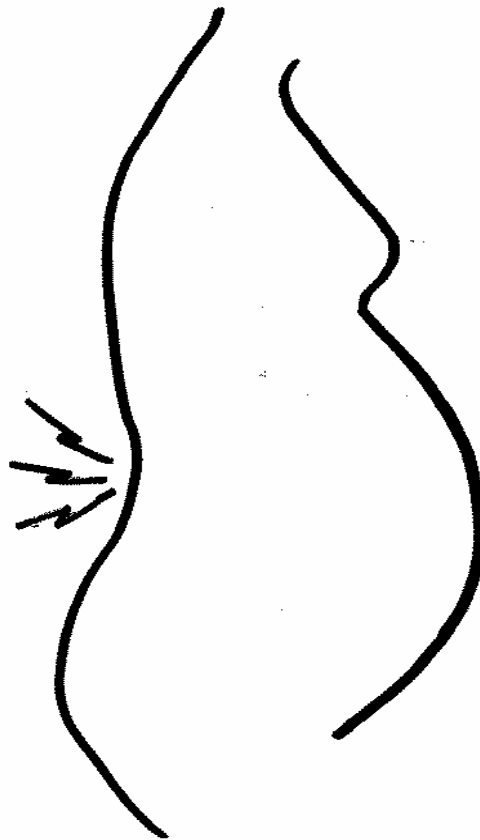


Pain from the pelvic area in relation to pregnancy

Prevention and explanation - two different approaches



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Sammanfattning

Med utgångspunkt från ett folkhälsoperspektiv studerades smärta från ländrygg och eller bäcken hos gravida kvinnor. Två interventioner, vattengymnastik respektive Friskis och Svettis´ Vänta-barn-gympa, utvärderades avseende symtom på smärta från ländrygg och bäcken samt sjukskrivning härför i samband med graviditet. I en interventionsstudie med 390 randomiserade kvinnor deltog 266 kvinnor i fysisk aktivitet under en timma per vecka under drygt halva graviditeten. Ingen var sjukskriven för ländryggsmärta i vattengymnastikgruppen jämfört med 6 kvinnor i gymnastikgruppen ($p=0.03$). Viss försiktighet föreslås när det gäller att rekommendera vanlig gymnastik till kvinnor med anamnes på ryggsmärta under graviditet medan vattengymnastik förefaller ha god effekt för just ländryggsmärta. Någon metod för att förebygga bäckensmärta finns inte beskriven.

Vidare studeras ett eventuellt samband mellan laktosintolerans och kvarstående bäckensmärta, något som inte tidigare undersökts. När det gäller sambandet graviditet – laktosintolerans gjordes en pilotstudie med 15 deltagare och lika många kontroller. Ett visst samband kunde konstateras, $p=0.05$, men resultaten måste verifieras i större studier. Den tänkbara förklaringsmekanismen bakom sambandet med laktosintolerans går via ”irritable bowel syndrome”, IBS. Symtom från IBS och från laktosintolerans överlappar varandra och det rekommenderas att laktosbelastning skall ingå i utredning av oklara buksmärter. Kan även bäckensmärter i samband med graviditet i vissa fall ha samband med laktosintolerans?

Nyckelord

Graviditet, bäckensmärta, ländryggsmärta, vattengymnastik, gymnastik, laktosintolerans

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Abstract

From a public health perspective pain from low back and/or pelvis was studied in relation to pregnancy. Two interventions, water gymnastics or Friskis and Svettis' gymnastics for pregnant women, were evaluated regarding effects on symptoms and need for sick leave due to low back or pelvic pain. In an intervention study with 390 randomised women, 266 participated in physical activity during 60 minutes once a week during just about half their pregnancies. No one was sick-listed due to low back pain in the water gymnastic group compared to 6 women in the land-based exercise group ($p=0.03$). Some doubts may be raised regarding recommendations to pregnant women with a history of low back pain to participate in gymnastics. On the contrary, water gymnastics seems to be beneficial regarding low back pain. Methods to prevent pelvic pain in relation to pregnancy are not known.

Furthermore, a possible relation between longstanding pelvic pain after pregnancy was investigated. Such a relation has never been described before. Fifteen subjects, women with defined posterior pelvic pain during and after pregnancy and as many controls without anamnesis of such pain were tested for lactose intolerance, using the BH₂-test. A correlation was found, $p=0.05$ but results need to be confirmed in larger studies. The possible link towards explaining such a relation goes through the fact that lactose intolerance and "irritable bowel syndrome", IBS, often overlap and lactose intolerance test is recommended to be included in investigation of IBS. Can low back/pelvic pain in relation to pregnancy sometimes be correlated to lactose intolerance?

Key words

Pregnancy, pelvic pain, low back pain, water gymnastics, land-based gymnastics, lactose intolerance

ABBREVIATIONS

ACC	Antenatal Care Centre
IBS	irritable bowel syndrome
LBP	low back pain
LBPE	land based physical exercise
LI	lactose intolerance
LPP	lumbo-pelvic pain
PLBP	pregnancy related low back pain
PPGP	pregnancy related pelvic girdle pain
PP	pelvic pain
PPM	parts per million
PPP	posterior pelvic pain
RPT	registered physiotherapist
SEK	Swedish crowns
SIJ	sacro-iliac joints

Regarding pelvic pain in relation to pregnancy PPGP is generally used in this theses. Pelvic pain, PP, is used when the association to pregnancy is not obvious and posterior pelvic pain, PPP, is used when the defined term and its conditions are explicitly fulfilled. Lumbo-pelvic pain, LPP, is used when the description of pain refers to pain from both lumbar and pelvic area.

Felix qui potuit cognoscere causas

(Lucky he who has been able to find out the causes of everything)

Publius Vergilius Maro 70 – 19 A. Chr.

INTRODUCTION

Contact with women with low back pain and/or pelvic pain has continuously followed me through my thirty years of work with pregnant and newly delivered women. I have met them both in antenatal care centres and on in-patients wards. In contact with these women I have always felt inadequate, not knowing the causes of their pain, what would be the correct advice to give and why some women were affected and some not. I have experienced the times when these women got a pat on the back coupled with a “so sorry” and an invitation to return when they needed crutches or a wheelchair, but not much else. As time has passed we have seen the arrival of the pelvic belt, a blessing for so many but not for all. Why? In my experience, women have been cared for in hospital wards, more or less confined to their beds during long periods of time. Still no one could explain why they were so greatly troubled. Were they abnormally sensitive to pain or was there something else that set them apart as a group? Pregnancies were induced, or ended with planned caesarean section because of this pain. Afterwards the women were discharged and we lived under the misapprehension that their problems were over – but what did we really know? The questions were always there and I read everything I could lay my hands on. I worked with tips and suggestions in collaboration with these women and all the while I got more and more confused. Why was no one interested in these conditions of pain? Why did we content ourselves with caring without being able to understand or explain? The only existing explanation was that it was “hormonal”.

The beginning of the 1990s saw the publication of the first Swedish thesis on pelvic pain in relation to pregnancy – written by an orthopaedist (1). At last there was something to stand on, there were figures of prevalence and there was postnatal follow-up. When I then had the opportunity to invite a midwife working with water gymnastics for pregnant women to our clinic I started to realise that maybe I myself could do something, rather than complain over the lack of action from others! And so the work with one of the studies behind this thesis took off.

The thesis will focus on women with pain from the pelvic area, related to pregnancy. The main reason for studying lumbo-pelvic pain, LPP, in pregnant women is that it is common and causes long term suffering, resulting in high costs for society and sufferers. There are two main focuses: the first being prevention and the second, explaining a new, possible risk factor for pelvic pain in relation to pregnancy. Can pain from the pelvic area be prevented by physical activity? Is there a difference between two programs, specially designed for pregnancy? In contact with women with pelvic pain, PP, an unexpectedly high prevalence of adverse reaction to milk was discovered. One woman with disabling PP during three pregnancies was later diagnosed as having lactose intolerance, LI. Could there be a connection between LI and the development of PP? Can lactose intolerance be a piece in the puzzle of longstanding PP after pregnancy?

Pregnancy influences not only the woman but also the whole family and a complex situation affects the intimate relationship of marriage and the parental role. Women with PP during pregnancy seek support and information but are often given misinformation from specialists lacking evidence-based knowledge. Still, in 2007, personal documents of desperate women seeking advice for pain can be seen on the Internet. These life stories are examples of unmet needs and frustration.

BACKGROUND

To form a framework for studying low back pain, LBP, and pelvic pain, PP, in pregnant women, background data will be presented in 6 cog-wheels, representing the woman, pregnancy, midwife, health and pain all within the public health wheel (fig 1).

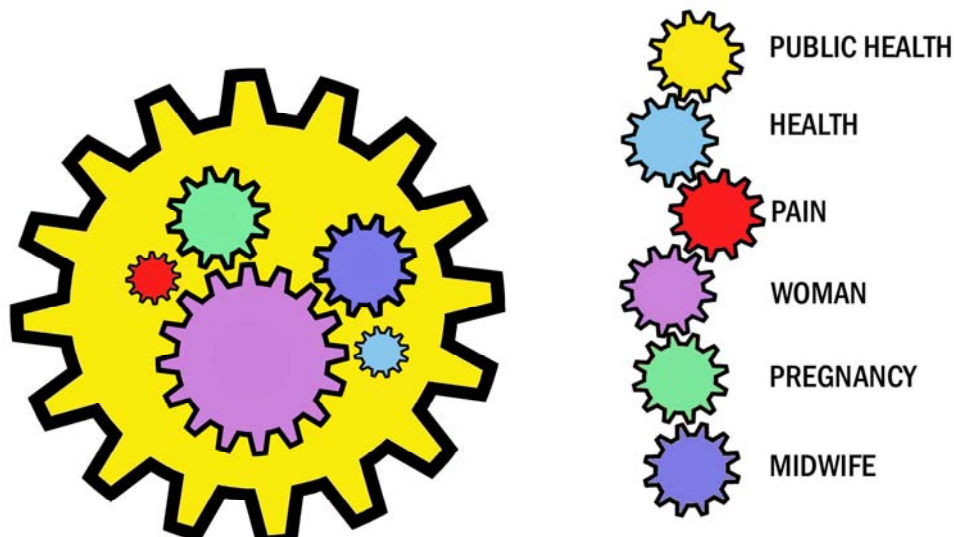


Fig. 1. A visual framework for studying low back and pelvic pain in pregnant women.

