since many women experience pain before mechanical changes occur it has been suggested that hormones play a role in the aetiology of pregnancy-related lumbopelvic pain. However, studies of the pregnancy-related hormone relaxin show contradictory results [74, 102]. Studies of biomechanical changes such as maternal weight gain affecting the spine [101, 126, 229] and a possible increase in the lumbar lordosis in pregnancy [135, 152] have likewise failed to explain the cause of pregnancy-related lumbopelvic pain. A recent review [124] indicates that increased joint motion in the pelvis may be one of the factors involved in the cause of pregnancy-related pelvic pain. In one study a difference in laxity between the two sacroiliac joints during pregnancy led to moderate to severe pregnancy-related postpartum pelvic pain [36]. Herniated lumbar discs causing lumbopelvic pain in pregnancy are unusual, the prevalence of herniation being only one per 10,000 women [101, 104]. Furthermore, imaging studies have reported the same prevalence of disc abnormalities and spondylolisthesis in pregnant as in non-pregnant women [178, 232]. The above indicate that other factors may be involved, besides the normal pregnancy-related changes [9]. It has been suggested that psychological and social factors may be involved in the pathogenesis of pregnancy-related lumbopelvic pain [124] though studies are needed to confirm this.

1.1.1.4 Riskfactors for back pain and pregnancy-related lumbopelvic pain

The origin and course of low back pain are affected by a multitude of factors with different aetiologies [96, 112, 117, 162, 227]. In non-pregnant populations, different individual (e.g. older age, previous back pain, low physical fitness, high levels of pain and disability), occupational (e.g. bending and twisting, job dissatisfaction) and psychosocial (e.g. bad cognitive functioning, inappropriate pain behaviour, depression) factors have been associated with low back pain and negative consequences related to back pain [117, 227]. Also, low general health [48, 96, 188], and low health-related quality of life [76, 216] have been shown to influence the development of future back pain.

For the development of lumbopelvic pain during pregnancy a number of risk factors have been identified. They include individual factors (e.g. younger age [47, 151], multiparity [134, 151], high body mass index (BMI) [101], lack of exercise before pregnancy

[108], hypermobility [134]), occupational factors (e.g. work dissatisfaction [4, 134], uncomfortable working positions [108], twisting and bending [151]) and psychosocial factors (stress [4], low socioeconomic status [145]).

Also for persistent lumbopelvic pain postpartum various risk factors have been identified; they include individual (e.g. older age [73, 212], earlier onset of pain in pregnancy [133, 212], high pain intensity due to lumbopelvic pain in pregnancy [133, 153], combined pain (low back and pelvis) [73], severity of complaints in pregnancy [16, 172], higher BMI [133], low endurance of back flexors [73], and hypermobility [133]) and occupational (work dissatisfaction [73]) factors.

Furthermore, studies show that previous back pain, while pregnant or non-pregnant, and strenuous work should be considered important risk factors for lumbopelvic pain both during pregnancy and persistent pain postpartum [8, 249].

In a recent study of a general population, cognitive factors (fear of movement (re)injury, self-efficacy, catastrophizing and pain expectations) and levels of pain intensity and disability at inclusion predicted pain intensity and disability at 12 months follow-up, both among those with first-episode and those with long-term low back pain [38].

Even though it has been suggested that bad coping strategies may be involved in the development of long-term pelvic pain postpartum [75] there is a lack of knowledge about the role of psychosocial factors in the process. Such factors are important in the development of low back pain in general [117, 227] and may also be important in the development of lumbopelvic pain in pregnancy and persistent pain postpartum. Knowing more about potential risk factors is essential for identifying women at risk at an early stage and also for forming effective strategies to prevent lumbopelvic pain in relation to pregnancy.

1.1.2 Treatment of lumbopelvic pain during and after pregnancy

Different exercise programmes, often in combination with other interventions, have been evaluated for pregnant women with lumbopelvic pain [42-43, 64, 136, 139, 154, 184, 205]. In a randomized controlled trial a targeted group exercise programme during 3 months in mid-pregnancy was shown to prevent self-reported lumbopelvic pain in late pregnancy [136]. Furthermore, water aerobics reduced sick leave for pregnant women with lumbopelvic pain to a greater extent than did a land-based physical exercise programme [64]. Several studies have evaluated the effect of different kinds of belts and corsets designed to decrease pain in the low back and/or the pelvic region [46, 79, 91, 103, 125, 139, 141, 154, 231]. The use of belts is often combined with other interventions. A recent review concludes that there is not enough evidence for maternity support belts, and recommends more research into biomechanics and physiology [80].

Acupuncture to reduce lumbopelvic pain in pregnancy has likewise been investigated in various studies [46, 103, 228, 231]. The limited existing evidence supports the use of acupuncture as treatment to reduce pain and disability in lumbopelvic pain; however, more research is needed. A recent review found limited evidence that manipulative

therapies could reduce lumbopelvic pain in pregnancy [95]. A review of chiropractic treatment for lumbopelvic pain during pregnancy indicates an association between treatment and improved outcome. However, only six studies, which all lacked randomization and control groups, were included [193].

Studies have investigated how interventions performed during pregnancy may affect postpartum lumbopelvic pain [45, 79, 139, 153]. One study indicates that interventions for lumbopelvic pain during pregnancy may have a long-term effect on pain postpartum. The study reports a correlation between pregnancy-related lumbopelvic pain and lumbopelvic pain 6 years postpartum in women who did not receive interventions. No such correlation was found for women participating in education and exercise programmes during pregnancy [153]. The other studies all showed a reduction in pelvic girdle pain postpartum, irrespective of which intervention was applied [45, 79, 139]. Studies that evaluate treatment of lumbopelvic pain postpartum are scarce [11, 125, 194-195]. Two different exercise programmes aiming to reduce postpartum pelvic pain showed contradictory results [125, 194]. Another study used an intervention with a more biopsychosocial approach, focusing on the women's worries about their condition. An increase in physical ability was found in the intervention group during the months after delivery compared with the group receiving the usual care [11].

Studies indicate that various interventions and treatments that have a positive effect on lumbopelvic pain during pregnancy, e.g. a reduction in sick leave [141, 154] and pain intensity [46, 64, 103], and increased physical ability [231]. Studies that use outcomes of a more psychosocial character are few; however, some report measures for e.g. health-related quality of life and anxiety [11, 184, 194-195].

1.2 PAIN CATASTROPHIZING

1.2.1 Pain catastrophizing in general

Catastrophizing is part of the cognitive-evaluative section of the pain experience and is included in the fear network, together with physiological reactivity and behavioural responses [110]. Catastrophizing is explained as an exaggerated negative orientation toward noxious stimuli [203]. It refers to a style of thinking in which the individual unintentionally magnifies the negative consequences of the feared event (e.g. a painful episode) [99]. Someone who catastrophizes (estimated using the Pain Catastrophizing Scale[203], PCS) is known to focus excessively on pain sensations and is unable to inhibit pain-related thoughts in anticipation of, during or following a painful event (i.e. rumination), to exaggerate the threat value of pain sensations (i.e. magnification), and to feel helpless and unable to control pain symptoms (i.e. helplessness) [165, 201]. It has been discussed whether catastrophizing should be considered more of a personal factor, stable over time, or more of a situational factor, dependent on the situation [215]. Studies have indicated that catastrophizing does not change over time [53, 203]. Women tend to report higher levels of catastrophizing than men [146-147, 198, 203-204]. Pain catastrophizing has been identified as an important psychological predictor of pain experience and other pain-related outcomes in a variety of pain-free and pain patient populations [110, 165, 201]. In a prospective study, catastrophizing at baseline predicted low back pain and disability at follow-up, both among those with and among those without initial low back pain [161].

1.2.2 Pain catastrophizing in pregnancy and postpartum

The Pain Catastrophizing Scale[203] (PCS) has been used for women in connection with labour and labour pain. Women catastrophizing about labour pain have been reported to anticipate and experience more intense pain during delivery [52]. They suffer more often than their non-catastrophizing counterparts from maternity blues and have decreased social functioning [50] and a poorer physical recovery postpartum [52]. Catastrophizing about labour pain has also been associated with fear of being overwhelmed by pain and tendencies to avoid the pain [225]. However, in one study, catastrophizing did not increase the use of epidural analgesia during delivery, which may be explained by the association between catastrophizing about and fear of insertion of the needle during that procedure [225]. Baseline scores for the Pain Catastrophizing Scale in women with postpartum lumbopelvic pain have been presented elsewhere [11]. Three weeks after delivery the median PCS scores (±standard deviation (SD)) on PCS in the usual care group and in the experimental intervention group were 12.2 (9.8) and 11.2 (8.4), respectively.

Catastrophizing is an important part of the pain experience [122-123] and has been associated with various pain-related outcomes [165]. Still, knowledge about the possible role of catastrophizing with regard to lumbopelvic pain during and after pregnancy is lacking. There is also limited overall knowledge about how catastrophizing develops over time in different populations.

1.3 FEAR-AVOIDANCE BELIEFS

1.3.1 Fear-avoidance beliefs in general

Fear-avoidance beliefs form part of the cognitive-evaluative aspect in the pain experience, while avoidance behaviour belongs to the affective-motivational aspect. Elevated levels of fear-avoidance beliefs have been shown to lead to increased disability in general populations and in patients with acute or chronic low back pain [22, 30, 56, 68]. Fear-avoidance in the context of pain refers to the avoidance of movements or activities based on fear.

> *"Fear is the unpleasant feeling that arises as a normal response to realistic danger. Emotions such as fear are response syndromes that are not defined by any single feeling or behaviour but can be recognized by their typical evoking stimuli, response patterns, and courses. Each emotion has its own varying range of features. The features of fear are cognitive-subjective, motor-behavioural, and physiological"* [118].

"Avoidance" refers to *"the performance of a behaviour which postpones or averts the presentation of an aversive event"* [92]. For example, individuals in pain anticipate that certain activities will increase their pain and suffering and so no longer perform these activities. Both fear of pain and fear of movement/(re)injury can lead to avoidance behaviour [99, 111]. Moreover, avoidance may cause a decrease in both social and physical activities [110]. Fear-avoidance beliefs seem to be established early in the pain experience [56]. It seems that health care providers sometimes unintentionally enhance patients' pain-

related fear by using diagnostic terms that may be interpreted as threatening or as evidence of serious pathology [19]. When healthcare providers hold fear-avoidance beliefs themselves it can affect their treatment recommendations towards making more cautious ones, such as avoiding painful movements and restricting work activities, which in turn can fuel the patient's pain-related fear [82, 115, 164].

1.3.2 Fear-avoidance beliefs in pregnancy and postpartum

Fears of childbirth have been variously studied [58, 174-175]. The most common fears seem to be fears for the baby's health and fear of pain [58]. Fear of labour is strongly associated with fear of pain in general [175]. One study during pregnancy found a weak association between fear of injury and the work activities; pushing, and reaching above the head, as well as between fear of injury and fast pace of work [26]. Furthermore, fear of movement evaluated using the Tampa Scale for Kinesiophobia (TSK) was significantly higher among pregnant women with pelvic girdle pain than in healthy pregnant women [248]. Moreover there was a negative correlation between fear of movement and walking velocity among women with pelvic girdle pain. The TSK has also been used to evaluate fear of movement in women with postpartum lumbopelvic pain before and after interventions, including the usual care, a tailor-made programme with a biopsychosocial approach including self-management and different fear avoidance reducing techniques [10-11], and specific muscle training [70]. There was no difference in fear of movement between baseline and follow-up for any of the interventions.

Fear-avoidance beliefs can lead to avoidance behaviour and, furthermore, to disability and other negative consequences [242]. To prevent this, increased knowledge is essential about the possible role of fear-avoidance beliefs in lumbopelvic pain and in negative consequences due to lumboplevic pain, during and after pregnancy.

1.4 PHYSICAL ABILITY

1.4.1 Physical ability in general

Different models of disability have been discussed in the literature [12, 88, 119]. The medical model sees disability as a "personal problem" caused by trauma or another health condition which requires medical care or other "correcting" individual interventions. By contrast, the social model views disability as a socially created problem that is not accommodated due to a social environment, where social action is required to solve the problem. In 2001 the World Health Organization (WHO) presented the International Classification of Functioning, Disability and Health (ICF) [235] incorporating both the medical and the social models and adopting a biopsychosocial approach towards disability [218]. In their document, disability is seen as an interaction between an individual (with a health condition) and that individual's contextual factors (personal and environmental factors). Impairments are interactions affecting the body; activity limitations are interactions affecting the individual's actions or behaviour; and participation restrictions are interactions affecting a person's experience of life.

1.4.2 Physical ability in pregnancy and postpartum

Pregnancy in itself, especially late pregnancy, causes significant restrictions in physical activities [101]. However, studies show that pregnant women with lumbopelvic pain report a higher degree of disability than do pregnant women without lumbopelvic pain [72, 101]. About one-third of pregnant women state that having lumbopelvic pain results in serious difficulties with normal activities of daily life [101, 151]. It has been suggested that women with combined lumbar and pelvic pain have the most limited physical ability both in pregnancy and postpartum [72, 140]. Lumbopelvic pain in pregnancy has been associated with difficulties in walking, standing, sitting, forward bending and lifting [43, 101]. In one study, about 7% of the women with pelvic pain in pregnancy used crutches [168]. Furthermore, considerable difficulties have been reported with activities such as housekeeping, working and sexual life [131]. It has been indicated that pregnant women with a combination of pain and asymmetric laxity of the sacroiliac joints report more pain and more disability than do women with pain but with no asymmetric laxity [35]. For women with lumbopelvic pain during pregnancy, a decrease in disability was reported already at 3 months postpartum [43, 139]. However, for women with remaining postpartum pelvic girdle pain, standing still represented the greatest disability, followed by walking, cycling, sitting, and lying [126, 170]. Having low back pain alone resulted in less difficulty with housework and walking than having combined pain or pelvic pain alone [140].

