# Psychological determinants of pregnancy-related lumbo-pelvic pain: a prospective cohort study

ESTHER C. BAKKER[1], CAROLA W. VAN NIMWEGEN-MATZINGER[2], WINNEKE EKKEL-VAN DER VOORDEN[3], MARJAN D. NIJKAMP[1] & TRIJNTJE VÖLLINK[1]

[1]Department of Health Psychology, School of Psychology, Open University of the Netherlands, Heerlen, [2]In Balans Nu, Practice for Psychology and Kinesiology, Oudenbosch, and [3]Vriend, Psychology Practice, Maurik, the Netherlands

## Abstract

*Objective.* To study whether pregnancy-related lumbopelvic pain outcomes at 36 weeks of gestation can be predicted by psychological determinants earlier in pregnancy. *Design.* Prospective cohort study. *Setting.* Nine midwifery practices in different regions of the Netherlands. *Population.* A cohort of 223 low-risk pregnant women in the Netherlands was followed from week 12 of gestation until 36 weeks of gestation. *Methods.* Both psychological determinants and lumbopelvic pain symptoms were investigated with a set of questionnaires at 12, 24 and 36 weeks of gestation. Psychological determinants were measured with the Perceived Stress Scale (PSS), the Symptom Checklist-90-Revised (SCL-90), the Pregnancy-related Anxiety Questionnaire (PRAQ), and the Utrecht Coping List (UCL). Lumbopelvic pain outcomes were measured with the Pregnancy Mobility Index (PMI) and the Overall Complaints Index (OCI). *Main outcome measures.* Lumbopelvic pain symptoms and their impact at 36 weeks of gestation. *Results.* There was a significant increase in scores on both the PMI and OCI across the three sampling occasions in pregnancy. Lumbopelvic pain outcomes showed significant associations with the psychological determinants perceived stress and recently perceived psychological and physical distress at all three times during pregnancy. Pregnancy-related anxiety was not a significant predictor of lumbopelvic pain outcomes, neither was coping. *Conclusions.* Lumbopelvic pain symptoms and their impact on daily activities at 36 weeks of gestation can be predicted by psychological determinants earlier in pregnancy; the combination of perceived stress and physical disability at 24 weeks of pregnancy seems to be the best predictor of disability in later pregnancy.

**Abbreviations:** OCI, Overall Complaints Index; PMI, Pregnancy Mobility Index; PRAQ, Pregnancy-related Anxiety Questionnaire; PSS, Perceived Stress Scale; SCL-90, Symptom Checklist-90-Revised; T1, 12 weeks of gestation; T2, 24 weeks of gestation; T3, 36 weeks of gestation; UCL, Utrecht Coping List.

## Introduction

Lumbopelvic pain, which encompasses pelvic girdle pain and low back pain, as well as their combination, is common during and after pregnancy. About half of pregnant women experience some degree of pain in the pelvic

## Key Message

Strategies for prevention and early detection of lumbopelvic pain during pregnancy should not only be focused on physical strain, but should also include psychological determinants, like stress.

region and/or the low back in late pregnancy (1–3). Pregnancy-related lumbopelvic pain can have considerable consequences in terms of health and functioning (1,4–6).

Previous studies identified multiparity, a higher bodyweight, a pre-pregnancy history of low-back pain, and previous pregnancy-related lumbopelvic pain as predictors of lumbopelvic pain in pregnancy (7–10). Growing evidence suggests that pregnancy-related lumbopelvic pain not only arises from physical factors, but is also related to psychological determinants such as stress (2,8), catastrophizing and fear-avoidance beliefs (11). From previous research, it is known that psychological factors related to pregnancy complaints in later pregnancy differ across the three trimesters of pregnancy (12,13). Most of the reported studies did not follow the women during pregnancy (8–11).

In this study, we followed a group of pregnant women from the 12th week of gestation until 36 weeks to identify psychological determinants of lumbopelvic pain symptomatology. More specifically, we studied perceived stress, physical and psychological distress, pregnancy-related anxiety and coping styles, in relation to pregnancy mobility and overall complaints. The question examined is whether pregnancy-related lumbopelvic pain outcomes in late pregnancy can be predicted by psychological determinants in earlier pregnancy.