The concepts of health and public health

There is no one clear definition of what health is, because the experience of health is individual. Everyone forms their own opinion about what health is from their context. WHO's definition, from 1947, of health as a state of complete physiological, psychological and social well-being, and not only as the absence of disease or handicap, can still be seen as a utopian goal for universal health promotion (2). In this thesis, the theoretical stance taken is that a person is considered healthy if she as a whole is functioning well, or if she in social and cultural contexts can realise all her vital goals. A vital goal means the necessary prerequisites to reach a state of minimal satisfaction (3). This definition focuses on the health of the individual.

Public health work entails measures to improve the possibilities for universal health and can be split into two main areas. On the one hand, measures aimed at creating the prerequisites and environments – social, cultural, physiological, psychological, political, economical and emotional – that promote the health of the individual. On the other hand efforts directly focused on groups or institutions. In Sweden, the Public Health Institute has drafted eleven objective domains for national public health work

(4). The objectives of direct concern for the work with pregnant women with pelvic pain are nr 3 “Secure and favourable conditions during childhood and adolescence”, nr 8 “Safe sexuality and good reproductive health” and nr 9, “Increased physical activity” while objective nr 6 “Health and medical care that more actively promotes good health” indirectly is concerned with measures to reduce the effects from pain during pregnancy.

In this thesis, physical fitness and exercise habits are central to help prevent pain from the low back and pelvic area in women, pregnant or not pregnant. Increased physical activity throughout life is focused in public health promotion, and to foster good exercise habits is an important task for society as well as for parents. Healthy habits may contribute to favourable conditions during childhood. Insufficient physical activity is a threat to public health and could have catastrophic consequences in terms of increased prevalence of osteoporosis, heart disease, obesity, hypertension and also LBP (5). To change this, it is important to foster good physical habits among children and adolescents. Available experience and scientific evidence show, that the regular practice of appropriate physical activity and sports provide people, both male and female, of all ages and conditions - including disabilities - with a wide range of physical, social and mental health benefits. Physical training is scientifically supported as an effective way to prevent LBP (6). At least 30 minutes of moderate physical activity, for example brisk walking, is enough to bring about many of these effects (7-9).

From a public health perspective LBP is a major problem in society today because it is the most common cause of disability in western societies, leading to increased costs for sick leave (10). One of the most important risk factors for developing pregnancy-related LBP is suggested to be lack of physical activity together with inappropriate working conditions. Active habits, grounded early in life will probably be retained even as an adult, thus contributing to better public health in society in a long-term perspective.

The concept of pain

Pain, as a human, clinical and economical problem is one of the greatest challenges to western society today. The International Association for the Study of Pain, IASP, defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage” (11). This means, that if individuals regard their experience as pain and they report it in the same way as any pain caused by tissue damage, it should be accepted as pain. This classification involves aetiology and body systems to describe chronic pain syndromes. The practical question of how to control pain will not be answered satisfactorily until we understand more of the context in which pain resides.

Aristotle (384 – 322 BC) thought that pain was an affect, a passion of the soul, distinct from the classic five senses. In modern pain research, a holistic view has developed where pain is described as a complex phenomenon, highly related to tissue damage as well as psychological aspects (12). The research focuses on medical, genetic,

physiological, and psychological as well as social factors, such as education and employability (13).

Pain in this thesis refers to pain from low back and pelvis during pregnancy. LBP is restricted to the description of pain from the lumbar and sacroiliac regions of the spinal cord (14). Pelvic pain includes a number of diagnoses and terminology varies over time, between countries and between professions. If PP is included in the diagnose results are interpreted as pregnancy related pelvic girdle pain, PPGP.

In short, the ancient view of pain as an affect, distinct from the five senses, has moved towards a holistic view where physical and psychosocial aspects are equally important for the experience of pain. To treat patients with long-standing pain, the caregiver must accept the patient's pain and communicate this acceptance and understanding to the patient. Treatment should be guided to the pain as well as to its consequences (10).

Women's health

Women's health is highly associated with childbearing and childrearing. More than 50% of human beings are women and almost all of them are to be pregnant at least once in a lifetime. Women are often occupied in working sectors where monotony is part of the work environment. Healthcare employs mainly women and health care workers report LBP more often than workers from other sectors (15).

During pregnancy, physiological and psychological adjustments take place in the female body. Changes in posture, with an increasing lumbar lordosis, have been thought to occur as body-mass increases and centre of gravity changes. More probably, a deep lumbar lordosis before pregnancy means a greater risk for developing LBP during pregnancy (16). Functional changes in back muscle activity is shown to correlate with pain intensity and prediction of LBP during pregnancy. This might be a useful tool to identify pregnant women at risk for LBP (17, 18).

Pain from the pelvic area has long been regarded more or less part of normal pregnancy. Changes in the female pelvis due to pregnancy were first reported by Hippocrates (460 – 377 BC), who thought that lifelong changes occurred during a woman's first pregnancy. In 1890, Cantin (referred by Östgaard 1991) stated, that of all the trouble a pregnant woman might suffer from, there was none more common – and more often overlooked – than the relaxation of the pelvic joints (1).

The raised concentrations of sex hormones in serum during pregnancy may be partly responsible for many symptoms, like nausea, constipation, excessive tiredness and back pain (19). Variable exposures to these hormones could possibly initiate LBP in certain women, with or without connection to pregnancy (19). Women who have experienced LPP during one pregnancy might give up further pregnancies for fear of worse pain (19). LBP is more common in females than in males. This gender discrepancy with regard to LBP may be caused by different patterns in sex hormone exposure between the sexes (19). LBP is known to be associated with pregnancy and working conditions

(20-26). Oral contraceptives have been suspected to contribute to LBP but have not been found to increase the risk (27). However, progesterone is associated with musculoskeletal symptoms like pain from legs or low back (28).

To be a woman and stay physically active demands internal as well as external resources. Both having fun and learning during these activities are important factors in influencing inactive young women to take up exercise (29). A sense of fellowship along with various forms of support such as child minding, household help, carpooling and low costs all influence the willingness to participate (29). Women, who exercise during pregnancy, tend to feel better, have greater self-confidence and have fewer depressions during pregnancy. They also experience delivery to be less strenuous and often have a shorter active birth time (30, 31). Walking and jogging are suggested as alternative treatments for gestational diabetes and positive effects in terms of better immunological defence in the offspring are discussed (30). A sedentary life-style as well as excessive physical activity and certain socio-cultural factors such as age, gender, social class and work satisfaction have been reported to increase the risk for LBP (32).

PP, as seen in general practice, is frequent among fertile women and is regarded more or less part of normal pregnancy (33). A high community prevalence of chronic PP in non-pregnant women of reproductive age with a three-month prevalence of 24% in women aged 18-49 has been reported (34, 35). This is comparable to prevalence of migraine, back pain and asthma in primary health care (36). Half of the women with pelvic pain also have urogenital symptoms and/or irritable bowel syndrome. Irritable bowel syndrome, IBS, and stress are the most common diagnoses received by patients with chronic PP, but 50% have never received a diagnosis. There is a substantial overlap between chronic PP and other abdominal symptoms in women (37). Duration of symptoms of more than 2 years for PP and IBS and/or cystitis is the most common (37). High symptom-related anxiety in these women emphasises the need for information about chronic PP and its causes. Since pain can reduce quality of life and general well being for fertile women, research on effects of pain on daily living is needed (38). Many women with long-standing pelvic pain attending primary health care are not referred to secondary care. Therefore, women seen in secondary care for long-standing PP are a highly selected group and are likely to represent only the tip of the iceberg (39).

Adverse reactions to milk include lactose intolerance, LI, caused by lactase deficiency, and milk hypersensitivity. In Scandinavia almost every adult can consume milk. In Sweden, for example, more than 80% of the adults are supposed to have the dominant gene making this possible. Generally, LI is estimated to be 2-3% of the population in Sweden but a review from 1988 reports a prevalence of LI of 12% among Swedes (40). During pregnancy, loss of intestinal lactase activity among adults could theoretically limit milk consumption and hence dietary availability of calcium (40, 41) although women with lactose malabsorption are known to handle lactose better than usual in late pregnancy (42). Among women diagnosed as lactose maldigesters in pregnancy week 15, almost half of them had become digesters by term (42). Post partum changes may occur and diagnosed LI might worsen, be the same or improve (42). Bone density decreases during pregnancy and lactation. It remains unclear whether bone loss is associated with back and pelvic pain during lactation (43).

Midwifery and Public Health

Midwifery focuses on health, health prevention, normality and lifestyle topics all of which are essential parts of the consultation. Midwifery deal with women's reproductive health from puberty to senium and includes biological, physiological, psychological and social aspects of life. Pregnancy is not a disease; it is part of a woman's normal life. The Swedish midwife independently treats normal pregnancy and birth and consult an obstetrician when she defines the pregnancy or delivery as abnormal.

The transition to motherhood consists of three phases: fusion, differentiation and separation (44). The mother-to-be has to pass the three phases to grow into motherhood and the moving from one phase to the next requires a successful process in the former phase. A woman in pain might face difficulties in going through the parenthood transition process. By preventing or mitigating symptoms of low back and/or pelvic pain, in relation to pregnancy, stress on the family could be less prominent and possibilities for a positive transition process increase. This might in a long-time perspective be of positive value to the newborn child.