Sick leave is common during pregnancy. In one study, 68% of all women had been on sick leave at sometime during pregnancy [131]. In addition, as many as 43% of all women reported being on sick leave for one or more periods of at least 7 days during the current pregnancy [211]. Lumbopelvic pain is the main reason for sick leave during pregnancy [210-211]. In a retrospective study as many as 21% of all women reported having been on sick leave during pregnancy due to lumbopelvic pain, and the average total period was 7.5 weeks [150]. Among women with persistent lumbopelvic pain at 6 months postpartum, 20% reported having been on sick leave for an average of 8 weeks due to lumbopelvic pain after pregnancy [132]. It has been suggested that women with postpartum pelvic girdle pain may have difficulties in returning to work [75].

There is an association between high pain intensity, high degree of disability, and increased number of days on sick leave for pregnancy-related lumbopelvic pain [101, 151]. However, the mechanisms behind disability due to pregnancy-related lumbopelvic pain are not clear and more research is needed. Furthermore, little is known about the influence of disability on health-related quality of life during pregnancy.

1.5 QUALITY OF LIFE

In the literature, general quality of life (QoL) and health-related quality of life (health-related QoL) are distinguished.

1.5.1 General quality of life

Quality of life (QoL) is an increasingly important issue in health. The most common way to describe QoL is to use four main categories: psychological factors, interpersonal relations, physical factors and social activities [24, 29, 37, 144]. Quality of life is individual to a person and stands for the person's own estimation of their life

situation. It also describes the life situation in a complex and global aspect. There are many factors affecting the QoL; among the most important are a person's expectations and to what extent they are fulfilled [192]. Aspects of life that most people consider important for their quality of life are having a positive psychological outlook and emotional well-being, having good physical and mental health and the physical ability to do the things they want to do, having good relationships with friends and family, participating in social activities and recreation, living in a safe neighbourhood with good facilities and services, having enough money to ensure a reasonable/the expected standard of living, and being independent [20]. According to Shin and Johnson QoL is *"the possession of resources necessary to the satisfaction of individual needs, wants and desires, participation in activities enabling personal development and self-actualization and satisfactory comparison between oneself and others"*, all of which are dependent on previous experience and knowledge [185]. Men and women have more or less the same idea of what is important for their desired QoL [51]. General trends in studies made in western countries show little or no difference between men and women in QoL when it is measured as life satisfaction from a global perspective [221].

1.5.2 Health-related quality of life

Health-related QoL, with the important components health and well-being [24], is considered one dimension of the wider QoL [20]. When a group of 3000 Americans were asked about quality of life, 95–98% considered health as important or very important for the concept QoL [51]. There seems to be a strong connection between a person's health status and their satisfaction with life, with poorer health resulting in a lower life satisfaction [221]. The concept of health contains the patient's subjective experience of the symptoms as well as objective factors such as high blood pressure or X-ray findings [97-98]. According to the WHO definition, health is *"a state of complete physical, mental and social well-being and not merely the absence of disease"* [234]. This definition has been criticized and is not used much today, but it still summarizes the components that are considered part of health-related QoL [41]. Therefore, health-related QoL is an important part of health research as it evaluates the patient's own experience of disease and symptoms and how they affect well-being and daily life [41]. Gender differences in health-related QoL can partly be explained by biological and social differences among men and women and are more pronounced in some age groups [84].

1.5.3 Health-related quality of life in pregnancy and postpartum

Studies show that health-related QoL decreases during pregnancy [83, 85] . The factors that most seriously affected the health-related QoL have been reported to be related to physical ability [83]. Furthermore, pregnant women with lumbopelvic pain have reported more negative affects on health compared with women without lumbopelvic pain [72, 131]. In one study, women with combined pain (i.e. lumbar and pelvic) reported the lowest health status [72]. Acupuncture treatment for pelvic pain during pregnancy significantly decreased disability and increased health-related QoL, estimated using the Euroquol-5 Dimension (EQ-5D) VAS [44]. Women with pelvic pain about one month after delivery reported a decreased health-related QoL, estimated with the Nottingham Health Profile (NHP), compared with women without pelvic pain [125]. Women with recurrent pain

postpartum reported better health than women with persistent lumbopelvic pain [132]. In addition, women with persistent pain had higher health care use.

Other factors besides lumbopelvic pain that may have a negative effect on health-related QoL during pregnancy are, e.g., sleep disturbances, depression [34, 181] nausea and vomiting [105], and risk for preterm delivery [120]. Factors that may effect postpartum health-related QoL are, e.g., mode of delivery [89, 120, 213] and depression [33, 181].

It has been indicated that lumbopelvic pain in pregnancy and postpartum has a negative effect on health-related QoL. The woman's own experience of how lumbopelvic pain affects her life is important and may be involved in non-recovery [69]. However, there is still a lack of knowledge about health-related QoL during pregnancy and about the possible role of pain, disability and psychological factors, in health-related QoL in the context of lumbopelvic pain and pregnancy.

1.6 THEORETICAL FRAME

This thesis is inspired by two theoretical models, the fear-avoidance model and the movement continuum theory of physical therapy.

1.6.1 The fear-avoidance model

The experience of a multi-professional team (clinicians such as psychologists, physiotherapists and occupational therapists) working with patients with low back and sciatic pain has resulted in the fear-avoidance model of exaggerated pain perception, as described by Letham et al. [111]. The central concept of the model is fear of pain and the model was an attempt to explain why some individuals develop chronic pain and how this might happen. There are two extreme responses to fear of pain, according to the model: confrontation and avoidance. Confrontation results in a reduction of fear, while avoidance maintains and aggravates fear. Often the response includes both confrontation and avoidance [111], and it has been suggested that the mixture of these two responses is influenced by the psychosocial context in which the painful event occurs [56]. The psychosocial context, in itself, is influenced by stressful life events, personal pain history, personal coping strategies for dealing with pain, and personality characteristics [111]. The model by Letham et al. [111] has been much discussed and elaborated on by different authors [159, 186, 220].

Years after Letham et al. designed the fear-avoidance model, Vlaeyen et al. [242] introduced the cognitive-behavioural model of fear of movement/(re)injury to try to explain how chronic back pain disability develops and is maintained. Most individuals do not interpret the pain as threatening, and therefore they will adopt appropriate behavioural restrictions gradually confronting painful movements, which promotes recovery. However, according to the model, pain may also be interpreted in a catastrophic way, as a serious threat. In this case, it will be assumed that activity will increase the pain or cause damage or re-injury. This will result in pain-related fear, an increased attention to pain, and in avoidance behaviour. Long-term avoidance of activity might lead to disability, disuse and depression. The term"disuse syndrome", describing a situation when avoidance behaviour persists beyond the expected healing time, was introduced by Bortz [18]. The "disuse syndrome" is the possible result of

physical inactivity and long-term avoidance and their subsequent impact on the musculoskeletal and cardiovascular system [18].
Both disuse and depression have been associated with decreased pain thresholds, which might promote the pain experience [121, 169]. The model by Vlaeyen et al. [242] has been much discussed and elaborated on [7, 22, 243]. The model has been further developed and now includes hypervigilance (increased attention to possible signals of threat), negative affectivity (increased attention to all forms of threat (internal and external) [230] and consequently, sensibility to develop specific fears (e.g. fear of pain), and threatening illness information (e.g. negative test results) [243]. For the fear-avoidance model by Vlaeyen and Linton [243] see Figure 1. The discussions about the model are still ongoing [236] and other constructs like self-efficacy have been introduced [245]. There is still a lack of knowledge about the relationships between the different elements of the model.

Health-related quality of life is not part of the present fear-avoidance models; however, research suggests an association between pain-related fear and disability on the one hand, and health-related QoL on the other [100, 156-157]. Furthermore, it has been indicated that catastrophizing has a negative effect on mental aspects of general health status and general health [182], and is more strongly associated with lower QoL than pain intensity [107].

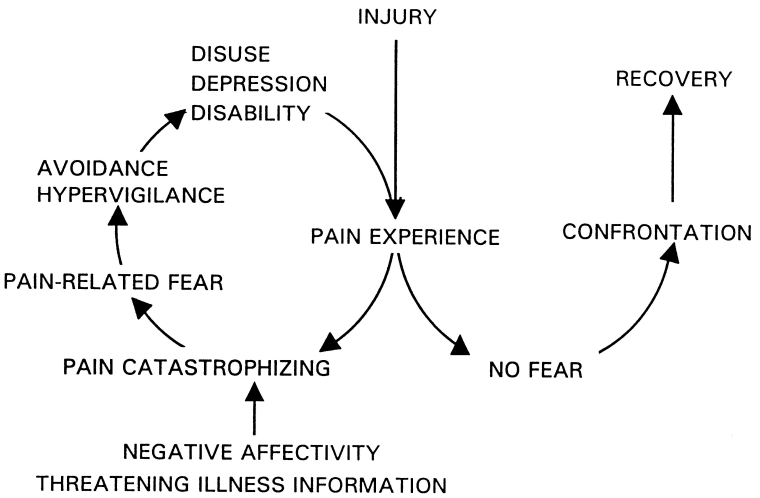

***Figure 1**. The fear-avoidance model as designed by Vlaeyen and Linton [243]. If pain, possibly caused by an injury, is interpreted as threatening (pain catastrophizing), pain-related fear evolves. This leads to avoidance behaviours, and hypervigilance to bodily sensations followed by disability, disuse and depression. The latter will maintain the pain experience thereby fueling the vicious circle of increasing fear and avoidance. In non-catastrophizing patients, no pain-related fear and rapid confrontation with daily activities is likely to occur, leading to fast recovery. Pain catastrophizing is assumed to be also influenced by negative affectivity and threatening illness information. This Figure has been reproduced with permission of the International Association for the Study of Pain® (IASP®). The Figure may not be reproduced for any other purpose without permission.*

1.6.2 The movement continuum theory of physical therapy

Consequences of the kind described in the fear-avoidance model are often present among patients visiting a physiotherapy practice. According to Cott et al. [28] who described the movement continuum theory of physical therapy, the aim of the physiotherapy is to minimize the differential between a patient's preferred and their current movement capacity. This is most often done by preventing a decrease in the current movement capacity or by maintaining or improving the current capacity.
In physiotherapy there needs to be an understanding of pathology and physiological functioning. However, an understanding is also required about the individual socio-psychological context and of the broader physical and social contexts. The physiotherapist must identify both internal and external factors involved in the restriction of performance of activities, and understand their interactions before being able to select and apply effective treatment strategies. In the model a biopsychosocial approach is used where movement levels on the continuum are influenced by physical, psychological, social and environmental factors. A combination of these factors determines the maximum achievable movement potential.

1.7 RATIONALE

The studies included in this thesis are intended to deepen the knowledge about lumbopelvic pain and associated contexts, during and after pregnancy. This will add to the understanding of possible mechanisms involved in restriction of performance due to lumbopelvic pain in pregnancy and related consequences. This may enhance the process of finding and applying targeted interventions so the affected women can achieve their preferred movement capacity. Increased knowledge may also help to identify women at risk for long-term pain and allow for preventive strategies to be applied at an early stage.

2 OVERALL AIMS

The overall aims of this thesis work were to study aspects of pain, catastrophizing, fear-avoidance beliefs, physical ability, and health related quality of life during and after pregnancy, among women with and without lumbopelvic pain.

2.1 SPECIFIC AIMS

Specific aims were–

- to examine and compare catastrophizing, fear-avoidance beliefs, physical ability and health-related quality of life in women with and without lumbopelvic pain at weeks 19–21 of pregnancy *(Study II)*;

- to compare physical ability and health-related quality of life in women with and without lumbopelvic pain at weeks 34–37 of pregnancy *(Study I)*;

- to study the influence of lumbopelvic pain and physical ability on health-related quality of life at weeks 34–37 of pregnancy *(Study I);*

- to evaluate whether catastrophizing, fear-avoidance beliefs, pain intensity, physical ability, and health-related quality of life, in weeks 19–21 of pregnancy, are determinants of self-reported lumbopelvic pain six months postpartum in women with and without lumbopelvic pain during pregnancy. *(Study III)*; and

- to explore how catastrophizing develops over time, and investigate the associations between catastrophizing on the one hand and lumbopelvic pain and level of physical ability postpartum on the other *(Study IV)*.

3 MATERIALS AND METHODS

3.1 DEFINITIONS AND TERMINOLOGY

In S*tudy I* the terms “back problems” and “back pain” are to be considered synonymous. They include problems from the back and/or anterior (symphysis) and/or posterior pelvic joints (sacroiliac joints). Later, this definition was further developed and in *studies II-IV* we used the following terms: “lumbopelvic pain” is defined as self-reported pain in the region of the lower back and/or anterior and/or posterior region of the pelvis. The expression “lumbopelvic pain” is used in the frame of this thesis when referring to the results of all the four studies *(studies I-IV)*.