## Material and methods

In a prospective cohort study, a group of low-risk pregnant women in the Netherlands was followed from the 12th week of gestation until the 36th week. The women were recruited by nine midwifery practices in different regions of the Netherlands. A set of questionnaires was handed out by the midwife or the practice nurse and personally collected at three different points of time during pregnancy (12, 24 and 36 weeks of gestation). Women were eligible for the study if they were Dutch-speaking and had a normal pregnancy at intake. At 12 weeks of gestation (T1), all eligible pregnant women ($n = 271$) received written information about the study and the anonymous processing of data; 223 consented on participation, of which 217 completed all of the questionnaires at T1. The second questionnaire was administered to 98 women at 24 weeks of gestation (T2); three of the midwifery practices only administered questionnaires at 12 and 36 weeks because it was thought to be too burdensome for the women to fill out the questionnaires three times. At 36 weeks of gestation (T3), 171 of the respondents at T1 completed the third questionnaire. The study was approved by the Ethics Committee of the Open University of the Netherlands (cETO 08022013).

The outcome variable lumbopelvic pain is operationalized by two different scales measuring pain and mobility during pregnancy according to self-report: the Pregnancy Mobility Index (PMI) and the Overall Complaints Index (OCI). The PMI (14), originally based on the Quebec Back Pain Disability Scale (15), consists of 27 (sub)items concerning day-to-day activities, reflecting upon daily mobility, ability to perform household activities, and mobility outdoors. The total score varies from 0 to 81, with higher scores representing more severe symptoms of lumbopelvic pain.

To measure the impact of pelvic pain on daily activities, the OCI was used (16). With five questions, the OCI asks for the maximum amount of pain-free minutes when performing the following daily activities: walking, standing, sitting, lying down and difficulties in changing posture. A minimum score of 0 means that the patient is able to do all of the activities for at least 30 min without experiencing pain. The maximum score of 15 on the OCI means that the patient continuously experiences pain in all the activities and experiences difficulties when changing postures.

The Dutch version of the Perceived Stress Scale (PSS (17); Dutch version (18)) was used to measure stress at all three times in pregnancy. This scale consists of 14 items, which measure the perceived stress during the preceding 4 weeks; total scores range from 0 to 56. A higher score indicates more perceived stress.

Pregnancy-related anxiety was measured using a shortened version of the Pregnancy-related Anxiety Questionnaire (PRAQ) (19), measuring "fear of giving birth" (three items), "fear of bearing a handicapped child" (four items) and "concern about one's own appearance" (three items). Total scores can vary from 10 to 70, with higher scores representing more pregnancy-related anxiety.

The Dutch version of the Symptom Checklist-90-Revised (SCL-90-R) (20,21) was used to measure recently experienced physical and psychological distress. Possible total scores range from 90 to 450. Higher scores correspond with more physical and/or psychological complaints during the last week; 81 items comprise eight subscales: "anxiety" (10 items, range 10–50), "agoraphobia" (7 items, range 7–35), "depression" (16 items, range 16–80), "somatization" (12 items, range 12–60), "cognitive performance deficits" (9 items, range 9–45), "interpersonal sensitivity and mistrust" (18 items, range 18–90), "acting-out hostility" (6 items, range 6–30) and "sleep difficulties" (3 items, range 3–15).

To examine the coping strategies of the respondents, the Utrecht Coping List (UCL) was used (22). The UCL consists of 47 items, comprising seven scales. Similarly to the study of Huizink et al. (12), the scales were combined to form a scale for Problem-focused coping and a scale for Emotion-focused coping.

Furthermore, at 12 weeks of gestation, the women's age, body mass index, educational level, history of back

pain before pregnancy, parity and lumbopelvic pain in earlier pregnancies were registered. A more detailed description of the methods is published online as Supporting Information Data S1.