Midwifery work includes health promotion and supporting healthy habits in daily life. Lifestyle matters are often discussed, as well in contraceptive counselling as in pregnancy supervision and at postpartum check up. Midwives are therefore key informants regarding a healthy lifestyle including fitness and physical exercise. To facilitate physical activity is probably as important as to inform about smoking, drinking, drugs, food and environment to improve health before, during and after pregnancy. Pain from the pelvic area in relation to pregnancy, delivery and the immediate postnatal period is part of pregnancy but not of normal pregnancy and experts should be consulted. There is a need to involve the woman and her partner in decision-making to recognise psychological, social and cultural background as well as level of education and employability to make successful recommendations (24). Pain from the pelvic area is known to influence the intimate relationship negatively (22, 45, 46). A majority of pregnant women are on sick leave at some time during pregnancy, which makes pregnancy related LPP an important public health issues 47).

Pregnancy-related pain from the pelvic area, terminology

Research on pregnancy related pelvic girdle pain, PPGP, usually follows two tracks: one is etiology or diagnosis, the other is treatment. That LBP and PP in relation to pregnancy are two different diagnoses is accepted without questioning today, but unitary concepts are still not defined or used. This makes it difficult to compare studies from different times or different countries. Just about 2/3 of published studies deal with LBP, 1/3 with PP, though studies on this later topic have increased during the nineties. At least, pelvic pain is probably best defined as both a biological and a cultural phenomenon (48). Despite the magnitude of the problem, for single individuals as well

as for society, there is a lack of uniform definition of pain from the pelvic area in relation to pregnancy (49).

Over time, terminology regarding LBP has changed from wide concepts like back ache or back pain to the more specific LBP. For PP the same trend can be seen, from terms of dysfunction, loosening or insufficiency to more exact concepts like PPP or PPGP. Focus is more on the woman's experience and her pain, than on aetiology in terms of dysfunction or disturbance. Efforts are made to find an exact definition that can be accepted worldwide but this will need some time (50). Different views on pain from the pelvic area can be seen between professions. Chiropractors often use the term sacro-iliac joint, SIJ, malfunction or SIJ position while physiotherapists have a biomedical perspective in terms of inflammation or weakness (51). An overview of trends in terminology is shown in Table 1.

Table 1. Terminology, trends over time

<u>Period</u>	<u>terminology</u>
1970ies – 80ies	Wide, imprecise terms. i.e. back ache, low back pain, pelvic pain (52-55)
1990ies	Two trends, focus on insufficiency (56-59) or a well-defined diagnosis (60-62) Differentiation between low back / pelvic pain (60)
1997 –	Symphysis pubis dysfunction (63-66)
2000 -	Focus on pelvic pain, several definitions suggested i.e. pelvic girdle pain or relaxation (67-70)

Prevalence and risk factors

In reviews, prevalence of LPP is said to be 25 - 90% (71, 72). This variability in prevalence figures is probably due to how LBP and PPGP are defined but there seems to be a connection to a cultural origin as well (48).

Mantle (1977) in a retrospective study found 48% of women reporting LBP during pregnancy (52). The first prospective study was carried out in 1984-85 and reported 49% prevalence (73).

In 2001 Albert defined four syndromes of pregnancy-related pelvic joint pain, pelvic girdle syndrome, symphyseolysis, one-sided or double-sided sacro-iliac joint syndromes (67). The overall incidence of objectively confirmed PPGP in pregnant women was 20.1%. Pelvic girdle syndrome incidence was 6.0%. This group

showed the most severe symptoms and had the worst prognosis. There seems to be an increasing prevalence in recent research with figures of more than 70% reported from 1999 (68, 74, 75). Whether this reflects a true increase or mirrors changing attitudes towards pain and sick listing is not clear and differences of terminology, countries, professions and study design make direct comparisons almost impossible. Pelvic pain in relation to pregnancy has often been said to be a problem in the northern European countries only but there are studies from all over the world (76, 77). Interestingly, Heiberg found that although pelvic pain during pregnancy is an unknown condition in Pakistan, Pakistani women in Norway experienced pelvic pain to the same extent as other pregnant women in Norway (78).

LBP is a major public health problem among women and is strongly related to pregnancy. It might occur as well during pregnancy as at any other time of life and the pregnancy is probably not a risk factor per se but LBP can accidentally coincide with pregnancy in time (14). The pain has great impact on daily life and influences not only the life of the pregnant woman herself but of the whole family. Despite the magnitude of the problem with approximately 50% of pregnant women experiencing pain during pregnancy, it is still unknown which women and when, even if a lot of risk factors have been identified. Research has focused on aetiology and treatment but “the whole truth and nothing but the truth” is not known as yet.

Generally, weak back muscles have been thought to correlate with LBP in pregnant women. Recent research, however, indicates that it might rather be the correlation between back and abdominal muscles that is of importance for LBP in the general population (15, 73). Research regarding LPP and pregnancy is now mainly focused on muscle function and correlation (17, 80-82).

Table 2 Suggested risk factors for low back pain

Biomechanical factors	(16, 53, 72, 83)
Pre-pregnancy factors	(17, 20, 84-88)
Work related factors	(23-26, 32, 84)
Smoking	(20, 24, 32)
Use of contraceptives	(20, 28, 88)
Female sex hormones	(54, 88-91)

In adult women, hormonal and reproductive factors are associated with chronic musculoskeletal pain in general. Factors related to increased estrogen levels may specifically increase the risk of chronic LBP (28).

Women who have suffered from LBP during a previous pregnancy run a higher risk to attract the same condition in the future, both during a subsequent pregnancy and during the non-pregnant state. Ninety-four percent of the women with previous disabling LBP during pregnancy report LBP in a subsequent pregnancy compared with 44% of controls (20). Women with disabling pain during pregnancy might give up future pregnancies (25).

The raised concentration of female sex hormones in serum during pregnancy may be responsible for *unspecified* back pain. It is primarily relaxin, with effects on muscles and tissues that has been of interest. Kristiansson et al (1996) found correlation between relaxin in early pregnancy (12 weeks) and PPGP later in pregnancy (89). Relaxin in early pregnancy, produced by the ovarian corpus luteum seems to influence the woman also when production of hormones takes place in the placenta (90). This could explain why PPGP in some women debuts very early in pregnancy, when physiological changes of the body have hardly taken place. These findings might help to explain differences between studies where relaxin is measured at onset of episode of PPGP and not shown to correlate with PPGP and studies indicating such a relation.

Table 3 Suggested risk factors for *pelvic* pain

Multiparity	(73, 76, 87)
Low age of woman	(54, 73, 76, 92)
Low socio-economic class	(92)
Level of education	(24)
Relaxin	(89, 90, 93)

LPP have a negative impact on perceived health and sexual life during pregnancy (47). Health problems are considered risk factors for developing postnatal depression and back pain can lead to significantly increased risk for depression within 6 months post partum. This, in turn, can negatively influence mother and baby attachment (45, 46, 94). Back pain can lead to significantly increased risk for depression within six months post partum. A link can be seen between maternal and emotional well-being and physical health and recovery (45). Women frequently report that LBP starts in relation to pregnancy, even if this pregnancy occurred several years earlier (85).

An important risk factor for developing pain is suggested to be lack of physical activity together with inappropriate working conditions (95). Regular exercises before pregnancy reduce risk for LBP during pregnancy (49). This could be a strong incitement for a good and life-long physical exercise culture. The American College of Obstetricians and Gynecologists (ACOG)'s Bulletin on Exercise during pregnancy and the post partum period states that, in absence of obstetric or medical complications, pregnant women can continue to exercise throughout pregnancy and derive related benefits (95). Women who have achieved cardiovascular fitness prior to pregnancy should be able to safely maintain that level of fitness during pregnancy and the post partum period. Depending on needs and physiological changes some women may have to modify exercise regimens. Maternal fitness and sense of well-being may be enhanced by exercise but beneficial effects in perinatal outcome have not been demonstrated (96-98).

Need for sick leave is a poor measure of effectiveness of treatment unless patient reactions are taken into account. Sick leave probably mirrors the society where research was conducted, social insurance systems, labour market and economy rather than objective needs. Differences between countries are probably more related to different systems and policies than to the needs of the pregnant women at the time studied. If there is a need for sick leave duration it is usually long, 50 days or more.

Pelvic pain in relation to pregnancy is often said to be an unknown problem outside Scandinavia or Europe, but PPGP is not a welfare complaint. Research has mainly been concentrated to Europe, especially Scandinavia, but there are studies presented from almost all over the world. Recent research report a prevalence of 49% in Sweden, 77% in Finland, 66% in Rufiji, Africa and 81% in Zanzibar (77). Due to Fast (1990) prevalence of PPGP is lower among Spanish women (55).

In short, the correlation between back and abdominal muscles and muscle functioning plays a role in the development of LPP during pregnancy. Smoking and biomechanical, pre-pregnancy and work related factors are suggested risk factors for LBP. For PPGP hormones are suggested a risk factor together with multiparity, young age, level of education and socio-economic class.

Management of pelvic pain

Individually designed programmes including counselling and adjusted physiotherapy are shown to be effective, not only during pregnancy but with remaining positive effects six years after delivery (table 4). A pelvic belt or support binder can possibly be of help to some women while others do not appreciate them at all. The most promising therapy seems to be acupuncture. Water gymnastics is also tested for symptom relief. (Table 4).

Table 4 Management, methods and principles

Support / counselling	(71, 92, 95)
Physiotherapy / training	(22, 30, 33, 60, 70, 80-82, 96-98, 100-101)
Pelvic belt	(22, 33, 102-104)
Massage	(22, 33)
Acupuncture	(105-109)
Water exercises	(74, 102, 110)

AIMS OF THE THESIS

A sedentary lifestyle is common among young people today and any physical activity that does not harm the pregnant woman or her baby should be encouraged (90, 91). Today, little is known about effects of physical programs available. In 1993 and 1994, a pilot study was conducted, offering water gymnastics for subjectively healthy, pregnant women. The results indicated positive effects on need for sick leave due to back pain (105) and showed no negative effects on mother or baby. Therefore, a comparison and evaluation was undertaken between a specially designed water aerobics programme and a gymnastics program, available all over Sweden, Friskis' and Sveltis' programme for pregnant women.