Also, “health related quality of life” is defined as a person’s own experience and estimation of a situation where health and well-being are the most important components, and is rated using the Nottingham Health Profile [85, 240].

Furthermore, we have chosen to focus on the positive aspect, ability, instead of the more negative “disability”, consequently the term “physical ability”, as measured using the Disability Rating Index [177] (DRI), is used throughout the thesis when referring to the results of the included studies.

3.2 DESIGN AND DATA COLLECTION PROCEDURE

This thesis is based on two samples which resulted in two cross-sectional studies, one performed in women at weeks 19–21 of pregnancy *(Study II*) and the other in women at weeks 34–37 of pregnancy *(Study I),* and two longitudinal prospective studies *(studies III and IV)*. *Study III* included measurement occasions in weeks 19–21 of pregnancy and 6 months postpartum while *Study IV* included measuring occasions at weeks 19–21 and 34–37 of pregnancy and 6 months postpartum.

All women were recruited from midwife clinics. For sample I (*Study I)*, the women were recruited from two clinics in central Stockholm, while for sample II (*studies II-IV)* the study population were recruited from one clinic in the centre of Stockholm, two on the outskirts of Stockholm and two in a medium-sized town, with approximately 130,000 inhabitants. Both women with and women without lumbopelvic pain were included in the studies. Recruitment of participants is shown in Table 1.

***Table 1**. Recruitment of participants, and midwives involved, in the different demographic areas. The Table gives response rate (%), and number of women responding/total number of women receiving questionnaires.*

	Study I	**Study II**	**Study III**	**Study IV**
Centre of Stockholm (10 midwives)	85% 136/160	70% 84/120	86% 72/84	74% 62/84
Outskirts of Stockholm (5 midwives)		62% 93/150	84% 78/93	70% 65/93
Medium-sized town (5 midwives)		74% 147/200	84% 123/147	78% 115/147
Total	85% 136/160	69% 324/470	84% 273/324	75% 242/324

The pregnant women received information about the project and the voluntary nature of participation from the midwives. Those who agreed to participate received a cover letter together with the questionnaires. Participants were provided with pre-paid envelopes in which to return the questionnaires within a week.

Sample I (Study I)
Between September 1999 and February 2000 all women in the 34th-37th week of pregnancy, who attended two specific midwife clinics in the central Stockholm, were handed questionnaires by the midwives. They were asked to fill in the questionnaires at home and send them back to the researcher (C.O.) at the Department of Physiotherapy, Serafen, Stockholm, within a week.

Sample II (studies II-IV)
Participants were recruited from five midwife clinics in three different demographic areas during March 2005 to September 2006. In the Stockholm clinics women in the 19th-21st week of pregnancy were invited to join the study and if they agreed to participate were given questionnaires by the midwives. At the other clinics all women visiting before week 19 of pregnancy were invited by their midwife to participate and those who agreed to participate were sent questionnaires by one of the authors (C.O.). They were asked to fill in the questionnaires at home and send them back to the researcher (C.O.) at the Division of Physiotherapy, Karolinska Institutet, Huddinge, within a week. The women who returned the questionnaires at weeks 19–21 were sent questionnaires also at weeks 34–37 of pregnancy, and 6 months postpartum. If no response was obtained within approximately 10 days, a reminder was mailed.

3.3 PARTICIPANTS

Participants included in Study I
Altogether 160 women in the 34th–37th week of pregnancy were asked consecutively to participate in *Study I* and they all agreed. Out of these, 136 (85%) women completed *Study I*. For background data on participants included in the analyses see Table 2.

Participants included in Study II
Altogether 470 women in the 19th–21st week of pregnancy agreed to participate. Out of these, 324 (69 %) women completed *Study II* (Table 2 and Figure 2).

Participants included in Study III
The 324 women who answered the questionnaires in weeks 19–21 of pregnancy in *Study II* were included also in *Study III*. Out of these 84% answered also 6 months postpartum and completed *Study III* (Table 2 and Figure 2).

Participants included in Study IV
Out of the 324 women who answered the questionnaires in weeks 19–21 of pregnancy in *Study II*, 79% answered on all three occasions. The study sample consisted of the 75% who completed the Pain Catastrophizing Scale on all three occasions (Table 2 and Figure 2).

***Table 2**. Background data at inclusion, on participants who were analysed in studies I-IV. The participants included in studies III and IV are part of the sample in Study II.*

	Study I weeks 34–37 (n=136)	**Study II** weeks 19–21 (n=324)	**Study III**[4] weeks 19–21 (n=273)	**Study IV**[4] weeks 19–21 (n=242)
Lumbopelvic pain (%)	51	44	41	43
Age, mean (yrs) (SD)	31 (4)	31 (5)	31 (5)	31 (5)
Married/cohabiting (%)	97	96	97	96
Employed[1] (%)	91	84	86	84
Exercise before pregnancy[2], (%)	61	72	72	72
Previous pregnancies, (%)	50	56	55	55
Sick leave[3], (%)	41	4	5	5
Sick-leave due to lumboelvic pain, (%)	12	2	<1	<1

[1] *Working at present, full or part time (not including students, maternity leave, or sick leave)*
[2] *Minimum 45 minutes/week*
[3] *Sick leave, full and part time*
[4] *Part of the sample in Study II (n=324)*

3.3.1 Non-respondents and drop-outs

There is no known data about the 24 women who did not fill in the questionnaires in *Study I*.

Four hundred and seventy women agreed to participate in *Study II*. Twenty-four women declined participation, and four women had miscarriages between agreeing to participate and entering the studies. These 28 women are not included in the 470 women who were sent questionnaires. Of these 470 women, 324 (69%) completed the questionnaires in weeks 19–21 (Figure 2). Out of the 324 women, 86% completed them in weeks 34–37 and 84% at six months postpartum. There are no known data (e.g. age, previous pregnancies) for further analyses on the 146 women who did not fill in the questionnaires at weeks 19–21 of pregnancy for *(studies II-IV)*.

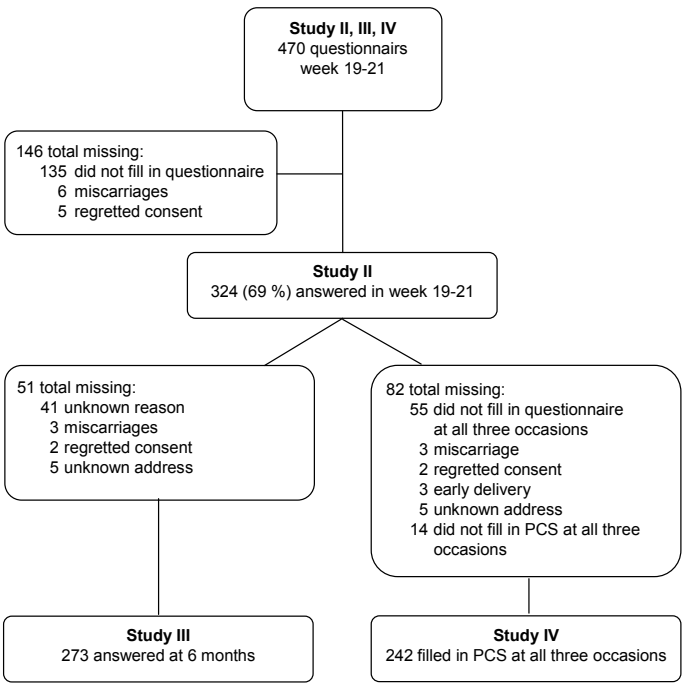

Figure 2. *Flow chart for studies II-IV showing number of women who were asked to participate and who answered at the three measurement occasions, number of women included in the analyses, and number of non-respondents and drop-outs.*

At weeks 19–21 *(Study II)* the response rate was 70% from women at the clinic in the centre of Stockholm, 62% from women enrolled at the clinics on the outskirts of Stockholm, and 73% from those at the clinics in the medium-sized town. In *Study III,* the response rates were 86%, 84% and 84% respectively, and in *Study IV,* 74%, 70% and 78% respectively.

3.4 INSTRUMENTS

All collected data were self-reported. As well as background questions a number of instruments were used in the studies, viz. the visual analogue rating scale for pain [23], the Disability Rating Index [177], the Pain Catastrophizing Scale [203], the Fear–Avoidance Beliefs Questionnaire [220], and the Nottingham Health Profile [85, 237, 240]. For instruments included in each study see Table 3. For response scales for the main outcomes in s*tudies I-IV* see Table 4.

Table 3. *Instruments used in the studies included in this thesis.*

Instrument	Study I	Study II	Study III	Study IV
Visual Analogue Scales (VAS), pain intensity	●	●	●	
Pain Catastrophizing Scale (PCS)		●	●	●
Fear-Avoidance Beliefs Questionnaire (FABQ)-activity		●	●	
Fear-Avoidance Beliefs Questionnaire (FABQ)-work		●		
Disability Rating Index (DRI)	●	●	●	●
Nottingham Health Profile (NHP) part I	●	●	●	
Nottingham Health Profile (NHP) part II	●	●		

3.4.1 Background questions

In s*tudies I-IV* the questionnaire included questions about: age, duration/stage of pregnancy, civil/marital status, employment/occupation, exercise, number of previous pregnancies, sick leave and reason for sick leave, and the onset, frequency and location of any lumbopelvic pain. In *Study I* a question about previous back problems in or outside pregnancy was included. In s*tudies II-IV* the questionnaire also included questions about maternity allowance, maternity leave Caesarean section and number of previous born children.

3.4.2 The main dependent outcomes

The main dependent outcomes were lumbopelvic pain, physical ability and catastrophizing.

For lumbopelvic pain a yes/no answer alternative was given and the two questions were, “At present, do you have pain in the anterior part of the pelvis/symphysis?” and “At present, do you have pain in the back/pelvis?”

If at least one of the questions had a yes answer the woman was classified as having lumbopelvic pain.

3.4.3 The visual analogue scale for rating of pain

At the time of filling in the questionnaire subjects rated pain intensity, i.e. present pain and maximum pain, on two VASs, each 100 mm long, with 0 mm indicating no pain and 100 mm indicating intolerable pain [87]. The scale has shown sufficient reliability and validity for acute pain [14] and low back pain [167].

3.4.4 The Pain Catastrophizing Scale

The Pain Catastrophizing Scale (PCS) is a 13-item self-report measure whose items reflect painful experiences. The scores indicate to what extent respondents have exaggerated negative thoughts [203]. Each item is rated on a 5-point Likert scale ranging from 0 ("not at all") to 4 ("all the time"). Total scores range from 0 to 52, with a higher score indicating a higher degree of catastrophizing. The PCS, conceptualizes catastrophizing as a single construct with three dimensions, each with a separately summed score [147, 203]: rumination (four items, maximum score 16), magnification (three items, maximum score 12) and helplessness (six items, maximum score 24). The PCS is found to be a valid and reliable instrument for measuring catastrophizing in individuals with chronic low back pain [60, 129, 222].

3.4.5 The Fear-Avoidance Beliefs Questionnaire

The Fear-Avoidance Beliefs Questionnaire (FABQ) focuses on respondents' beliefs about how physical activity and work affect their low back pain [220]. It is a 16-item, two factor, self-report questionnaire in which the items are scored on a 7-point Likert scale ranging from 0 ("strongly disagree") to 6 ("strongly agree"). Two sum scores are obtained, one for physical activity (four items, maximum score 24) and one for work (seven items, maximum score 42). High scores indicate increased levels of fear-avoidance beliefs. The FABQ has shown good psychometric properties, when tested on patients with low back pain [189, 207]. In *Study II* the FABQ-activity and FABQ-work scales were both used. In *Study III* the FABQ-activity scale was used.

3.4.6 The Disability Rating Index

The Disability Rating Index (DRI) consists of twelve visual analogue scales which allow respondents to rate their ability to perform daily physical activities [177]. The twelve activities are dressing (without help), outdoor walks, climbing stairs, sitting for a longer time, standing bent over a sink, carrying a bag, making a bed, running, light work, heavy work, lifting heavy objects and participating in exercise/sports. The scales range from 0 mm ("can perform without difficulty") to 100 mm ("cannot perform at all"). The mean score of the twelve ratings is used as a disability rating index, DRI. The index has shown high reliability and validity for different populations (e.g. low back pain) [177].

3.4.7 The Nottingham Health Profile

The Nottingham Health Profile (NHP) [85] is a generic health status instrument for assessing QoL. In this case, "QoL" refers to health-related quality of life, in which health and well-being are the most important components [84, 240]. The NHP instrument is divided into two parts [84, 240]. Part I consists of 38 statements which convey limitations or distress in six dimensions: emotional reactions, sleep, energy, pain, physical mobility

and social isolation. Summed scores (0–100) are calculated for each dimension and the total mean score is then calculated for the part I. A high score indicates low health-related QoL. Part II of the NHP covers the seven aspects of life that are most affected by respondents' health states: occupation, ability to perform jobs around the house, social life, home relationships, sexual life, hobbies, and holidays. A yes/no answer indicates which areas are currently affected. The NHP was developed for use in primary care settings and has been shown to have good validity and reliability [84, 237, 240].