### Statistical analysis

Repeated measures analyses of variance were used to study changes between T1, T2 and T3. Multiple linear regression analyses were used to study the associations between potential psychological determinants on T1, T2 and T3, and the outcome variables at T3: the PMI and the OCI. Based on the literature (7–10), the following background variables were studied with correlation analyses and were also included in the regression analyses: parity, age at delivery, education, body mass index and back pain before pregnancy. To identify the strongest predictors of lumbopelvic pain at 36 weeks of pregnancy, separate multiple linear regression analyses were conducted; with PMI scores and OCI scores earlier in pregnancy (at T1 and T2), and the significant psychological determinants as independent variables. The statistical analyses were conducted in SPSS 18.0 (SPSS Inc., Chicago, IL, USA). In the statistical analyses, a *p*-value < 0.01 was considered significant, unless mentioned otherwise.

## Results

In total, 223 low-risk pregnant women from different regions within the Netherlands were included in this study, of which 217 completed the questionnaires at 12 weeks of gestation (T1), 98 at 24 weeks of gestation (T2) and 171 at 36 weeks of gestation (T3). Table 1 presents the characteristics of the study population. The drop-outs at T2 did not differ from the respondents with respect to their clinical characteristics. However, their scores on the PSS, the SCL-90 and the PRAQ at T1 and T3 were higher when compared with the women who did respond at T2 (17.5 vs. 13.1 on the PSS at T1, *p* < 0.001; 118 vs. 107 on the SCL-90 at T1, *p* < 0.001; and 27.2 vs.

22.7 on the PRAQ at T1, *p* = 0.002). The drop-outs at T3 did not differ from the respondents at T3 with respect to clinical or psychological variables.

Table 2 shows the means and standard deviations for all psychological measures and lumbopelvic pain outcomes at all three points in time. Repeated measures analysis of variance showed a significant increase in lumbopelvic pain symptoms and their impact on both the PMI and the OCI across the three points of time in pregnancy. Furthermore, significant differences between T2 and T3 were found in the scores on the SCL-90 total scale and all SCL-90 subscales. There was a particular increase in cognitive performance deficits and sleep problems during the last trimester of pregnancy. The scores on the PSS, the UCL and the PRAQ did not change significantly during pregnancy.

The scores on the PMI and the OCI showed a strong significant correlation (*R* = 0.743, *p* < 0.001 at T3). Both lumbopelvic pain outcomes showed significant associations with the psychological determinants PSS and SCL-90 scores at all three moments during pregnancy (Table 3). Pregnancy-related anxiety was not a significant predictor of lumbopelvic pain outcomes, neither was coping (UCL Social support, UCL Problem-focused coping and UCL Emotion-focused coping, Table 3).

From the measured background variables (parity, age, education, body mass index and back pain before pregnancy), only parity and back pain before pregnancy showed significant correlations with lumbopelvic pain outcomes (*R* = 0.201, *p* = 0.009 and *R* = 0.280, *p* < 0.001 for PMI at T3, for parity and back pain, respectively; and *R* = 0.238, *p* = 0.002 and *R* = 0.303, *p* < 0.001 for OCI at T3). Including the background variables as covariates in the models did not change the results. Most of the adjusted associations between lumbopelvic pain outcomes at 36 weeks and the scores on the PSS and the SCL-90 during pregnancy were again significant. The non-significant results from Table 3 remained non-significant after adjustment for the mentioned covariables.

No significant interactions could be found between the psychological determinants and parity in the models predicting lumbopelvic pain outcomes. Moreover, the interactions between the coping scores (UCL Emotion-focused coping and UCL Problem-focused coping) and the scores on the PSS were studied, but no significant interaction between these variables could be found at any of the three moments during pregnancy.