In contact with women with pelvic pain, an unexpectedly high prevalence of indigestion was discovered thus turning interest towards possible effects of LI on the development of pelvic pain. No earlier research on this topic has been found. A pilot study was designed, aimed at exploring the possibility of LI contributing to pain from the pelvic area, and especially to longstanding pain after pregnancy. The intention was to compare frequency of lactose intolerance in a group of women with longstanding PPP after pregnancy with a matched control group of mothers without such pain.

The aims of this thesis were to test two hypotheses:

A. Land based physical exercise, adjusted to pregnancy, or water aerobics, do not differ regarding pain from low back and/or pelvis and sick leave in pregnant women (study 1)

B. Lactose intolerance is more frequent in women with post partum PPP than in matched subjectively healthy females.

SUBJECTS AND METHODS

Study 1

A prospective, population-based study with randomised intervention was carried out to evaluate effects of regular exercises. Setting was a Swedish town with 55 000 inhabitants, consisting of both rural and urban areas. White and blue-collar workers were predominant among the population. Figures of unemployment were low when the study was planned but rose during study time, as well as all over Sweden.

Criteria for inclusion in the study were to be permanently living in the town area and attendance to either of three local Antenatal Care Centres, ACC. Women were informed of the study at the registration visit, usually around gestational week 12. They were free to enrol as soon as they wanted to, but generally participation started after the ultrasound examination in gestational week 17. Exercises were available during the whole pregnancy but with breaks during summer months.

Three-hundred-and-ninety interested women were randomly assigned, by date of birth, to either land-based physical exercise, LBPE, (n=198), specially designed for pregnant women, or to water aerobics (n=192), equally designed for pregnancy. Flow chart for eligible and recruited participants, following the CONSORT recommendations, is shown in figure 2 (page 17). Gymnastics/water aerobics took place once a week, starting at any time after the registration visit.

All women answered a questionnaire about age and previous experience of LPP, related or unrelated to pregnancy, and habits of physical activity. Subjective symptoms from the pelvis and/or low back were recorded. Their average age turned out to be 29 years (range 18-44 years). Symptoms reported from both pelvis and low back were recorded as pelvic pain since this condition is regarded as more serious, requiring special care. Records were kept at the ACC together with medical records, and filled out at every visit, regarding symptoms of pain from the pelvic area as well as need for sick leave. A summary was made at the antenatal check up visit, usually 10 to 12 weeks after delivery.

Statistics

Statistic analysis was undertaken per protocol. Student's t-test (independent samples) was used to compare mean age between groups. Mann-Whitney's test was used for skewed data such as number of days on sick leave. Chi-square-test was used for dichotomous variables (parity, symptoms, sick leave). Age and parity were analysed for each of the two randomised groups and means, ranges and standard deviation (S.D.) was calculated. Numbers needed to treat (NNT) with 95% confidence interval was calculated by Newsome's method.

Ethical considerations

The Ethical Committee of Gothenburg University approved the study (Dnr 268-95). Every registered woman obtained both oral and written information about the study and criteria for inclusion. Information was given about the possibility to cancel participation at any time. Those women who did not fulfil the criteria for participation obtained the same written information about low back pain and/or pelvic pain during pregnancy as the participants did and information about possibilities of taking part in physical activities other than those offered within the study.

Study 2

A pilot study was designed, consisting of 15 women under treatment for persisting pelvic pain after delivery. They should fulfil the same criteria for PPGP during pregnancy and at a second evaluation prior to inclusion. A control group was recruited, consisting of midwifery students (n=4), staff members at a maternal care unit (n=6) and women attending midwives for contraceptive counselling (n=5). Groups were matched for age, parity, ethnicity and smoking. Study participants and controls answered questionnaires on medical history, underwent lactose intolerance test and blood samples were monitored for IgA, IgE, IgG and s-Gliadin.

For lactose intolerance tests, the BH₂ – method was used. BH₂ hydrogen breath test is the most widely used procedure (111-114).

Subjects were instructed to refrain from eating high-carbohydrate meals the day prior to testing and to fast after 8 p.m. Exhaled BH₂ was initially measured on arrival to clinic. After ingesting 50g lactose in 200 ml of water exhaled BH₂ was measured again at 30 minute intervals for 180 minutes after ingestion. A rise in the BH₂ concentration of 20 – 50 PPM was considered as lactose malabsorption, a rise of > 50 PPM as lactose intolerance. This method is considered a fairly reliable method for the diagnosis of lactose intolerance (113).

Statistics

Two-tailed signs test was used to compare laboratory findings. In case of incomplete matching conditional logistic regression was used with presence of PGPP as independent variable.

Regarding lactose intolerance the recommended grading in three levels was adopted where less than 20 PPM in the BH₂ test during three hours was defined as lactose intolerance grade zero, 20-50 PPM as grade one and more than 50 PPM as grade two.

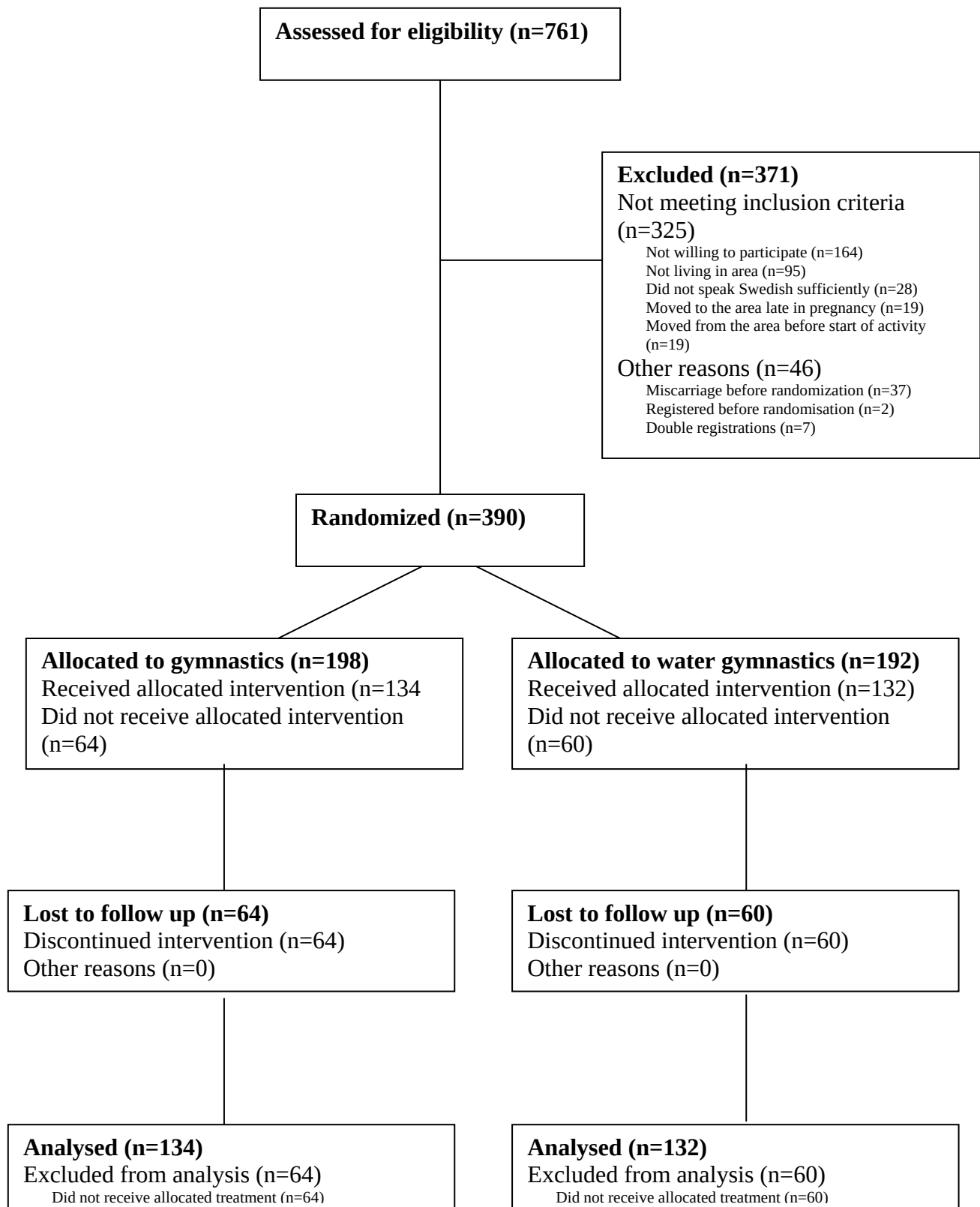


Figure 2. Participants flow in the intervention study (study 1).

Ethical considerations

The Ethical Committee of Gothenburg University approved the study (L 503-97 and L242-98). A physiotherapist, specialised in caring for women with longstanding pain after delivery, gave information about the study. Those willing to take part received written information, together with a questionnaire, and were informed that the researcher would contact them to arrange for testing. The testing took place at a hospital clinic and participants could bring a child, if they had difficulties in arranging childcare. After testing a light breakfast was served before leaving the hospital. Controls were recruited from the university, from women attending an ACC for counselling on contraceptives and among volunteers from a hospital ward. They had the same information about the possibility to cancel participation as participants and other conditions were as similar as possible. If positive test results, they were offered medical consultation and counselling within the study.

RESULTS

The intervention study (study 1) on exercise as a possible means for prevention of low back or pelvic pain during pregnancy attracted most registered women. Out of 761 consecutively registered pregnant women 325 did not meet inclusion criteria (fig 1). Randomisation included 390 women and 266 have been analysed. Inclusion usually took part in gestational week 19 (range 16-29) after routine ultrasound. A later start was mainly due to the interruption of activities during summer months. Dropouts had a higher prevalence of multiparity compared to those completing the study ($p=0.009$) but did not differ in any other respect.