Table 4. *Response scales for the main outcomes in studies I-IV and cut-off points for the instruments used in studies III and IV. The cut-off points for PCS and NHP are based on the total score and for DRI on the total index.*

Variable	**Instrument/ measure**	**No. of items**	**Response format**	**Cut-off points** *(studies III and IV)*
Lumbopelvic pain	Background questionnaire	2	yes/no	
Pain intensity	VAS	2	0–100 mm	
-present pain				≤33 / >33
-maximum pain				≤69 / >69
Catastrophizing	PCS	13	5-point Likert scale	≤17 / >17
Fear-avoidance beliefs-activity	FABQ-activity	4	7-point Likert scale	≤12.3 / >12.3
Fear-avoidance beliefs-work	FABQ-work	7	7-point Likert scale	
Physical ability	DRI	12	0–100 mm	≤25 / >25
Health-related quality of life	NHP part I	38	yes/no	≤13.6 / >13.6
Health-related quality of life	NHP part II	7	yes/no	

DRI = Disability Rating Index; FABQ = Fear-Avoidance Beliefs Questionnaire; NHP = Nottingham Health Profile; PCS = Pain Catastrophizing Scale; VAS = visual analogue scale

3.5 DATA TREATMENT AND STATISTICAL ANALYSES

An overview of the statistical methods is given in Table 5. Analyses in S*tudy I* were preformed using Statistica for s*tudies II-IV* SPSS 14.0–17.0 (SPSS Inc., Chicago, IL, USA) was used.

In *Study II,* missing values for the Fear-Avoidance Beliefs Questionnaire were replaced by the median of all known values for that attribute. For FABQ-activity 13% were missing values and for FABQ-work 14%. Calculations were made both with and

without median imputation. After removing all data on women who did not answer the FABQ there were significant differences ($p \leq 0.01$) between the women with (n=140) and without (n=143) lumbopelvic pain in all variables where significant differences were found when comparing all women in the two groups (n=141; n=183). No difference was seen in the analysis with and without median imputation for missing values. Missing values for other measures were few and were not replaced.

Dichotomizing (Study III and IV)
In *Study III* the variables PCS (total score), FABQ activity scale, DRI (total index), and NHP (total score) were dichotomized using the highest tertile of the mean score for the whole sample during pregnancy (n=324) as cut-off point [161]. Pain intensities (rated using the VAS) at present and at maximum were dichotomized using the highest tertile of the mean score for the women with lumbopelvic pain (n=141). For cut-off points used in s*tudies III and IV,* see Table 4.
In *Study III,* background factors were dichotomized and tested for confounding. The questions on married/cohabiting, exercise before pregnancy (minimum 45 minutes/week), exercise at present (minimum 45 minutes/week), sick leave (full-time and part-time), and Caesarean section at delivery had yes/no answer alternatives, and were dichotomized. Occupation (students included, maternity leave and sick leave not included) was dichotomized into sedentary versus non-sedentary work. Previous pregnancies was dichotomized into first pregnancy versus having been pregnant before; onset of pain into onset of pain before week 12 of pregnancy versus onset of pain at week 12 or later; and (for the population with lumbopelvic pain) frequency of pain was dichotomized into experiencing pain occasionally versus experiencing pain daily or experiencing constant pain. In *Study IV* catastrophizing was dichotomized using the highest tertile of the mean score [161], 17, for the whole sample in weeks 19–21 of pregnancy (n=324) as cutoff point (≤ 17 or >17), here referred to as non-catastrophizing/-ers (≤ 17) and catastrophizing/-ers (>17). Four groups of women were formed on the basis of reported frequency of catastrophizing during and after pregnancy: non-catastrophizers, catastrophizing once, catastrophizing twice, and catastrophizers (Figure 4, on page 26). *(Study IV).*

Differences between groups (Study I-IV)
For comparison between two groups, the Student's *t*-test was used for continuous, normally distributed data (age, pregnancy week) and the Mann-Whitney *U*-test for ordinal or not normally distributed data (instruments). Possible differences based on nominal data were verified with the chi-square test (background factors e.g. exercise, sick-leave). If 20 % of the expected cell frequencies were <5, the Fisher's exact test was used. In the additional analyses, for comparison between women in sample II the Wilcoxon signed-rank test was used.

For comparison between three or more groups in S*tudy IV,* the Kruskal-Wallis test was used for ordinal or not normally distributed data. In s*tudies I and II,* p-values less then 5% ($p<0.05$) were regarded as statistically significant. In *Study III and IV* $p \leq 0.05$ was considered statistically significant.

Correlations (studies I and III)
Relationships between the instruments used (ordinal data), both subscores and total scores, were tested with Spearman's correlation coefficient. The correlation was interpreted according to Colton's guidelines [27]: correlations ranging from 0.00 to 0.25 indicate little or no relationship; those from 0.25 to 0.50 suggest a fair degree of relationship; values of 0.50–0.75 have a moderate to good correlation; and values >0.75 are considered to have a good to excellent correlation[27].

Cox proportional hazards model (Study III)
Cox proportional hazards (PH) model with a constant time variable was used to identify predictors for lumbopelvic pain 6 months after delivery for the women with and without lumbopelvic pain separately. Hazard ratios (HRs) and 95% confidence intervals (95% CI) were calculated for each potential predictor. The abovementioned background factors were tested for confounding, one at a time. Exposures that turned out to be associated (i.e. $p<0.10$) with the outcome of interest (lumbopelvic pain 6 months after delivery) were used in multiple models for the women with and without lumbopelvic pain separately. Potential interaction was tested for the included variables. Confounders were considered significant if they were associated with the outcome ($p<0.10$) or if the B-coefficient of the exposures changed by 10% or more. Confounders and interactions with p-values >0.10 were excluded from the final model. Reduction of the number of predictors was based on the criteria above. Hazard ratios were considered significant if $p\leq0.05$.

Table 5. *Statistical methods used in the different studies in this thesis work*

Methods	Study I	Study II	Study III	Study IV
Non-parametric				
Chi-square test (Fisher's exact test)	●	●	●	●
Kruskal-Wallis test				●
Mann-Whitney *U*-test	●	●	●	●
Spearman's correlation coefficient	●	●		
Parametric				
Student's *t*-test	●	●	●	●
Regression				
Cox proportional hazards model			●	

3.6 ETHICS

Approval for *Study I* was obtained from the Local Ethics Committee. Approval of s*tudies II-IV* was obtained from the Regional Ethics Committee, Karolinska Institutet, Stockholm. All participants received written and oral information about the studies. Participation in the studies was voluntary. Verbal informed consent was obtained from all participants.

The pregnant women in the medium-sized town had a scheduled visit at the midwife clinic early in pregnancy, at which time they were asked about participation in s*tudies II-IV*. The women who gave consent were sent questionnaires in weeks 19–21 of pregnancy. However, by this time some of them had miscarried. On being informed of a miscarriage the midwives in question passed on the information to the researcher, which resulted in no questionnaires being sent out. Unfortunately the midwives did not always get information about a spontaneous miscarriage; therefore, a few women received questionnaires after they had miscarried.

4 RESULTS

This section presents the main results. The results are presented following the course of pregnancy. Detailed results for each study can be found at the end of the thesis.

4.1 LUMBOPELVIC PAIN

(Study II) In weeks 19–21, the 324 women who responded were divided into two groups: women with lumbopelvic pain and women without lumbopelvic pain, 44% and 56% respectively. For the women with lumbopelvic pain, the median value for rating pain was 20 mm (range 0–75 mm) for pain at present and 56 mm (range 8–100 mm) for maximum pain (Figure 3).

(Study I) In weeks 34–37, the 136 women who answered the questionnaires were divided into women with and women without lumbopelvic pain, 51% and 49% respectively. For women with lumbopelvic pain, the median value for the rating of pain intensity was 18 mm (range 0-68) for pain at present and 59 mm (range 11–97mm) for pain at its maximum (Figure 3).

(Additional analyses) For sample II, women in weeks 34–37 of pregnancy (additional data, not included in s*tudies I-IV*) rated significantly higher pain intensity at present (p=0.000) and for maximum pain (p=0.000) than in weeks 19–21 *(Study II)*. In addition, in weeks 34–37 of pregnancy there were differences between the women in sample I *(Study I)* and the women in sample II (n=280, additional data, not included in *Study I-IV*). The women in sample II reported a higher prevalence of lumbopelvic pain (p=0.015), and a higher pain intensity for present pain (p=0.014) and worst pain (p=0.010) compared to the women in sample I. (Figure 3).

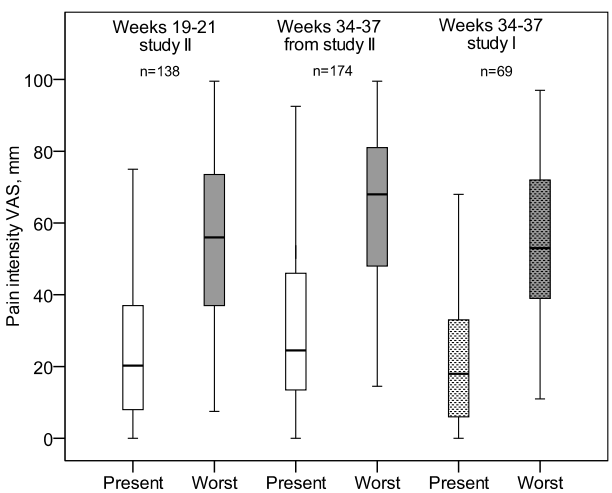

***Figure 3**. Boxplots showing pain intensity at present and at maximum for women with lumbopelvic pain at weeks 19–21in sample II (Study II) and weeks 34–37 of pregnancy in sample I (Study I), and for the women in weeks 34–37 of pregnancy in sample II (additional data, not included in Study I-IV). The median value, the quartiles, ranges are shown. High scores indicate higher pain intensity.*

(Study III) Of the 324 women in sample II, 84% answered both in weeks 19–21 and six months after delivery. Forty-one percent had lumbopelvic pain during pregnancy while 59% did not, and 29% reported lumbopelvic pain 6 months after delivery. Of the 112 respondents with lumbopelvic pain during pregnancy, 38% reported postpartum lumbopelvic pain while 22% of those not reporting pain during the pregnancy reported pain after. Ratings for pain intensity in weeks 19–21 were not linked to lumbopelvic pain 6 months postpartum in any of the Cox proportional hazards models.

(Study IV) Four groups were identified postpartum based on the reported frequencies of catastrophizing on the three measurement occasions during and after pregnancy. The prevalences of lumbopelvic pain in the different groups were 24%, 42%, 38% and 36%, respectively. There was no significant difference in reported prevalence of lumbopelvic pain (p=0.068) between the four groups. (Figure 4).

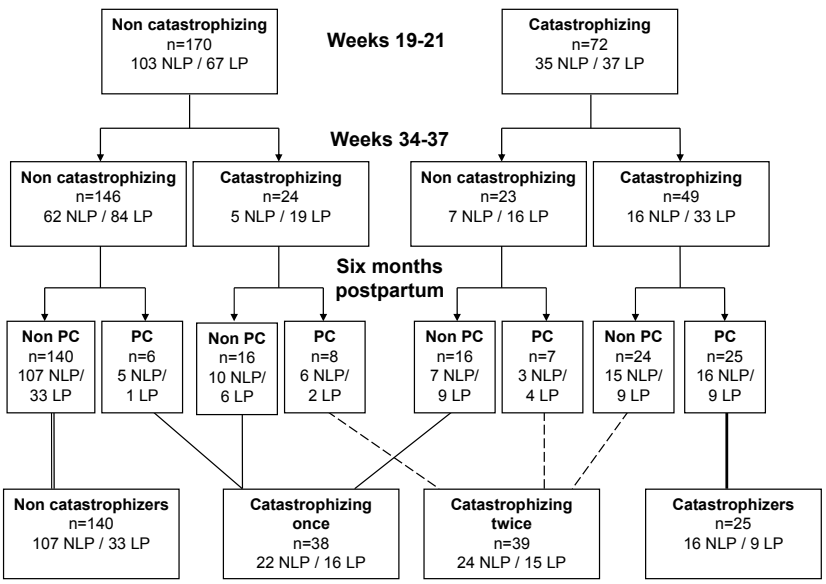

Figure 4. *Flowchart over total number of women catastrophizing (PC; above the highest tertile, >17) and non catastrophizing (non PC; below or equal to the highest tertile, ≤17) at weeks 19–21 and 34–37 of pregnancy and 6 months postpartum, with lumbopelvic pain (LP) and without lumbopelvic pain (NLP). Four groups were formed on the basis of reported frequency of catastrophizing during and after pregnancy.*

4.2 CATASTROPHIZING

(Study II) In weeks 19–21, women with lumbopelvic pain reported significantly more exaggerated negative thoughts on the Pain Catastrophizing Scale, in both total score ($p<0.001$) and the different dimensions, of rumination ($p=0.002$), magnification ($p=0.015$) and helplessness ($p<0.001$), compared with women without lumbopelvic pain. (Figure 5).