To determine whether the significant psychological determinants added to the prediction that was based on physical factors only, a model with both PMI scores earlier in pregnancy and either PSS scores or SCL-90 scores as independent variables was tested. In simple linear regression analyses, PMI scores at T1 significantly

**Table 1.** Clinical characteristics of the study population (*n* = 223).

| Characteristic | Mean (SD) or *n* (%) |
|---|---|
| Age (years) | 30.5 (4.10) |
| Body mass index before pregnancy (kg/m$^2$) | 24.2 (4.20) |
| Parity (Primiparae/multiparae) | 115/107 (52/48%) |
| Education (low/middle/high) | 27/162/30 (12/74/14%) |
| Backpain before pregnancy (never/sometimes/frequently/always) | 76/110/27/6 (35/50/12/3%) |
| Lumbopelvic pain in previous pregnancy (yes/no) | 11/209 (5/95%) |

**Table 2.** Psychological measurements and lumbopelvic pain outcomes at T1, T2 and T3.

| | T1 12 weeks ($n$ = 217) Mean (SD) | T2 24 weeks ($n$ = 98) Mean (SD) | T3 36 weeks ($n$ = 171) Mean (SD) |
|---|---|---|---|
| PMI total | 3.5 (5.54)[a] | 10.5 (10.50)[b] | 18.2 (13.44)[c] |
| OCI | 1.2 (2.05)[a] | 2.0 (2.37)[b] | 3.2 (2.80)[c] |
| PSS | 15.6 (7.64) | 13.0 (7.32) | 15.8 (7.46) |
| SCL total score | 113.5 (21.10)[a] | 109.5 (19.43)[a] | 126.1 (27.41)[b] |
| SCL anxiety | 11.6 (2.76)[a] | 11.1 (2.19)[a] | 12.1 (2.90)[b] |
| SCL agoraphobia | 7.4 (1.38)[a] | 7.3 (0.86)[a] | 7.9 (2.18)[b] |
| SCL depression | 21.8 (5.62)[a] | 20.3 (5.86)[a] | 22.4 (5.56)[b] |
| SCL somatization | 17.7 (4.49)[a] | 16.7 (4.31)[a] | 19.1 (5.58)[b] |
| SCL cognitive performance deficits | 12.4 (3.50)[a] | 12.6 (3.45)[a] | 15.7 (5.39)[b] |
| SCL interpersonal sensitivity | 20.8 (4.39)[a] | 19.9 (3.05)[a] | 22.2 (5.12)[b] |
| SCL acting-out hostility | 7.3 (1.83)[a] | 7.0 (1.31)[a] | 7.8 (1.98)[b] |
| SCL sleep difficulties | 4.6 (1.98)[a] | 5.0 (2.27)[b] | 6.5 (2.79)[c] |
| PRAQ | 25.2 (10.38) | 22.8 (10.01) | 25.5 (10.31) |
| UCL PFC | 46.1 (7.46) | 45.4 (7.94) | 45.7 (7.48) |
| UCL EFC | 47.8 (6.97) | 46.3 (7.99) | 48.1 (7.37) |

[a,b,c]Significant differences are indicated by different letters (a differs from b and c, b differs from a and c etc.); significances based on Repeated measures analyses of variance with complete cases only.
PMI, Pregnancy Mobility Index; OCI, Overall Complaints Index; PSS, Perceived Stress Scale; SCL-90, Symptom Checklist-90-Revised; PRAQ, Pregnancy-related Anxiety Questionnaire; UCL, Utrecht Coping List; PFC, Problem-focused coping; EFC, Emotion-focused coping.

**Table 3.** Associations between lumbopelvic pain outcomes at 36 weeks and psychological determinants at 12, 24 and 36 weeks of pregnancy (T1, T2 and T3, respectively).