The women attended sessions in the land-based physical exercises, LBPE group on average 13.5 times (range 5-19) and in the water aerobics group 16.2 times (range 5-19). In the LBPE group 134 women took active part compared to 132 women in water aerobics. Water aerobics diminished PLBP significantly better than gymnastics ($p=0.04$).

In this study 42% reported symptoms of PLBP, PPGP or both. Sick leave due to PLBP was significantly lower in the water exercise group with no one in this group on sick leave due to PLBP compared to six in the LBPE group ($p=0.03$). Number of days with sick leave due to any cause was significantly fewer in the water aerobics group ($p<0.001$).

The main findings were that water aerobics was shown to diminish sick leave and can be recommended to pregnant women. The benefits of LBPE are questionable and further evaluation is needed.

To contribute to possible explanations of PPGP a small prospective cross-sectional controlled study with 15 matched pairs was designed to investigate possible relations to LI (study 2). It was hypothesised that LI might be more frequently present among women with longstanding pain following pregnancy than in a normal Swedish female population. To test this, 15 women with known posterior pelvic pain during pregnancy and remaining pain more than 3 months after delivery were tested for lactose

intolerance. Patients and controls were matched for age, parity, ethnicity and smoking. Patients were recruited among women in treatment for persistent pain after delivery while controls had returned to work after their last delivery. Hence, there is a significant difference in the time interval between BH₂ and last delivery, with controls usually having a longer interval. This may be a confounding factor. However, both patients and controls in our study were tested fairly long after delivery, thus reducing the possibly confounding effect. Coeliaki and LI are frequently thought to correlate but in this study there was no finding of coeliaki among patients or controls. It might be that our study was too small to detect any correlation.

The main finding in this study was a strong correlation between PPGP and lactose intolerance. Lactose intolerance was more common in patients with PPGP than in healthy controls ($p=0.02$). This may have implications for future research on etiologic factors of PPP. No correlation was found between PPGP and celiac disease or allergic propensity. Reported allergy was equally distributed among patients and controls but number of allergens was somewhat greater among patients. Monitored antibodies (IgE) did not differ between groups.

DISCUSSION

The use of a population based study with registered women in a defined area and follow up after delivery provided a good picture of pain from low back and/or pelvis in a pregnant population. Every pregnant woman who fulfilled inclusion criteria (living within the area, registered at one of three ACC: s in the community and with enough knowledge of the Swedish language to be able to take part in activities) was invited to participate. Randomisation was made by day of birth, which was a simple way to divide participants in two groups but not the best way to randomise from a scientific perspective. By collecting data for the entire population, not only those actively involved, it has been possible to control for most of the negative effects from poor study design. Only those taking active part in the training were included in analysis, not everyone randomised. This could be a weakness, but it does not make sense to include everyone when the object studied is physical activity once a week for not more than 20 weeks. There are so many other factors in the participants' daily life that we cannot control so therefore comparisons cannot be relevant.

An intervention with physical exercise during pregnancy (study 1) showed positive effects from water aerobics regarding need for sick leave due to LBP. Adjusted gymnastics (not physiotherapy) during pregnancy has been offered for many years but an evaluation of possible effects has never been undertaken. Also, a comparison between two forms of physical activity and possible impact on need for sick leave is new.

NNT was calculated. Comparisons were made between the two activities but there was no control group without activities to compare with which is a weakness in study design. To avoid one woman with symptoms of LBP 9 women need to be treated, to avoid sick leave due to LBP 22 women need to be treated. A group generally consists of

10 to 15 women and should probably be cost effective taking into account symptoms as well as need for sick leave.

Water gymnastics turned out to be better than gymnastics for women with LBP regarding need for sick leave. Nobody in the water gymnastic group needed sick leave due to low back pain although symptoms were present. In the gymnastics group several participants needed sick leave for this reason. Such an effect for LBP, without pelvic pain involved, from water gymnastics during pregnancy has not been shown previously.

PP in relation to pregnancy is a special phenomenon and probably cannot be prevented by means of activity, but pregnant women with such pain often express a feeling of well being when offered warm water exercises. Women with an anamnesis of LBP when not pregnant should perhaps not be recommended to attend gymnastics even if adjusted for pregnant women. Water gymnastics turned out to be more effective than expected when a woman had symptoms of low back pain during pregnancy while water gymnastics is usually recommended to women with PPGP only.

Pregnancy is a period, where both mothers and fathers are highly motivated to change their lives in different directions. If adequate information is given, they are easily motivated towards a healthier life-style (115). Physical exercises in groups should be provided and groups should be easily available and be held during feasible hours (early evenings and Saturday/Sunday). Options for childcare or activities should be offered at the same time as exercise classes (29). Physical activities should be regarded as normal public health activity and do not replace usual counselling or treatment, if symptoms occur.

LPP as remaining result of pelvic problems during pregnancy is problematic, not only for the woman herself and her family. A person in long term pain probably involves his or her family in the pain process and the pain affects daily life of significant others (115). Society is affected in several aspects, too. For social insurance systems it means costs due to long term sick leave. To employers and the job market, problems will occur with employed women absent for long periods and a lack of competent personnel or skilled workers. Any effort to prevent LPP during pregnancy and postpartum would be beneficial for women, families and society. After delivery, a majority of women with low back or pelvic pain during pregnancy recover within three months. A small percentage, about 10%, will need help due to remaining symptoms, since spontaneous recovery later than after 3 to 6 months is seldom seen.

If an individual is aware of his or her own responsibility for his or her health and has access to tools to influence health, need for care will be lower and societal costs decrease. Activity habits are part of the life-style factors that are widely discussed today within public health. A more pronounced focus on life style and individual responsibility from school age and throughout life would be beneficial for the entire population, not only for pregnant women. But in order to involve women, more facilities are needed, not too far from where people live, at a low cost (29).

Recently, increased physical activity at school has been discussed as a powerful method to reduce stress levels among children and adolescents. If young people were aware of the fact that lack of physical activity might mean life-long health problems, this could be a strong incentive to a good and lasting physical exercise culture. Physical exercises during pregnancy do not negatively influence mother or child during pregnancy (117).

To better understand the mechanisms behind PP is important for many reasons. Professionals who meet with these women need to better understand the pain to be able to explain and support those suffering. The women and their families are desperately seeking information on their condition.

Women with long standing pelvic pain often have IBS (34). Furthermore, LI is correlated with IBS (34, 113,114). Thus, our finding of a correlation between LI and PPGP is in agreement with previous findings. IBS is more frequent in women than in men. Pelvic pain is a common cause for women to attend primary care. IBS and LI give similar symptoms and may coexist. Testing for LI is recommended in investigation of IBS.

In the study of lactose intolerance (study 2) participants should have had PPP (as defined by Östgaard 1994) during pregnancy and with the same condition after delivery (60). Therefore, patients were recruited from the only RPT in Gothenburg, specialised in treatment for women with longstanding PPP after delivery. For recruiting controls matching was made for age, parity, smoking and allergies. Furthermore, they should be of Swedish ethnicity, born by Swedish parents, to exclude ethnic influence on presence / absence of the gene that rules the possibility to break down lactose. Differing prevalence of lactose intolerance in ethnic groups could be a confounding factor. To avoid this, we chose to study only one ethnic group. Our patients fulfilled the criteria for PPP both during pregnancy and at the second evaluation before inclusion. This second evaluation was made 1-3 months before the laboratory tests. Thus, all patients had persistent pelvic pain, although we cannot exclude the presence of other components such as low back pain or psychological factors.

Control persons were recruited partly from students and staff. This could be a confounding factor although matched in important aspects. There was a great difficulty to recruit controls since the testing procedure lasted more than three hours, requiring half a day spent in the hospital. Control persons were not informed about what tests were to be investigated until just before testing to avoid the possible bias of already diagnosed LI.

The present results indicate a relationship between LI and PPGP. This type of statistical correlation, however, does not necessarily imply a causal relationship. LI shall be seen as one possible explanation of low back and/or pelvic pain in pregnancy. An explanation can sometimes make it easier to bear the pain and perhaps some changes in lactose intake can make the situation better. LI may be more prevalent than currently thought and if greater attention is paid to these matters, more low-lactose products will

probably emerge along with lower prices for specialised foods. This will make it easier for everyone to choose alternative food, not only pregnant women.

Planning and realisation of the intervention study included the introduction of a local care plan for pregnant women with LPP. The care plans mean cooperation in teams with RPT, midwife, and obstetrician and, occasionally, an orthopaedist for optimal care. In most cases a general practitioner should also be involved as maternity care services are generally closed at about 12 weeks after delivery. It is important to transfer responsibility for care to another person in the team so that the woman still has a contact within the health care sector and can be offered extended support and referral if needed.

Implications for future research

Today, research on PP and pregnancy is mainly focused on muscle function and methods of treatment before as well as during and after pregnancy in order to prevent or diminish symptoms. More research is needed to explain women's experiences of the pain and its influence on pregnancy and daily life. Furthermore, the possible relationship between pelvic pain and increased prevalence of post partum depression in a Swedish population could be of interest to investigate.

Further studies are needed to clarify connections and effects of physical exercise but so far we conclude that pregnant women with a history of low back pain, with or without relation to pregnancy, should not be encouraged to take part in gymnastics during pregnancy. We also conclude that the women, willing to take part in gymnastics should be recommended to quit if symptoms of low back and/or pelvic pain occur. Counselling by a physiotherapist might be beneficial to identify women at risk early in pregnancy. Perhaps water gymnastics would be beneficial for non-pregnant persons with acute low back pain as well?

Regarding LI and its possible relation to pelvic pain there is no other research than the small study presented here. Further research is needed to verify these findings.

A questionnaire on lactose intake and digestive symptoms has been used as a tool for diagnoses (118). If a questionnaire can identify persons at risk of being malabsorbers, this could be a cost-effective way of screening before starting time- and money-wasting tests. Those identified can be tested and offered counselling so that they are able to avoid negative reactions without unnecessarily excluding important foods from their diet. Intervention studies with reduced lactose intake as well as a long-term follow up of women with LI could be a possible way to gain new knowledge. Do these women run an increased risk for osteoporosis after menopause?