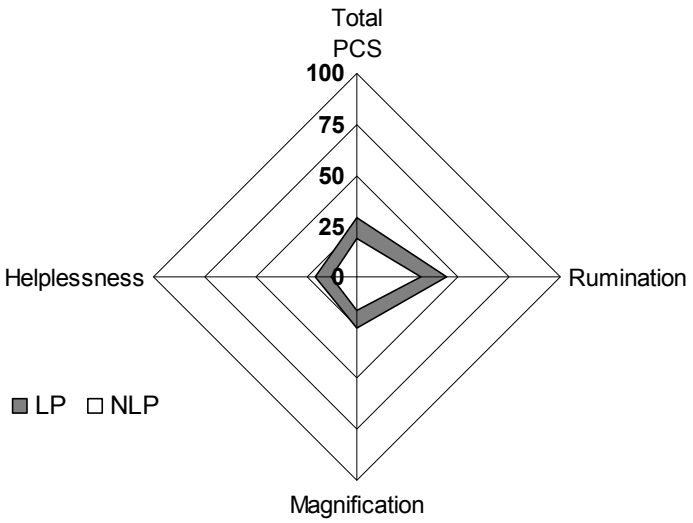

Figure 5. *Catastrophizing in women with (LP) and without lumbopelvic pain (NLP) in weeks 19–21 of pregnancy (Study II). Percentages of maximum scores are shown for the subscales and the total score for the Pain Catastrophizing Scale (PCS). High scores indicate higher levels of catastrophizing.*

(Study III) For women with lumbopelvic pain in weeks 19–21 the PCS-total score (HR=2.05, 95% CI=1.1–4.0) turned out to be associated with lumbopelvic pain 6 months postpartum, after adjusting for exercise during pregnancy and onset of lumbopelvic pain. The risk increased with an increasing total PCS score. (Table 6).

(Study IV) Based on the reported frequencies of catastrophizing during and after pregnancy, four groups were identified postpartum. The groups, which include women both with and without postpartum lumbopelvic pain, are: Group A: non-catastrophizing subjects (n=140); Group B: women who catastrophized once (n=38); Group C: women who catastrophized at two measuring occasions (n=39); and Group D: catastrophizing women (n=25). (Figure 4).

***Table 6**. Initial and final Cox regression analysis of women with lumbopelvic pain during weeks 19–21 of pregnancy (n=112). Hazard ratios (HRs) showing the risk of experiencing lumbopelvic pain 6 months postpartum, with 95% confidence intervals (95% CIs) and p-values.*

	Initial model		**Final model**	
Variable, cut-off at weeks 19–21	HR[1] (95% CI)	p-value	HR[1] (95% CI)	p-value
PCS-total score >17	1.98 (0.99–3.96)	0.052	2.05 (1.06–3.98)	0.034
DRI-total index >25	2.14 (0.93–4.89)	0.072	2.29 (1.10–4.74)	0.026
NHP-total score >13.6	1.15 (0.50–2.69)	0.739		

[1] *Adjusted for exercise during pregnancy and onset of lumbopelvic pain*
DRI = Disability Rating Index; NHP = Nottingham Health Profile; PCS = Pain Catastrophizing Scale

4.3 FEAR-AVOIDANCE BELIEFS

(Study II) In weeks 19–21 women with lumbopelvic pain had significantly (p<0.001) more fear-avoidance beliefs about physical activity and work compared with women without lumbopelvic pain. (Figure 6).

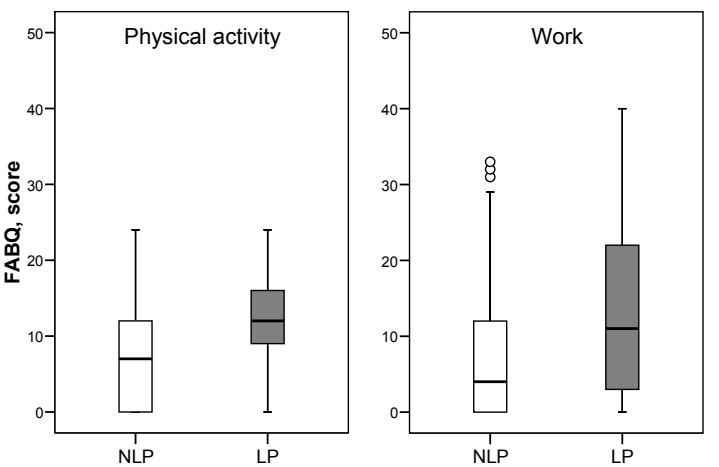

***Figure 6.** Boxplots showing fear-avoidance beliefs in women with (LP) and without lumbopelvic pain (NLP) at weeks 19–21 of pregnancy (Study II). The median Fear-Avoidance Beliefs Questionnaire (FABQ) value, the quartiles, range, and outliers are shown. High FABQ scores indicate more fear-avoidance beliefs.*

(Study III) Ratings on the FABQ-activity subscale at pregnancy weeks 19–21 were not linked to lumbopelvic pain 6 months postpartum in any of the Cox proportional hazards models.

4.4 PHYSICAL ABILITY

(Study II) At pregnancy weeks 19–21 the total index and the rating on each of the twelve activity scales in the Disability Rating Index were significantly higher ($p \leq 0.001$), indicating more limited physical ability, for women with than for women without lumbopelvic pain. *(Study I)* Also at weeks 34–37 the total index and the rating on all the twelve activity scales were significantly ($p<0.05$) higher for women with lumbopelvic pain. (Figure 7).

(Additional analyses) For sample II, women in weeks 34–37 of pregnancy (n=280, additional data, not included in s*tudies I-IV*) had significantly ($p<0.01$) more limited physical ability (DRI-total index) than in weeks 19–21 of pregnancy *(Study II)*.

(Additional analyses) In weeks 34–37 of pregnancy, the only significant difference between women with lumbopelvic pain in sample I *(Study I)* and sample II (additional data, not included in *Study I-IV*) was seen for the subscale dressing ($p=0.031$) (DRI). The women with lumbopelvic pain in sample II reported more limited physical ability for dressing, compared with women with lumbopelvic pain in sample I. For women without lumbopelvic pain there were no differences in physical ability. (Figure 7).

(Study III) For women with lumbopelvic pain in weeks 19–21 the total DRI rating (HR=2.29, 95% CI=1.1-4.7) was associated with lumbopelvic pain 6 months postpartum, after adjusting for exercise during pregnancy and onset of lumbopelvic pain. The risk increased with an increase in the total DRI rating. (Table 6).

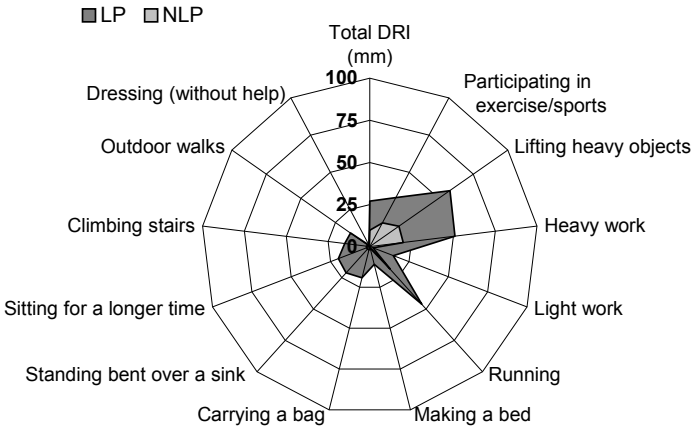

Figure 7A.

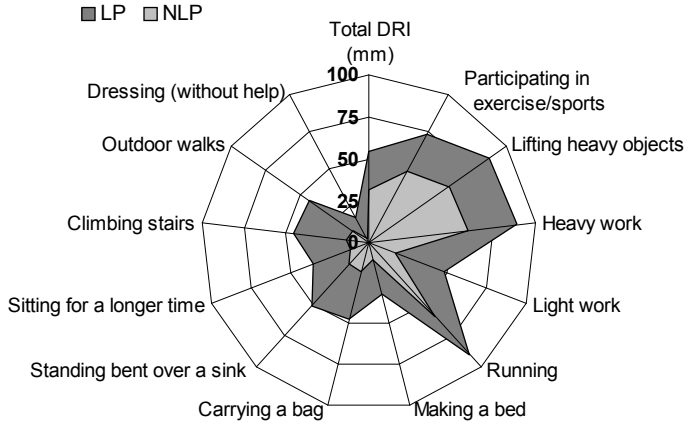

Figure 7B.

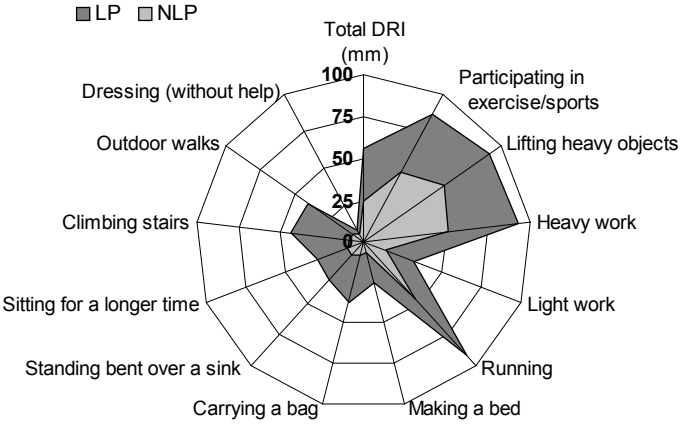

Figure 7C.

***Figure 7** (page 30). Physical ability in women with (LP) and women without lumbopelvic pain (NLP). The median values for the Disability Rating Index (DRI) and the subscales are shown. High scores indicate more limited physical ability. Fig.7A. Women at weeks 19–21 of pregnancy in sample II (Study II). Fig.7B. Women at weeks 34–37 of pregnancy in sample II (additional data). Fig.7C. Women at weeks 34–37 of pregnancy in sample I (Study I).*

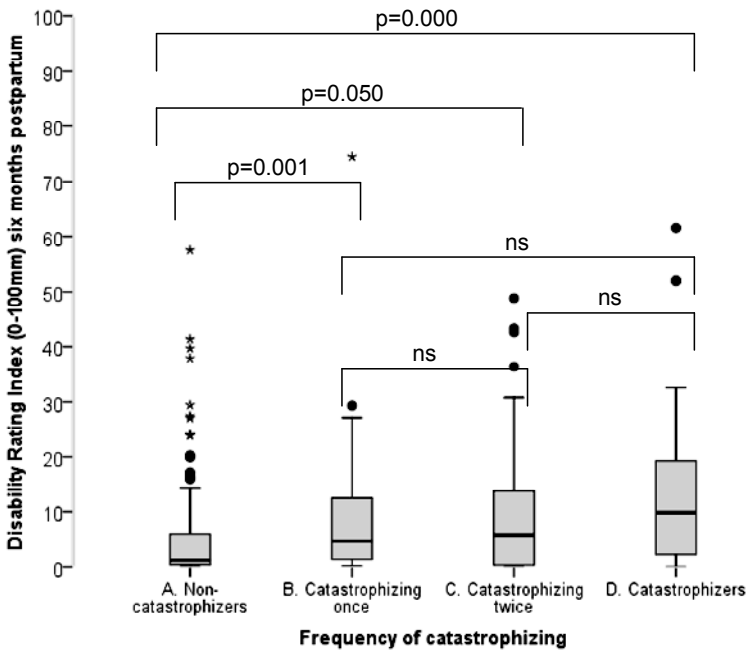

***Figure 8.** Box plots displaying physical ability at 6 months postpartum for the four groups, based on frequency of catastrophizing during and after pregnancy. The median value, quartiles, range, outliers and extreme outliers are shown. The groups, which include women both with and without postpartum lumbopelvic pain, are: Group A: non-catastrophizing subjects (n=140); Group B: women who catastrophized once (n=38); Group C: women who catastrophized at two measuring occasions (n=39); and Group D: catastrophizing women (n=25). The scores for the Disability Rating Index (DRI) (0-100 mm) are given in millimetres. High scores indicate low physical ability.*

(Study IV) Women who catastrophized on one or more of the three measurement occasions (groups B–D) reported significantly (p=0.000) more limited physical ability postpartum compared with non-catastrophizing women (group A). (Figure 8).

4.5 HEALTH-RELATED QUALITY OF LIFE

(Study II) At weeks 19–21 the total score for the Nottingham Health Profile, part I was significantly higher ($p<0.001$), indicating a lower health related QoL for women with lumbopelvic pain compared with women without lumbopelvic pain. The differences were also significant ($p\leq0.003$) for all six subscales (emotional reactions, sleep, energy, pain, physical mobility, and social isolation) (Figure 9). When comparing the seven aspects of life (NHP, part II) that are found to be most affected by a person's state of health, women with lumbopelvic pain had significantly ($p<0.001$) higher percentages of "yes" replies (%) for adverse effects on occupation, ability to perform jobs around the house, social life, home relationships, sexual life, hobbies and holidays ($p=0.002$).

(Study I) As at weeks 19–21, at weeks 34–37 the total score for the NHP, part I, was significantly higher for women with lumbopelvic pain ($p=0.000$). The differences were also significant regarding the subscales sleep ($p=0.003$), energy ($p=0.024$), pain ($p=0.000$), and physical mobility ($p=0.000$). There were no statistically significant differences between the subscales emotional reactions and social isolation (Figure 9). *(Study I).* The women with lumbopelvicpain at pregnancy weeks 34–37 had significantly ($p\leq0.01$) higher percentages of "yes" replies for adverse effects on occupation, ability to perform jobs around the house, social life, and hobbies. There were no differences between the other aspects, viz. home relationships, sexual life, and holidays.

(Additional analyses) For sample II, women in weeks 34–37 of pregnancy (n=280, additional data, not included in s*tudies I-IV*) had a significantly ($p\leq0.007$) lower health-related quality of life (NHP-total score) than in weeks 19–21 of pregnancy *(Study II)* for the total score and all subscales except for emotional reactions ($p=0.468$).

(Additional analyses) In weeks 34–37 of pregnancy the only difference in health-related QoL between the women with lumbopelvic pain in sample I (*Study I)* and the women with lumbopelvic pain in sample II (additional data, not included in *Study I-IV*) was seen for the subscale energy. The women in sample II was significantly ($p=0.012$) more affected compared with the women in sample I. For women without lumbopelvic pain there were differences for the subscales emotional reactions ($p=0.021$) and energy ($p=0.002$), and the total score ($p=0.003$). The women in sample I were more affected compared with women in sample II. (Figure 9).

Figure 9 *(page 33)**.** Health-realted quality of life in women with (LP) and women without lumbopelvic pain (NLP). Median values are shown for the Nottingham Health Profile, total score and subscales. High scores indicate lower health-related quality of life. Fig.7A. Women at weeks 19–21 of pregnancy in sample II (Study II). Fig.7B. Women at weeks 34–37 of pregnancy in sample II (additional data). Fig.7C. Women at weeks 34–37 of pregnancy in sample I (Study I).*

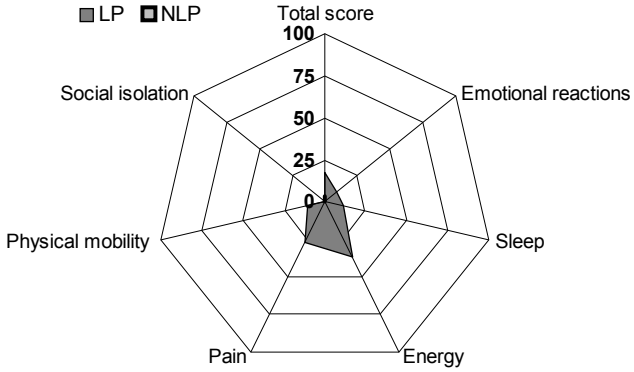

Figure 9A.

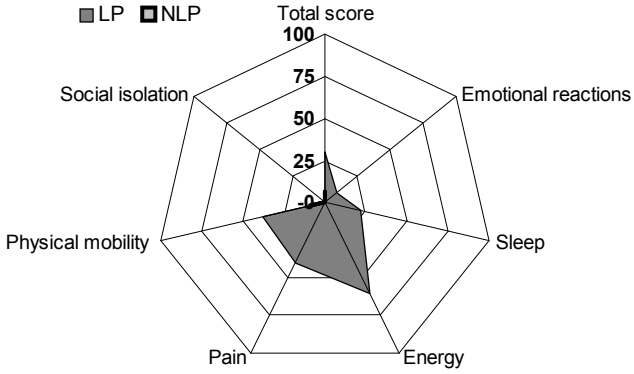

Figure 9B.

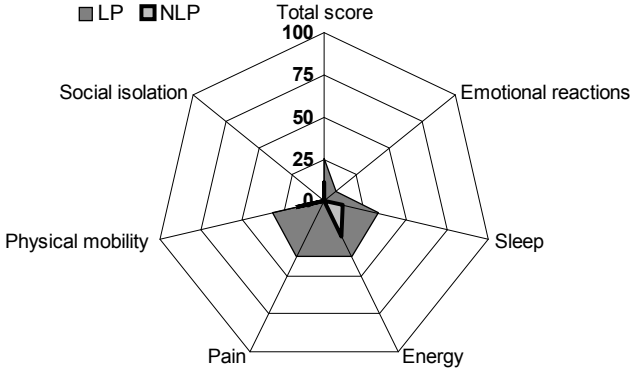

Figure 9C.

(Study III) For women without lumbopelvic pain at weeks 19–21, there were no associations between the main variables and postpartum lumbopelvic pain. (Table 7).

***Table** 7. Simple Cox regression analysis for women without lumbopelvic pain at weeks 19–21 of pregnancy (n=161). Hazard ratios (HRs) showing the risk of experiencing lumbopelvic pain 6 months postpartum, with 95% confidence intervals (95% CIs) and p-values.*

Variable	Cut-off in weeks 19–21	Number of women without lumbopelvic pain in weeks 19–21 (n=161)		HR[1]	95% CI	p-value
		Total	Pain six months postpartum			
PCS-total score	≤17	114	27	1.00		
	>17	42	9	0.76	0.34–1.68	0.499
FABQ-activity	≤12.3	100	26	1.00		
	>12.3	25	5	0.68	0.25–1.81	0.438
DRI-total index	≤25	135	29	1.00		
	>25	25	7	1.30	0.56–3.02	0.545
NHP-total score	≤13.6	139	27	1.00		
	>13.6	22	9	2.24	0.99–5.07	0.054

[1] *Adjusted for exercise before pregnancy and occupation*
DRI = Disability Rating Index; FABQ = Fear-Avoidance Beliefs Questionnaire; NHP = Nottingham Health Profile; PCS = Pain Catastrophizing Scale

4.6 CORRELATIONS

(Study I) At weeks 34–37 the correlation between physical ability (DRI-total index) and quality of life (NHP-total score) for the whole group of pregnant women, with and without lumbopelvic pain, was good (r=0.76). When dividing the whole group in lumbopelvic pain (r=0.73)/no lumbopelvic pain (r=0.62) the correlation was moderate to good. The strongest correlations among women with lumbopelvic pain were seen between physical ability (DRI-total index) and the subscales (NHP) physical mobility, pain and energy. For women without lumbopelvic pain the best correlations were seen between physical ability (DRI-total index) and the subscales (NHP) physical mobility and energy.

5 DISCUSSION

5.1 FINDINGS

5.1.1 Main findings

The studies in this thesis show that the women with lumbopelvic pain during pregnancy had more limited physical ability and a lower health-related quality of life compared with those without lumbopelvic pain. The same women also reported higher levels of catastrophizing and fear-avoidance beliefs in pregnancy weeks 19–21. High levels of catastrophizing and limited physical ability, in pregnant women with lumbopelvic pain, doubled the risk for postpartum lumbopelvic pain. The majority of women reported non-catastrophizing both during pregnancy and postpartum while about 10% catastrophized on all three measurement occasions. Surprisingly, for 32% of the women catastrophizing varied over time. Women catastrophizing on one or more of the three measurement occasions had limited physical ability postpartum compared with non-catastrophizing women.

5.1.2 Relation to the theoretical models

The fear-avoidance model [243] may be a possible way to explain future pain and disability in pregnant women with lumbopelvic pain. We found catastrophizing and fear-avoidance beliefs among women with lumbopelvic pain in pregnancy (*Study II).* Moreover, there was a double risk for postpartum lumbopelvic pain in pregnant women with pain in combination with high catastrophizing or limited physical ability *(Study III).* Furthermore, women who catastrophized on at least one of the measurement occasions had a lower physical ability postpartum *(Study IV).* In the model [243], catastrophizing is seen as a precursor to pain-related fear and avoidance behaviour, which may lead to increased pain and disability. However, in *Study III* no association was found between fear-avoidance beliefs during pregnancy and postpartum lumbopelvic pain. This may be because catastrophizing and fear of pain are closely related constructs and because catastrophizing predicts pain through a direct path, independent of fear [202]. The possible relationships between the elements included in the model are unclear and need to be studied further.

According to the movement continuum theory of physical therapy [28], increased knowledge about possible mechanisms involved in restriction of performance, and thereto related consequences provides better possibilities for physiotherapists to apply appropriate interventions and treatment strategies to help the women reach their preferred movement capacity, and to prevent future pain and disability.

It has been proposed that goals such as pain reduction, functional improvement and the reversal of dysfunctional beliefs and emotions should all be included in therapy for back pain [62]. In one study, physical training, cognitive-behavioural therapy, and a combination of the two decreased the levels of catastrophizing, pain and disability at follow-up for patients with low back pain, compared with the control group [187]. In addition, it has been suggested that interventions reducing fear of pain and disability early in the process may increase participation in daily and social activities [209].

The origin and course of back pain in general are influenced by a multitude of factors, which makes it difficult to ascertain determinants for the occurrence and persistence of low back pain and related disability [112, 227]. In addition, the prognostic value and impact of each single factor is usually low [112, 227]. It seems that also lumbopelvic pain during and after pregnancy is likewise influenced by many different factors [249] and it can be assumed that with lumbopelvic pain, too, each factor accounts for only a small part of the variance and that different factors interact with each other. There are other factors that may be of importance for lumbopelvic pain but that are not included in this thesis. For example, low self-efficacy [38, 54] and distress [65, 67] have been associated with future pain, disability and non-recovery in populations with low back pain. It would have been interesting to evaluate their possible role also in the context of lumbopelvic pain and pregnancy. Furthermore, depression is common among individuals with long-term pain [32, 138] and the construct is also included as a possible consequence, together with disability and disuse, in the fear-avoidance model [243]. The prevalence of depression in pregnancy has been reported to be 7–26% while postpartum it is10–15% [137, 173]. It has been indicated that pregnant women with pelvic instability have more depressive symptoms [224], and one study showed that women with postpartum lumbopelvic pain had far more depressive symptoms than women without pain [71]. Moreover, depressive mood seems to be involved in the transition from acute to chronic pain [162]. Including an instrument for depression in this thesis would probably have added to our results. People are different and it may be that diverse factors have an influence on, or predispose for, future pain and disability in different individuals. It may even be that the impact from diverse factors varies over time.

5.1.3 Lumbopelvic pain during and after pregnancy

A multitude of expressions are used for pain in the region of the lower back and/or pelvis during pregnancy and postpartum [249]. In *Study I* a definition was used that included problems from the back and/or anterior (symphysis) and/or posterior pelvic joints (sacroiliac joints).The two expressions “back problems” and “back pain” were to be considered synonymous. At the time that *Study I* was performed the review article [249] that proposed the use of the term “lumbopelvic pain” had not yet been published. However, this first definition was further developed, and in s*tudies II-IV* the following terminology was used: “lumbopelvic pain” is defined as self-reported pain in the region of the lower back and/or anterior and/or posterior region of the pelvis. The latter definition is more in line with the ones proposed by Wu et al. [249]. However, since it was not within the scope of this thesis to classify pain into different types, or according to location, no distinction was made between low back and pelvic pain. Even if the vast majority of women included in the studies reported onset of lumbopelvic pain during pregnancy we can not be sure that the pain was pregnancy-related since no anamneses or clinical examinations were performed. Therefore the term “pregnancy-related” was not included in our definition.

At weeks 19–21 (*Study II)* lumbopelvic pain was reported (by a yes/no answer) by 44% of the women, while at weeks 34–37 (*Study I)* it was reported by 51% and at 6 months postpartum (*Study III)* by 29% of the women. This is in line with the average overall prevalence found in a review of the literature, which reports a prevalence of 45% during pregnancy and 25% postpartum [249]. Our finding of a prevalence of 38% of

lumbopelvic pain postpartum in women who had lumbopelvic pain already during pregnancy agrees with the 43% found in other studies [133, 214]. Many women in our study reported lumboplevic pain during weeks 19–21 of pregnancy; however, only a few of them were on sick leave *(Study II).* This is in accordance with Gutke et al. [72] who found that not many affected women were on sick leave in weeks 12–18, despite lumbopelvic pain.

The studies in this thesis are based on self-report by questionnaire. In the questionnaires the woman had to select one of three pain locations: the region of the lower back/pelvis, the anterior region of the pelvis/symphysis, or both regions. The frequencies for lumbopelvic pain during weeks 19–21 are reported in *Study II* and for weeks 34–37 in *Study I*. A clinical examination would probably have specified more clearly where the pain was located and possibly the subgroups would have been different. Pain drawings have also been used during pregnancy for lumbopelvic pain classification [101, 151]. However, classification into sub groups was not within the scope of this thesis. These studies are among the first to evaluate catastrophizing and fear-avoidance beliefs in the context of lumbopelvic pain and pregnancy. Further studies are recommended that expand the present results and that also include subgrouping through examinations since it has been suggested that there are different likelihoods for long-term pain in different subgroups (e.g. pelvic girdle pain, lumbar pain and combined pain) of lumbopelvic pain [3, 73].

Studies have shown that high pain intensity constitutes a risk for continuing lumbopelvic pain after pregnancy [133, 153]. This was not the case in our study and one reason for this may be that the pain intensity in weeks 19–21 was not high enough to determine postpartum lumbopelvic pain (*Study III).*

5.1.4 Catastrophizing

The majority of the women reported non-catastrophizing at all of the three measurement occasions, while 10% catastrophized on all occasions. For 32%, catastrophizing varied over time *(Study IV).* This was not expected, since it has been indicated that catastrophizing remains rather stable over time [53, 203]. It seems that pregnancy is unusual in this respect: it is a time-limited condition which ends with delivery and the woman's becoming a mother. Various worries and fears related to this period may affect the levels of catastrophizing, e.g. fear of labour and fear that something might be wrong with the baby. Other things might also have had an impact on catastrophizing, such as meetings with health care personnel, including midwives and physiotherapists. Turner and Aaron [215] propose that catastrophizing may be dependent on the situation rather than being stable over time. In the same study it is discussed whether catastrophizing might be dependent on both personality and situation.