Correlation between LI and PPGP still needs to be confirmed. The possibility of a correlation with long-standing pelvic pain in women not fulfilling the criteria for posterior pelvic pain and lactose intolerance should be investigated. Future research should aim toward clarifying the mechanisms for LI as a risk factor, and at exploring the role of lactose intolerance as a prognostic factor and its implications in future intervention strategies. Furthermore, the risk for women with or without PP developing

osteoporosis later in life might be interesting to study. The women's own perception of the pain and its influence on daily life should be investigated in order to better understand their situation.

Health promotion and population based prevention regarding low back pain will probably generate positive effects for pregnant women as well, and, on the other hand, preventative efforts during pregnancy might generate new ideas for population based prevention.

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Water Aerobics Reduces Sick Leave due to Low Back Pain During Pregnancy

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Objective: To compare the effect of a land-based, physical exercise program versus water aerobics on low back or pelvic pain and sick leave during pregnancy.

Design: Randomized controlled clinical trial.

Setting: Three antenatal care centers.

Participants: 390 healthy pregnant women.

Interventions: A land-based physical exercise program or water aerobic once a week during pregnancy.

Main Outcome Measures: Sick leave, pregnancy-related low back pain or pregnancy-related pelvic girdle pain, or both.

Results: Water aerobics diminished pregnancy-related low back pain ($p = .04$) and sick leave due to pregnancy-related low back pain ($p = .03$) more than a land-based physical exercise program.

Conclusions: Water aerobics can be recommended for the treatment of low back pain during pregnancy. The benefits of a land-based physical exercise program are questionable and further evaluation is needed. *JOGNN*, 35, 465-471; 2006. DOI: 10.1111/J.1552-6909.2006.00066.x

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Introduction

Pain from the pelvic area occurs often during pregnancy. The terms describing this condition vary, making study comparisons difficult (Stuge, Hilde, & Vollestad, 2003; Wu et al., 2004). Recently, the

terms “pregnancy-related pelvic girdle pain” (PPP) and “pregnancy-related low back pain” (PLBP) have been proposed (Wu et al., 2004). More than one third of women experience back pain during pregnancy (Albert, 2001; Heiberg Endresen, 1995; Kristiansson, Svärdsudd, & von Schoultz, 1996; Mogren & Pohjanen, 2005; Ostgaard & Andersson, 1991; Perkins, Hammer, & Loubert, 1998; Runge, 1993; Stuge et al., 2003; Wang et al., 2004; Wu et al., 2004; Young & Jewell, 2005). This may interfere with work, daily activities, and sleep (Mens, Vlemming, Stoeckart, Stam, & Snijders, 1996; Perkins et al., 1998; Young & Jewell). Low back pain (LBP) before pregnancy increases the risk for long-standing LBP postpartum (Brynhildsen, Hansson, Persson, & Hammar, 1998). Long-standing LBP begins during pregnancy in 10% to 15% of cases (Brynhildsen et al., 1998; Svensson, Andersson, Hagstad, & Jansson, 1990).

Women with PPP will typically report fluctuating pain located at the sacroiliac joints, increased pain when turning in bed, and having a positive pain response to specific tests developed for PPP (Albert, Godskesen, & Westergaard, 2000). Management of pain from the pelvic area during pregnancy focuses on advice whereby no effective methods for treatment have been identified (Perkins et al., 1998). Low back pain may, of course, occur at any time and not just during pregnancy. Correct differentiation between PPP and PLBP is crucial for establishing correct care (Albert, 2001; Kristiansson et al., 1996; Perkins et al.; Wu et al., 2004). Pregnancy-related pelvic girdle pain and PLBP symptoms may, however, overlap or occur simultaneously. Both PPP and PLBP can become long-standing and prevention is important.

Moderate exercise is recommended at least three times a week during pregnancy to enhance maternal fitness and well-being.

Based on the findings of Clapp et al. (Clapp, 1990; Clapp, 2000; Clapp, Kim, Burciu, & Lopez, 2000), the American College of Obstetricians and Gynecologists (ACOG) recommends moderate exercise at least three times a week during pregnancy to enhance maternal fitness and well-being (ACOG Technical Bulletin no. 189, 1994). In a randomized controlled trial, water aerobics seemed to reduce sick leave due to PLBP when compared to no physical exercise (Kihlstrand, Stenman, Nilsson, & Axelsson, 1996; Young & Jewell, 2005). In the study by Kihlstrand et al. (1996), LBP was not defined and may have included women with pelvic pain as well. However, in present studies, it is unclear whether all physical exercise or only water aerobics are beneficial to women with PLBP or PPP (Brynhildsen et al., 1998; Perkins et al., 1998; Svensson et al., 1990).

The aim of this study was to compare the effect of land-based physical exercise (LBPE) with water aerobics, on pain (PLBP and PPP) and sick leave in pregnant women.

Methods

Pregnant women were invited to participate in a study evaluating physical activity during pregnancy. Prior to inclusion, midwives provided verbal and written information about the study. Women were asked to fill out a registration protocol including written consent. Those responsible for antenatal care in the area and the Ethical Committee of Göteborg University approved the study.

Selection of Women

Consecutive pregnant women registering for antenatal care at three antenatal care centers were invited to participate in a study of physical exercise during pregnancy. Inclusion occurred from August 1, 1995, to May 31, 1996. Participants were residents able to understand Swedish and willing to participate in the study.

Randomization

Participants were randomized to LBPE or water aerobics. Randomization was by date of birth (even dates allocated to water aerobics and odd to LBPE). Randomization was not blinded.

Interventions

Both interventions were especially designed for pregnant women and were well established and extensively

used throughout Sweden. They consisted of 45 minutes of activity followed by 15 minutes of relaxation. Weekly group interventions were begun soon after the initial registration visit took place (gestational week 11-12), continued throughout pregnancy, and were lead by experienced leaders. Leaders for LBPE groups were experienced aerobic instructors, and for water gymnastic groups, specially trained midwives.

Both interventions focused on strength, flexibility, and fitness, and included warming up, stretching, and relaxation.

Both interventions focused on strength, flexibility, and fitness, and included warming up, stretching, and relaxation at the end of each session. Land-based physical exercise was a set of exercises developed by physiotherapists for fitness during pregnancy. They consisted of movements accompanied by music of varying tempos. Focus was on improving aerobic and movement capacity including light jogging, sit-ups, and pelvic mobility exercises. Jumps and heavy loads were avoided.

Water aerobics consisted of exercises developed by midwives and physiotherapists for pregnant women. Water aerobics had the same focus on aerobic and movement capacity as LBPE but with considerably less risk for unwanted weight-bearing loading of anatomic structures. The main difference between interventions was the aquatic environments elimination of gravity and dampening resistance to movement. The movements in both interventions targeted similar muscle groups. However, due to the aquatic medium of the water-based exercises, they were not identical. In both groups, women with severe PPP were also offered individual physiotherapy. Women with only PLBP did not receive individual treatment.

Measurements

Women experiencing pain when attending a scheduled checkup of their pregnancy were referred to one of three physiotherapists for classification. They were examined using a standardized examination and classified with PLBP or PPP, or both (Table 1) (Ostgaard, Zetherstrom, & Roos-Hansson, 1994).

Two obstetricians at the antenatal care center were responsible for registering sick leave at each visit. If on sick leave from work or would have been whether she had a job, she was defined as in need of sick leave. If sick leave was partial, partial sick leave days were transformed to whole days. Since the majority was on full-time sick leave, missing data were registered as full-time sick leave.

TABLE 1
Criteria for PPP and PLBP

PPP	PLBP
A history of time- and weight bearing-related pain in the posterior pelvis, deep within the gluteal area	Tenderness of the back muscles
The pain was experienced for the 1st time during a pregnancy	The pain had normally been experienced before the 1st pregnancy ^a
A pain drawing with well-defined markings of stabbing in the buttocks distal and lateral to the L5-S1 area, with or without radiation to the posterior thigh or knee but not into the foot	Pain in the lumbar spine area with reduced or painful motion with or without radiation into the calf or foot
Free movements in the hips and spine and no nerve root syndrome	
Pain when turning in bed	
Pain-free intervals	
A positive “posterior pelvic pain provocation test (PPP test)” ^b	A negative “posterior pelvic pain provocation test”
<i>Note.</i> PPP = Pregnancy-related pelvic girdle pain; PLBP = Pregnancy-related low back pain. ^aAll criteria for PPP and PLBP had to be present except this one. However, almost all patients diagnosed as having PLBP had prior to their 1st pregnancy experienced low back pain. ^bThe PPP test was performed with the woman supine and the hip flexed to an angle of 90° on the side to be examined. A light manual pressure was applied to the patients flexed knee along the longitudinal axis of the femur, while pelvis was stabilized by the examiner’s other hand resting on the patient’s contralateral superior anterior iliac spine. The test was positive when patient felt a familiar, well-localized pain deep in the gluteal area on the provoked side.	

Statistics

Analysis was per protocol. Student’s *t* test was used to compare mean age between groups. Mann-Whitney’s test was used for skewed data such as sick leave. Chi-square test was used for comparing dichotomous variables such as parity, symptoms, and sick leave. The computer program Epi Info version 3 (Windows version) (Centers for Disease Control and Prevention (CDC), Atlanta, GA) was used for chi-square test, Student’s *t* test, and Mann-Whitney’s test.

Numbers needed to treat with 95% confidence interval was calculated by Newcombe’s method using the software Confidence interval Analysis version 2.1.1 (University of Southampton, Southampton, Great Britain).

Sample size was initially all available patients in the area during a 10-month period (summer excluded). A statistical sample size was not calculated.