At weeks 19–21 of pregnancy, women with lumbopelvic pain reported significantly higher levels of catastrophizing compared with women without lumbopelvic pain *(Study II).* Sullivan et al. [201] have shown that catastrophizing contributes to pain intensity, but it has also been suggested that high pain intensity may lead to catastrophizing. However, in one study, pregnant women without lumbopelvic pain

also reported higher levels of catastrophizing (mean 11.6) than pain-free individuals in a general population (men and women, mean 7.88), indicating more exaggerated negative thoughts [183]. Furthermore, pregnant women with lumbopelvic pain reported more negative thoughts (mean 15.9) *(Study II)* than individuals with musculoskeletal pain (mean 10.95) [183]. Women are known to report higher levels of catastrophizing than men[146-147, 198, 203-204]. This may explain why pregnant women reported more exaggerated negative thoughts than a general population, of both men and women. Another reason may be that levels of catastrophizing are influenced by the specific features of the pregnancy and postpartum period. It has been found that women who catastrophized about labour pain experienced more intense pain during delivery and had a poorer physical recovery during the weeks after delivery [52]. Furthermore, reporting extreme pain during delivery has been associated with pain intensity due to lumbopelvic pain at follow-up after 18 months [172]. Whether it is the same women who catastrophize at different stages of pregnancy (e.g. early and late pregnancy, or close to labour), needs to be studied further. As do the effects this catastrophizing has on presence and intensity of lumbopelvic pain, and on recovery after pregnancy.

It has been proposed that bad coping strategies may be a reason why some women develop postpartum pelvic pain [75]. We found that pregnant women who catastrophized had a twofold risk for reporting postpartum lumbopelvic pain *(Study III).* Catastrophizing in combination with low back pain has also been found to predict low back pain and disability at 6 months follow-up in a general population [161]. The cut-off points used were almost at the same level, >17 versus ≥18, in that study. When a higher cut-off was used (≥24) exaggerated negative thoughts predicted low back pain and disability at follow-up also in a pain-free population [161]. In *Study IV*, women who reported non-catastrophizing at all occasions had better physical ability postpartum compared with women who catastrophized on one or more of the occasions. This finding is supported by studies where high levels of catastrophizing have been associated with subsequent activity intolerance [198] and perceived disability [208]. In addition, catastrophizing has been associated with disability in both acute [208] and chronic back pain [246]. In fact, it has been suggested that catastrophizing is more important than the pain itself for the actual level of disability [200-201, 243]. It has been discussed whether there is an overlap between closely related constructs like catastrophizing and depression [215]. However, research suggests that catastrophizing contributes to and predicts pain independent of its relation to depression [200, 203].

5.1.5 Fear-avoidance beliefs

Pregnant women have reported their most common fears to be fear for the baby's health and fear of pain [58]; however, all kinds of fears related to becoming a mother or to labour have been mentioned [58, 175]. In one study, about 50% of women reported having some fear about childbirth while about 5% reported having intense fear [58]. It has been suggested that women with fear of childbirth differ in personality characteristics from other pregnant women, e.g in being more anxious and having a greater vulnerability [174-175]. Fear of labour is strongly associated with fear of pain in general [176].

Women with lumbopelvic pain in *Study II* reported about the same levels of fear-avoidance beliefs as patients with acute back pain did in a study by Grotle et al. [68]. There are no established cut-off scores for the FABQ. However, a median score of >15 for the FABQ-activity scale has been suggested as being elevated [31] and a FABQ-work scale score of >34 identified patients at risk of not returning to work [55]. In *Study III* the highest tertile, >12.3, was used as cut-off value.

Fear-avoidance beliefs in pregnancy were not associated with lumbopelvic pain at 6 months postpartum *(Study III)*, which is in accordance with the findings in another study of acute low back pain, where no association was found between fear-avoidance beliefs at baseline and poor outcome at follow-up [65]. The highest tertile, >17, was used as cut-off value [65], which is higher than the one used in *Study III*. Another study found a significant association, between the FABQ-activity scale score and disability at follow up in patients with chronic low back pain [67] but no such association in the acute sample. The study reports no difference in FABQ-activity scale scores between the acute and the chronic sample at baseline. However, in the acute sample, fear-avoidance beliefs about activity decreased during the first month and then remained stable until follow up, while in the chronic sample almost no change occurred. The possible role of fear-avoidance beliefs in the development of future back pain and disability is not clear and review studies show that results are conflicting [110, 163]. In addition, it may be that the importance of fear-avoidance beliefs varies between acute and chronic pain [17, 163]. Still, it has been indicated that the FABQ-activity scale could be used as an outcome measure for acute low back pain, after physiotherapy interventions [59]. With a decrease in the fear-avoidance beliefs, pain intensity and disability have been reported to also decrease. It has also been indicated that women with persisting non-specific pregnancy-related low back pain and severe activity limitations benefit from self-management and fear-avoidance reducing techniques [11]. Further studies are needed to develop targeted interventions.

5.1.6 Physical ability

A median DRI rating of 39 mm (IQR 19.5) has been considered to represent mild to moderate disability in populations with neck/shoulder/low back pain [177] and the median DRI rating was <1 mm in a group of healthy women at the age of 30–39 years. In this thesis work, at weeks 19–21, the median for pregnant women with and without lumbopelvic pain was 27 mm and 9.7 mm, respectively, and at weeks 34–37 it was 58 mm and 24 mm respectively *(studies II and I)*. Six months postpartum, women who catastrophized on all measurement occasions had a median rating of 10 mm while non-catastrophizing women had a median rating of 1 mm *(Study IV)*. These results underscore that lumbopelvic pain during pregnancy, and even pregnancy in itself, constitutes substantial restrictions of activities. Furthermore, catastrophizing seems to be involved in the process. Catastrophizing has been associated with heightened disability, even when controlling for pain intensity [199-200]. Decreased physical ability in weeks 19–21 of pregnancy was associated with postpartum lumbopelvic pain *(Study III)*. This is in accordance with the results by Kopec et al. [96] who found that activity restrictions predicted back pain among women in a general population.

Moreover, there seems to be an association between physical ability and health-related quality of life. In individuals with back pain, physical impairment was related to lower quality of life [100]. In addition, when pregnant women rated their health-related functional (physical and psychological) status the most affected areas were physical functioning, role limitation due to physical problems, and pain [83]. In *Study I* we also found a correlation between limited physical ability and health-related quality of life.

5.1.7 Health-related quality of life

Pregnant women with lumbopelvic pain reported a lower health-related quality of life *(studies I and II).* This may be explained by the fact that the Nottingham Health Profile contains subscales for pain and physical mobility. However, the differences between women with and without lumbopelvic pain, at weeks 19–21, were significant also for the other subscales (emotional reactions, sleep, energy and social isolation) and at weeks 34–37, for sleep and energy. This indicates that lumbopelvic pain affects several dimensions in the pregnant woman's life. This is in line with Horng et al. [81] who found that health-related quality of life for individuals with general low back pain was connected with both functional status and psychological factors.

Lower health-related quality of life showed a tendency ($p=0.054$) to be associated with lumbopelvic pain postpartum for women without lumbopelvic pain during pregnancy, but not for women with lumbopelvic pain. Other studies have shown that a lower health-related quality of life in populations with low back pain was associated with poor outcome [69, 216], and was the best predictor of not returning to work [76]. Several factors that might be considered part of health-related quality of life [41] have per se been shown to be involved in the development of low back pain [117].

In one population of women who had been on sick-leave during pregnancy 74% stated that their health had been good or excellent during pregnancy [211]. The major reasons for sick-leave had been lumbopelvic pain and other pregnancy-related complaints. Moreover, in spite of physical symptoms being common the year after pregnancy the majority of women rated their health as good or very good [180]. In the present study, associations between sick leave and health-related quality of life were not analysed.

Among the most important factors that influence quality of life are a person's expectations and to what extent they are fulfilled [192]. Pregnancy is a period full of expectations, e.g. about giving birth [106] and parenthood [77, 155]. Nothing is known about the possible expectations of the women included in this thesis and consequently nothing is known about how this might have influenced the results.

5.2 METHODOLOGICAL CONSIDERATIONS

There are several methodological issues that need to be discussed.

5.2.1 Data collection and data treatment

We were interested in comparing women with and without lumbopelvic pain. The specific time points for the three measurement occasions in this thesis work were chosen on purpose. The first occasion, at weeks 19–21, was chosen because at this point the women would have passed the first trimester, during which miscarriages often occur [143, 191]. Also, quite a few women would already have lumbopelvic pain [249], and several of the clinics involved schedule a visit for the pregnant woman to see a midwife close to this period, which allowed for distribution of the questionnaires. The second occasion took place at weeks 34–37 because this is just before delivery. Many of the women would have considerable pregnancy-related difficulties with daily activities and sleep, and we expected many women to have lumbopelvic pain. The last occasion was at 6 months postpartum, because lumbopelvic pain usually levels off during the months following delivery [101, 153] and having pain after this may indicate a poor prognosis.

All data in this thesiswork are self-reported and there were no other sources of verification, such as behavioural tests or physical examinations. However, it has been argued that because back pain is a subjective phenomenon, self-report is the most appropriate method of measuring this outcome [96].

Yes/no questions were used for subdividing women into two groups, with and without lumbopelvic pain. The yes/no question is frequently used in the Nordic Musculoskeletal Questionnaire when reporting work-related pain in different body locations [40] .Many individuals who report pain only have small problems, such as infrequent and low-intensity pain [114]. Therefore, if the main interest had been to investigate only a population with lumbopelvic pain it would have been adequate to identify a cut-off point for what was considered as having pain (e.g. >10 mm, or 20 mm pain intensity rating on the VAS) [72, 250].

In *Study I* the women were asked whether they had had previous lumbopelvic pain, during and before pregnancy. Having had previous back pain during an earlier pregnancy was more common among women reporting lumbopelvic pain in the present pregnancy, compared to pain free women. A question about earlier back pain has been included in many studies of lumbopelvic pain during and after pregnancy. There is strong evidence that previous back pain increase the risk for lumbopelvic pain in pregnancy and postpartum [249]. Since this issue has been studied many times previously, no question about earlier back pain was included in s*tudies II-IV* and it is not likely that this could have influenced the results to a large extent.

Even though the majority of women reported the onset of lumbopelvic pain as having been during the present pregnancy *(studies I and II)* it was not possible, from the questionnaire, to tell whether the pain was an old recurrent pain or a new pain. Ostgaard et al. [151] have shown that as many as one out of five women studied had ongoing back pain already before getting pregnant. It must be assumed that this may be

true also for a number of women included in these studies, and this was the reason why the term "pregnancy-related" was not used together with "lumbopelvic pain" for these women.

This thesis consists of two different samples. Sample I with measurement only at one point of time, and sample II, with three measuring occasions at different times. *Studies I and II* were analyzed in a cross-sectional way while *Studies III and IV* were analyzed prospectively. The two cross sectional studies at two different time points allowed us to describe the differences between women with and women without lumbopelvic pain at different time points with respect to the variables included in s*tudies I and II.* In *Study III* the findings in the cross-sectional studies were further examined. The design of *Study III* was suitable for examining potential predictors; it was prospective, and women who reported lumbopelvic pain after pregnancy could be compared with those who did not. It has been argued that more prospective studies are needed to evaluate how psychological factors develop over time [236]. In cross-sectional studies there is always a "which came first the chicken or the egg dilemma", i.e. it is not possible to determine the direction of causality. *Study IV* adds to the knowledge of the development of catastrophizing and disability in the context of pregnancy and lumbopelvic pain. Catastrophizing seems to be involved in the development of postpartum physical ability. To our best knowledge this is the first time a prospective study has made it possible to follow the development of catastrophizing over time, during and after pregnancy. Also in *Study IV*, women both with and without lumbopelvic pain were included, which enabled us to look at the relationship between catastrophizing and lumbopelvic pain.

In *Study III*, a dichotomization of the predictors was performed because this meant that the results would be of greater clinical interest, with cut-off points and "limits" that are applicable in clinical use e.g. in screening before targeted interventions. Cox regression analysis provides hazard ratios which allow for relative risks to be expressed. Dichotomising made it possible to highlight the doubled risk for low back pain postpartum for all significant predictors. To avoid bias, the distribution of data was controlled before dichotomizing.

Since there are no recommended cut-off points for pregnant women for the instruments used in this thesis cut-off points were based on the results in *Study II*. Therefore, in *Study III* the highest tertile was used as cut-off point and the potential predictors for postpartum lumbopelvc pain were dichotomized. The highest tertile has been used as cut-off value in other studies [65, 161]. In this study, the cut-off for pain intensity at present was >33 and for pain at worst >69, but neither of them determined postpartum lumbopelvic pain in *Study III*. An earlier study has shown that the risk for postpartum lumbopelvic pain increases with higher pain intensity in preganancy [133]. The cut-off for catastrophizing in Study *III* was >17, almost at the same level as the cut-off value used elsewhere in a general population with low back pain, ≥18 [161]. In both studies, catastrophizing predicted pain (low back or lumbopelvic) at follow up. In *Study III* the cut off value for fear-avoidance beliefs was >12.3 and did not determine postpartum lumbopelvic pain. This is lower than the cut-off, >17, used in one study in a sample with acute low back pain at baseline [65]. In that study, fear-avoidance beliefs were not predictive of non-recovery at 3 months follow-up. Had we used different cut off values

this would possibly have changed the results in *Study III* and may also have provided different clinical relevance. Identifying possible determinants of lumbopelvic pain is not easy. The populations are different between studies, as are the tested predictor variables, definitions, measurements and analyses used, all of which produce differing results between studies [96]. Moreover, it is important to study factors at different time points since the effect of a certain factor may vary in relation to time and developmental stage [112]. In *Study III* we investigated the possible effect of variables at weeks 19–21 of pregnancy on postpartum lumbopelvic pain in order to find predictors. The results and cut-off points used may have differed if variables from weeks 34–37 had been used instead. More studies at different time points are needed to confirm the results in *Study III*.

5.2.2 Participants

In sample I women in weeks 34–37 of pregnancy in central Stockholm were included. The response rate was 85%. These women differed from pregnant women in other studies [101, 151] with respect to age and number of previous pregnancies; they were older and more women were pregnant for the first time. From the answers it was also possible to tell that almost all of the women had professional jobs. With this in mind a wider perspective was desired for the other studies and consequently three different demographic areas were included central Stockholm, clinics on the outskirts of Stockholm, and a medium-sized town. However, the background questions we included did not allow for any conclusions to be drawn with regard to socioeconomic status or education; consequently, the results were not presented separately for the different areas. One strength is that the respondents were spread across several postal codes representing both residential and rural areas, and suggesting a wide variation in socio-economic status. It is also notable that the percentages of women with and without lumbopelvic pain in s*tudies II-IV* are in accordance with those reported in other studies.

In second sample, which constitutes the base for *studies III and IV*, the lowest response rate was seen for the outskirts of Stockholm (62%). Additional analyses show that when comparing the three different areas the respondents from the out skirts of Stockholm were less often primiparous, and of those who were primiparous, 47% reported onset of pain before week 12 of pregnancy. In addition, they reported more combined lumbar and pelvic pain, exercised less during the present pregnancy, had more catastrophic thoughts and fear-avoidance beliefs, had more limited physical ability, and lower health-related quality of life. It seems that respondents from this area were “worse off”, more affected, than respondents from the other areas. Therefore, response bias can not be excluded, leading to an underestimation of the results. However, since no information is known about the non-respondents it can not be excluded that only the women with most severe problems responded.

Only few of the non-response in *Study II* are due to miscarriages and to women returning questionnaires but withdrawing consent for further participation. It may also be possible that some non-respondents were women who regretted having given consent and decided not to send back the questionnaires. A contributing factor may have been the number of instruments included. A weakness of this study is that there are no recorded data of the women who did not want to participate or who dropped out

of the study. The number of non-respondents may have affected the generalizability of the results when it comes to analyses of frequency, but less so when it comes to calculations of associations between variables.

In *Study III* 273 women, out of the 324 included in *Study II*, answered also postpartum and were included in the analyses. The women who responded only during pregnancy differed from women who responded on both occasions, rating more daily pain, more limited physical ability and lower health-related quality of life. The drop-outs in *Study III* compared to *Study II* might have influenced the hazard ratios.

In *Study IV*, 242 women, out of the 324 included in *Study II*, completed the Pain Catastrophizing Scale (PCS) on all three occasions and were included in the analyses. The drop-outs may have reduced the generalizability of the results. Four groups of women were formed on the basis of reported frequency of catastrophizing during and after pregnancy. A very large study group would have been required from the beginning, in pregnancy, to make it possible to divide women into groups based on postpartum catastrophizing which also included a certain number of women with and without lumbopelvic pain. For this reason, we chose to combine groups, including both women with and women without lumbopelvic pain, in order to reach statistical power for comparison between the groups.

5.2.3 Instruments

All of the six included instruments have been used in numerous studies in different populations, e.g with back pain. Only for three of the instruments the Swedish version have been tested for psychometric properties; the visual analogue rating scale for rating of pain [23], the Disability Rating Index [177] and the Nottingham Health Profile [84, 238, 240].

5.2.3.1 The Visual Analogue Scale for rating of pain

The Visual Analogue Scale was used for rating of pain intensity. Pain is multi-dimensional and the respondents communicate far more than just intensity about their pain [241]. However, the scale as used cannot distinguish between different dimensions of pain, such as affective or emotional components, which may affect the evaluation [233]. Pain can vary rapidly over time. This affects the possibilities of test-retest for reliability [233]. When the VAS is used to evaluate treatment the obtained values may reflect the variation in pain rather than the treatment effects [14]. The scale has been tested for reliability and validity on a number of occasions, with differing results [14, 23, 167, 233, 241]. However, the VAS used for rating of pain intensity in low back pain showed good reliability over 24 hours [167] and the VAS also showed sufficient reliability when used in acute pain [14]. Clear instructions are needed for how to use the scale. “No pain” is easy to understand while “intolerable pain” has no absolute value. Hence, the estimation will depend on the respondent’s interpretation and previous experience [233]. Furthermore, it seems difficult to recall a previous pain experience [23], which makes it problematic to use the VAS for estimating pain when there is no pain at present. The results from the ratings of pain in this thesis have been presented as median (range) to give an idea of the estimated pain. The results have also been used in *Study III* as possible predictors of postpartum lumbopelvic pain.

5.2.3.2 The Pain Catastrophizing Scale

The Pain Catastrophizing Scale was developed by Sullivan et al in 1995 [203]. Before that, the construct "catastrophizing" had, surprisingly enough because of its well-known importance, only been included as subscales in some instruments for assessing pain coping strategies [146], such as the Coping Strategies Questionnaire (CSQ) [171]. In studies that include catastrophizing, one of these two instruments is usually used. The PCS covers catastrophizing in a broader perspective while the CSQ focuses on the helplessness dimension [165]. Therefore, the PCS was used in this thesis.

There are no published data for validity and reliability for the Swedish version of the PCS and the instrument has not been tested specifically on a population of pregnant women. However, the PCS has been used on pregnant populations in relation to labour pain [50, 52] and to epidural anaesthesia [225]. Furthermore, the PCS has been found to work well in a wide range of populations, e.g. with chronic low back pain [60, 222] and acute low back pain [208], as well as in different pain populations [146, 182, 222] in general populations and [22, 182] in painfree individuals [222] and in students with and without pain [147, 203]. Little is known about whether catastrophizing is a stable personal factor or a situational response [215].

5.2.3.3 The Fear-Avoidance Beliefs Questionnaire

Two valid and reliable instruments have been proposed to measure pain-related fear, the Tampa Scale for Kinesiophobia (TSK) [130] and the Fear-Avoidance Beliefs Questionnaire [220]. The Swedish version of the TSK has been tested for psychometric properties [116] but there are no published data for the Swedish version of the original FABQ. However, a modified version of the FABQ has proved reliable when tested on a Swedish pain population [21]. The FABQ showed no systematic differences between test and retest for pregnant Swedish women (Nilsson-Wikmar, unpublished data). The original English version of the FABQ has been translated and the translations (German, Swiss-German, French, Dutch, Norwegian and Greek) show high to acceptable validity and reliability when used in chronic [61, 158, 189, 220] and acute [66, 207] low back pain patients. However, in two of the versions (German and the Greek) a different factor structure was found for FABQ-work scale compared with the original version [61, 158]. Moreover, the Norwegian version has shown low to moderate responsiveness, and floor and ceiling effects have been found [66].

The FABQ was chosen for the studies in this thesis work since the TSK contains items relating to physical exercise, which may not be applicable in pregnancy. However, the FABQ also contains items that do not have relevance during pregnancy, e.g "I do not think I will be back to my normal work within 3 months" in the FABQ-work scale. The analysis in *Study II* was performed both including and not including the scores from this item. Since the results did not differ we kept the item in the score that was used for the calculations. The analysis in *Study III* was performed using the FABQ-activity scale. It would have been possible to also use the FABQ-work scale even though some of the items are not as suitable for use during pregnancy. Both the FABQ-activity scale and the FABQ-work scale have been linked to negative consequences due to low back pain [56, 189, 220, 246].

5.2.3.4 The Disability Rating Index

The Disability Rating Index has been used on a wide range of musculoskeletal problems but was primarily developed for low back pain. The original version is Swedish and the instrument has been tested for validity and reliability on Swedish populations, among others with low back pain, with good results [177].

The DRI is perhaps not optimal for rating physical ability during pregnancy, given that activities such as "lifting heavy objects" and "running" may be avoided during this period. However, certain activities might be avoided because of catastrophizing and fear-avoidance beliefs or may be a result of advice from health care personnel with fear-avoidance beliefs. The DRI had previously been used in studies on pregnant women, which allowed comparisons [101, 231].

Another instrument, the Oswestry Low Back Pain Disability Questionnaire [49], has been recommended for use in low back pain populations [39]. However, it is required to have back pain in order to answer the questionnaire. The same goes for another back-specific instrument, the Roland and Morris Disability Questionnaire [90]. Since one of the aims of this thesis was to compare women with and without lumbopelvic pain these instruments were not suitable.

The DRI was used in this thesis because no pregnancy-related instrument for physical ability was found at the time when these studies were initiated. Later, the Pregnancy Mobility Index was developed [223]. It evaluates functioning in relation to back and pelvic pain in the following three main areas: daily mobility in the house, household activities and mobility outdoors. This instrument was not available when work started on these studies, however.

The DRI-total index, was used in all four studies in this thesis work. However, the total index gives no information about which areas are affected. Affected areas may change while the total index may remain the same. Therefore also the scores for the twelve different activities were included in the results in s*tudies I* and *II.*

5.2.3.5 The Nottingham Health Profile

The Swedish version of Nottingham Health Profile has been tested and found to have good reliability and moderate to high validity [86, 237, 240], and has been used e.g. in patients with musculoskeletal disorders [63, 239-240]. The NHP was chosen as instrument to measure the health related QOL mainly because it focuses on experienced distress and discomfort, as a proxy for health. Therefore it is suitable also for people who are in distress but who don't see their problems as being specifically related to health. There are other instruments for evaluating health and health-related quality of life, like the EQ-5D and short form 36(SF-36) health status questionnaire, which have been recommended for use in back pain populations [39]. One reason for choosing the NHP rather than EQ-5D [166] or SF-36 [197] was that the NHP contains a subscale for sleep. Sleep disturbances are common during pregnancy and even more common if the woman suffers from lumbopelvic pain [168, 179, 229]. As a matter of fact, the subscale sleep was more affected among women with lumbopelvic pain than among women without lumbopelvic pain, both in *Study I* and in *Study II*. Furthermore, when the English

version was tested for validity and reliability a population of pregnant women were included [85]. However, some of the subscales in the NHP have few items which limit the precision of scores. For example, the subscale emotional distress only contains three items, which is why the use of another instrument, focusing specifically on that dimension, would have been good as a complement.

5.3 FUTURE RESEARCH

Based on the present findings there is a need for further research in the context of pregnancy and postpartum–

- to further test variables proposed in different fear-avoidance models, e.g. threatening illness information, depression and self-efficacy;
- to establish cut-off scores that are predictive of outcome and have clinical relevance;
- to perform qualitative studies in order to deepen the knowledge concerning the role of catastrophizing, fear-avoidance beliefs, physical ability and health-related quality of life in lumbopelvic pain and its consequences;
- to investigate a multimodal approach compared to other interventions in randomized controlled studies to find the most effective treatment
- to investigate the possible role of the approach towards pregnant women by health care professionals; and
- to further test the present results in different subgroups of lumbopelvic pain

5.4 CLINICAL IMPLICATIONS

The results of this thesis imply that a broad perspective is necessary when meeting pregnant women both with and without lumbopelvic pain since, apart from biological factors, also psychosocial factors seem relevant.

6 CONCLUSIONS

Women with lumbopelvic pain at pregnancy weeks 19–21 had higher levels of catastrophic thoughts and fear-avoidance beliefs compared with women without lumbopelvic pain. However, pain-free pregnant women also reported catastrophizing and fear-avoidance beliefs. Pregnant women have reduced physical ability and health-related quality of life during pregnancy (weeks 19–21 and weeks 34–37) irrespective of lumbopelvic pain or not. However, women with lumbopelvic pain reported the most limited physical ability and the lowest health-related quality of life. For women with lumbopelvic pain in weeks 34–37 of pregnancy physical ability and health-related quality of life were moderately correlated. Irrespective of lumbopelvic pain, pregnancy affects many aspects of the woman's life.

High levels of catastrophizing and a limited physical ability doubled the risk for postpartum lumbopelvic pain for women with lumbopelvic pain in pregnancy. This indicates that other variables than pain intensity may be of importance for experiencing postpartum lumbopelvic pain.

The common idea that levels of catastrophizing are "stable" within an individual should be reconsidered, since for one in three women in our studies catastrophic thoughts changed over time during and after pregnancy. One out of ten women reported catastrophizing both during pregnancy and at 6 months postpartum and one out of three reported catastrophizing on at least one of the measurement occasions.

The results in this thesis work indicate that health care professionals should consider a variety of aspects, including biological and psychosocial factors, when selecting appropriate strategies for prevention and intervention for this group of women.

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