Results

Out of 761 consecutively registered women, 325 did not meet the inclusion criteria (Figure 1). Of 436 eligible women, 89.5% (*n* = 390) participated. Average gestational age at inclusion was 19 weeks (range 16-29). Most participants started after an ultrasound examination at the 17th gestational week. A later start was mainly due to interruption of activities during summer months. Dropouts had a higher prevalence of multiparity compared to those completing the study (*p* = .009) but did not differ from

attendees in any other respect. Reasons for not participating were problems with babysitting, difficulties reaching the training area, and inability to attend daytime groups. When comparing baseline data, no statistical difference was seen between groups (Table 2).

The women attended an average of 13.5 (range 4-19) sessions in the LBPE group and 16.2 (range 5-19) in the water aerobics group. In the current study, 42% reported symptoms of PLBP or PPP, or both. They were on sick leave for an average of 63 days. Women in the water aerobics group had less PLBP compared to women in the gymnastics group (*p* = .04) (Table 3). No one in the water aerobics group was on sick leave due to PLBP, compared to six women in the LBPE group (*p* = .03) (Table 3). No other differences between groups could be seen.

Discussion

The incidence of PLBP and PPP during pregnancy in the current study is comparable to another Swedish study (Kihlstrand et al., 1996) but lower than reported in a Norwegian study (Heiberg Endresen, 1995). Furthermore, the duration of sick leave in this study is comparable to other Nordic studies (Björklund & Bergström, 2000; Kihlstrand et al.; Heiberg Endresen). Hansen, Vendelbo-Jensen, and Larsen (1996) reported less sick leave. However, direct comparison is difficult due to divergent study designs, pain definitions, and symptom descriptions (Albert, 2001; Stuge et al., 2003).

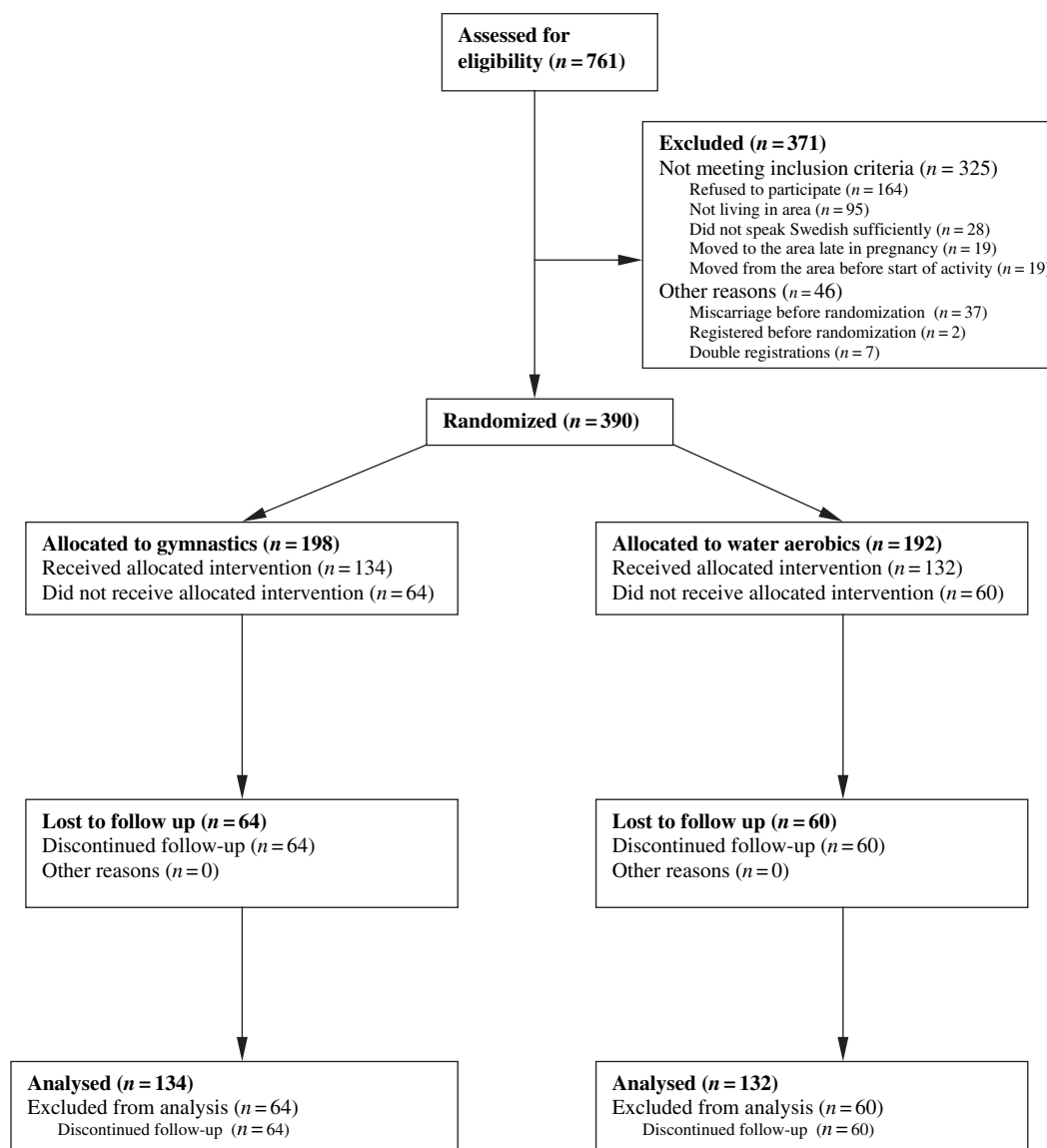


FIGURE 1
Participants flow.

Methodological Aspects

Randomization was by date of birth, which may be considered a suboptimal allocation method. Prior knowledge of randomization procedures might have affected midwives' introduction of the study to potential participants. However, in an open design with a problematic concealment of intervention where it is impossible to conceal treatment allocation, this possible bias was probably small compared to not concealing treatment allocation.

Before accepting participation and randomization, women were informed that interventions were group exercises or water aerobics once a week. It would perhaps have been better to let the women test each intervention before randomization and then ask whether they could accept both interventions. If not, they should not have been ran-

domized. Thus, in the current study, some were randomized to a form of physical activity they did not approve of. This has been pointed out as a reason for dropping out. The importance of freedom to choose exercise forms after personal preference is also acknowledged by Kardel and Kase (1998).

The ACOG has issued guidelines for exercise and recommend mild to modest regular exercise at least three times a week during pregnancy (ACOG Technical Bulletin no. 189, 1994). However, this was considered unrealistic. Thus, exercise once a week was chosen. Recently, a study from the Republic of Benin (Lawani et al., 2003) showed that pregnant women without medical counterindications can participate in antenatal gymnastics at a moderate pace.

TABLE 2
Baseline Values for Women Completing the Study

	<i>Land-Based Physical Exercise</i>	<i>Water Aerobics</i>	<i>p^a</i>
Number	134	132	—
Age—mean/ median ^b	29.2 (29) ± 4.54	29.1 (29) ± 4.50	NS
Age—range	18-41	19-39	NS
Nulli-/ multipara	66/68	65/67	NS

^a*p* value for comparison between groups. *p* > .05 is denoted NS.
^bMean (median) ± standard deviation.

The educational level of group leaders differed between groups. However, all leaders were very experienced and educated in their task, so it is our belief that the differences between groups were due to the intervention rather than the educational level of individual group leaders. The intervention had no time scheduled for individual consultations. However, the possibility that some pregnant women felt more secure with a midwife as group leader compared to a physiotherapist cannot be excluded. Both interventions were designed so that ordinary physiotherapists or midwives could function as group leaders without advanced leadership training.

Statistical estimates of sample size were not performed initially. A later power analysis revealed that power for

the three statistical significances found (Table 3) were 0.61, 0.70, and 0.23. To achieve a power of at least 0.80, this study should have been designed with a sample size of two groups each containing 206, 170, or 717 patients. Thus, this study should have been designed with a larger sample size. However, this does not eliminate the fact that differences were found between interventions (Table 3). With a larger sample size, even greater differences between interventions might have been found.

Pregnancy-Related Low Back Pain

There were no women on sick leave due to PLBP in the water gymnastic group as opposed to the LBPE group. If 22 pregnant women attended water aerobics, then one pregnant woman could avoid sick leave due to PLBP (Table 3). Since every activity group consisted of 10 to 12 women, the intervention was not costly. This implicates that water aerobics should be offered to pregnant women, especially those with PLBP. This effect of water aerobics on PLBP, in contrast to PPP, during pregnancy has not been previously reported.

Our finding of less sick leave in the group receiving water aerobics compared to the LBPE group is similar to another Swedish study comparing water aerobics with no exercise (Kihlstrand et al., 1996). This may indicate that the effect of LBPE on PLBP is no better than no exercise at all.

Pregnancy-Related Pelvic Pain

Pregnancy-related pelvic girdle pain in relation to pregnancy is a special phenomenon that can probably not be prevented by activity (Albert, 2001). By experience, pregnant women with PPP often express a feeling of well-being

TABLE 3
Pain and Sick Leave During Pregnancy

	<i>Land-Based Physical Exercise (n = 134)</i>	<i>Water Aerobics (n = 132)</i>	<i>p^a</i>	<i>NNT^b</i>
LBP ^c	34	19	.04	9.1 (5.2-33)
PP ^c	34	32	NS	—
Sick leave due to any cause ^d	23	14	NS	—
Sick leave due to LBP ^d	6	0	.03	22 (13-194)
Sick leave due to PP ^d	11	11	NS	—
Sick leave due to any cause ^e , number of days	9.8 (0) ± 27.6	6.1 (0) ± 22.4	<.0001	—

Note. LBP = low back pain; PP = pelvic pain.

^a*p* value for comparison between groups. *p* > .05 is denoted NS.

^bNumber needed to treat with water aerobics if land-based physical exercise considered as control (95% confidence interval).

^cNumber of women developing pain during pregnancy.

^dNumber of women in need of sick leave during pregnancy.

^eMean (median) ± standard deviation, days on sick leave during pregnancy. *p* value calculated with Mann-Whitney test due to skewed data.

when offered exercises in a temperate aquatic environment. However, an effect of water aerobics on PPP during pregnancy has not yet been documented.

Water aerobics has been shown to diminish sick leave and can be recommended to pregnant women.

Implications for Nursing and Future Research

Pregnant women should be encouraged to continue with moderate physical activity as long as possible. Water aerobics is a simple and inexpensive form of physical activity.

Future research should explore whether women with previous LBP are at greater risk for developing PLBP and consequently whether they could have an even greater benefit from water aerobics than this study shows.

Conclusion

Water aerobics has been shown to diminish sick leave and can be recommended to pregnant women. Some doubts regarding the benefits of LBPE have been raised.

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Lactose intolerance and long-standing pelvic pain after pregnancy – a case control study

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Abstract

Background. Long-standing pelvic pain during pregnancy and after delivery (PPP) is common. Its causes are not fully understood. A scientifically undocumented clinical observation is PPP patients often reporting unspecific abdominal pain and adverse reactions to milk. The main objective in this pilot study was to investigate if lactose intolerance, celiac disease or allergic propensity are risk factors for developing pelvic pain after delivery.

Methods. A matched case control study where consecutive patients consulting a registered physiotherapist specialized in treating women with post partum pelvic pain where compared to matched controls.

Results. Lactose intolerance was found in 10 of 15 patients, and in 3 of 15 matched, healthy controls ($p=0.05$). No difference was seen between groups in prevalence of celiac disease or allergic propensity.

Conclusion. This study suggests that lactose intolerance might be a possible risk factor for pelvic pain after delivery.

Keywords. Case-Control Studies, Lactose Intolerance, Pelvic Pain, Low Back Pain, Pregnancy

Abbreviations

LBP	low back pain
PLBP	pregnancy-related low back pain
PPP	pregnancy-related pelvic girdle pain
RPT	registered physiotherapist
IBS	irritable bowel syndrome

Introduction

Long-standing pelvic pain of at least six months among women is very common, and the community prevalence may be as high as 24% [1]. Pregnancy-related low back pain (PLBP) and pregnancy-related pelvic girdle pain (PPP) are frequently reported both during and after pregnancy [2-5].

PPP occurs in at least 20 – 30% of pregnant women in Scandinavia [6, 7]. Nine per cent of women with PPP are estimated to experience persistent pain of more than 18 months after delivery [4].

The etiology of PPP is not completely understood [5, 8]. Different biomechanical factors [7, 9, 10] or hormonal factors [3] are suspected.

A scientifically undocumented clinical observation is PPP patients often reporting unspecific abdominal pain and adverse reactions to milk. The population prevalence of lactose intolerance in western countries has been estimated to be 12%-17% [11-13]. Furthermore, there may be a correlation between celiac disease and unexplained skeletal disease [14]. A history of any type of allergic reaction has been shown to result in 43% greater odds for low back pain than those with no allergic history in the general population [15]. The possibility of a correlation between PPP and milk intolerance, celiac disease or allergic propensity has not been previously investigated.

The aim of the study was to compare the prevalence of lactose intolerance, possible celiac disease and allergic propensity in women with post partum PPP and individually matched healthy females.

Methods

Setting

All consecutive patients from the southern part of Bohuslän County, and from the city of Göteborg, October to December 1997, consulting one registered physiotherapist (RPT), specialized in treating women with post partum PP from this large geographic area. The ethics committee, Göteborg University, approved the study.

Patients

Women with diagnosed pelvic pain during pregnancy had typical onset early in pregnancy, fluctuating pain, nocturnal pain when turning in bed, absence of nerve root syndrome and a positive pain provocation test [16]. All women were re-evaluated for PPP at inclusion to ensure correct diagnose.

Furthermore, criteria for inclusion were also Swedish ethnicity (born in Sweden by Swedish parents) and not pregnant again.

Healthy controls

Every patient measured was paired with a healthy woman of Swedish ethnicity matched for age and being primipara or multipara. Matching of age aimed at an average difference within couples lower than 18 months with a maximum age difference in a single couple of no more than five years. If possible matching was also made for being smoker or not. Matching was performed after testing patients, but prior to testing of controls. Controls were recruited from midwifery students (n=4), staff members at a maternal care unit at Sahlgrenska hospital, Mölndal (n=6) and women attending a maternity care centre for prescription of contraceptives (n=5). Controls did not have PPP or PLBP during pregnancy.

Laboratory tests

Lactose intolerance was tested by breath hydrogen test (BH₂) [17]. IgA or IgG antibodies to gliadin were analyzed using DIG-ELISA. Anti-endomysium antibodies were detected by indirect immunofluorescence. An increase was considered possible celiac disease.

All individuals were questioned concerning history of allergy. The total IgE serum level was measured by radioimmunoassay (RIA) and values above 338 U/ml (population average + 2SD) were considered elevated.

Statistical analyses

Comparison of laboratory findings between groups was to be made with two-tailed signs test. In case of incomplete matching conditional logistic regression was to be used with presence of PPP or not as dependent variable. Patients with an increase of < 20 ppm in the BH₂ was defined as having lactose intolerance grade zero, 20-50 ppm as grade one, and > 50 ppm as grade two. For lactose intolerance three scenarios were analysed, having lactose intolerance or not where intolerance is defined as $\geq$ grade 1, defined as $\geq$ grade 2 or having a higher grade of lactose intolerance compared to the matched individual.

Results

Three of 22 consecutive, post partum women with PPP did not fulfil the inclusion criteria. One was of Korean ethnicity, one had pain after a car accident and one was pregnant. Sixteen of 19 women consented to participation but one moved before measurements could be taken. Thus, BH₂ was performed on 15 of 16 matched pairs (94%) and blood samples were analyzed from 14 of 16 pairs (88%). Blood samples from one healthy control were lost before analysis.

The mean age of patients was 35.4 years (range 30 - 41 years) versus 36.5 years (range 31 – 44 years) in the matched controls. Mean age difference within couples was 1.5 years with a

maximum age difference of four years. Number of pregnancies among patients was 2.5 (range 1-4) versus 2.7 (range 1-5) among controls. The mean time between last delivery and BH₂ was 33.2 months for patients (range 3–103 months) and 57.9 months for controls (range 4–156 months). Description of patients and controls are made in table 1.

No individuals had elevated total IgE or antibodies to gliadin or endomysium. Thus, this was not analysed statistically. Two patients had lactose intolerance, grade one, and eight had grade two. In the control group, two women had lactose intolerance grade one and one had grade two.

As seen in table 1 it was not possible to match completely for smoking. Thus, a conditional logistic regression was made with lactose intolerance and being smoker as independent variables. It shows that lactose intolerance (defined as $\geq$ grade 1) is slightly more common in patients with PPP compared to matched controls with odds ratio 7.84 (0.97-64, $p=0.054$). If lactose intolerance is defined as $\geq$ grade 2 we find similar result with odds ratio 7.86 (0.85-73, $p=0.069$). Using conditional logistic regression with rank for grade of lactose intolerance as an independent variable shows that lactose intolerance has a slightly higher grade in patients with PPP compared to matching controls ($p=0.054$).

Discussion

This small pilot study suggests a correlation between PPP and lactose intolerance. However, this study should be considered hypothesis generating suggesting strategies for future research.

Methodological aspects

Our patients fulfilled our criteria for PPP both during pregnancy and at the second evaluation 1-3 months before testing. Thus, all patients had PPP. Co morbidity of PPP might be higher in

patients attending for other causes than PPP. Thus, a clinic-based control group might have been more appropriate than healthy controls.

The prevalence of differing lactose intolerance in ethnic groups could be a confounding factor. To avoid this, we chose to study only one ethnic group. The use of BH₂ is considered a reliable and frequently used method for the diagnosis of lactose maldigestion [17, 18].

Is the correlation between PPP and lactose intolerance coincidental?

Due to practical and economical reasons we made a pilot study including 30 individuals, 15 patients and 15 individually matched healthy controls. The use of matched pairs design greatly decreases the need for having large numbers of individuals but including more individuals would of course have been better. The p-values between 0.054-0.069 obtained in this small pilot study indicates that this topic should be further investigated in future larger studies.

Women with long standing PPP often have irritable bowel syndrome (IBS) [19]. Furthermore, lactose intolerance is correlated with IBS [20]. Although our finding of a correlation between lactose intolerance and PPP is new it is in agreement with previous findings of a correlation between IBS and pelvic pain.

Is lactose intolerance a risk factor or an etiologic agent?

The present results indicate a relationship between lactose intolerance and post partum PPP. This type of statistical correlation, however, does not necessarily imply a causal relationship. Other factors might explain this statistical correlation. However, lactose intolerance might be a risk factor for post partum PPP.

Implications for future research

PPP is often a long-standing condition, causing individual suffering and costs for society. Its causes are not entirely known. If lactose intolerance could be verified as a risk factor for post partum PPP, it will have implications for future research and the prevention of PPP.

Correlation between lactose intolerance and PPP needs to be confirmed. The possibility of a correlation with long-standing pelvic pain in women not fulfilling the criteria for PPP and lactose intolerance should be investigated. Future research should aim toward clarifying the mechanisms for lactose intolerance as a risk factor, and to explore the role of lactose intolerance as a prognostic factor and its implications in future intervention strategies.

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Table 1. Description of participating individuals

	PPP ^a + Control ^b -	PPP + Control +	PPP - Control -	PPP - Control +
Smoking	1	0	12	2
Occupation – Skilled and unskilled workers	3	0	9	3
Occupation – Small scale employers, officials of lower rank and foreman	3	9	0	3
Occupation – Large scale employers and officials of high and intermediate rank	0	0	0	0
Pain – at menstruation	5	4	4	1
Pain – at ovulation	1	0	10	3
Abdominal symptoms present	5	4	4	2
Abdominal symptoms a health problem	1	0	13	1
History of allergy	0	1	13	1

^a Patients with pregnancy related posterior pelvic pain^b Matched controls without PPP