| | PMI | | | OCI | | |
|---|---|---|---|---|---|---|
| | B[a] (SE) | β[b] | $p$ | B[a] (SE) | β[b] | $p$ |
| PSS T1 | 0.561 (0.148) | 0.291 | 0.000 | 0.077 (0.031) | 0.195 | 0.014 |
| PSS T2 | 0.845 (0.200) | 0.427 | 0.000 | 0.181 (0.042) | 0.439 | 0.000 |
| PSS T3 | 0.702 (0.128) | 0.390 | 0.000 | 0.108 (0.028) | 0.289 | 0.000 |
| SCL total score T1 | 0.201 (0.055) | 0.278 | 0.000 | 0.037 (0.012) | 0.242 | 0.002 |
| SCL total score T2 | 0.306 (0.087) | 0.368 | 0.001 | 0.067 (0.018) | 0.388 | 0.000 |
| SCL total score T3 | 0.196 (0.050) | 0.408 | 0.000 | 0.033 (0.011) | 0.315 | 0.004 |
| PRAQ T1 | 0.066 (0.102) | 0.051 | 0.518 | −0.001 (0.021) | −0.004 | 0.962 |
| PRAQ T2 | 0.166 (0.151) | 0.123 | 0.274 | 0.068 (0.031) | 0.241 | 0.031 |
| PRAQ T3 | 0.198 (0.099) | 0.152 | 0.048 | 0.024 (0.021) | 0.089 | 0.250 |
| UCL PFC T1 | 0.071 (0.144) | 0.039 | 0.625 | 0.024 (0.030) | 0.063 | 0.427 |
| UCL PFC T2 | 0.028 (0.192) | 0.016 | 0.885 | 0.000 (0.041) | 0.000 | 0.997 |
| UCL PFC T3 | −0.115 (0.138) | −0.064 | 0.406 | −0.027 (0.029) | −0.074 | 0.343 |
| UCL EFC T1 | −0.039 (0.161) | −0.019 | 0.811 | 0.005 (0.034) | 0.011 | 0.886 |
| UCL EFC T2 | 0.272 (0.201) | 0.151 | 0.180 | 0.066 (0.042) | 0.175 | 0.120 |
| UCL EFC T3 | 0.111 (0.140) | 0.062 | 0.428 | 0.022 (0.029) | 0.059 | 0.444 |

[a]Regression coefficient with standard error; [b]Standardized regression coefficients.
PMI, Pregnancy Mobility Index; OCI: Overall Complaints Index; PSS, Perceived Stress Scale; SCL-90, Symptom Checklist-90-Revised; PRAQ, Pregnancy-related Anxiety Questionnaire; UCL, Utrecht Coping List, PFC: Problem-focused coping, EFC: Emotion-focused coping.

predicted PMI scores at T3 ($R^2$ = 0.190, $p$ < 0.001). Adding SCL-90 total scores at T1 did not change the model ($R^2$ = 0.193, $p$-change = 0.077). However, adding PSS scores at T1 slightly changed the model ($R^2$ = 0.222, $p$-change = 0.014).

PMI scores at T2 were an even stronger predictor of PMI scores at T3 ($R^2$ = 0.528, $p$ < 0.001), compared with

the PMI scores at T1. Adding SCL-90 total scores at T2 did not change the model ($R^2$ = 0.539, $p$-change = 0.141). However, adding PSS scores at T2 significantly changed the model ($R^2$ = 0.572, $p$-change = 0.006). Both PMI at T2 (β = 0.657, $p$ < 0.001) and PSS at T2 (β = 0.220, $p$ = 0.006) were independent significant predictors of PMI scores at T3. The combination of these two

measures at T2 predicted 57% of the variance in scores on the PMI at T3. The results of analyses with OCI scores as dependent variable were comparable, but less significant. As an indication, the model with the OCI score on T2 and PSS scores on T2 as independent variables predicted 37% of the variance in OCI scores on T3 (β OCI = 0.474, $p < 0.001$; β PSS = 0.224, p < 0.05).

## Discussion

The results of this study indicate that the scores on the PSS and the SCL-90 at 12, 24 and 36 weeks of gestation show significant associations with the lumbopelvic pain outcomes at 36 weeks, as measured with the PMI and the OCI. These results correspond with the earlier studies of Albert et al. (8) and Robinson et al. (2), suggesting that psychological determinants play a role in the etiology of lumbopelvic pain. Pregnancy-related anxiety and coping did not predict lumbopelvic pain outcomes. An earlier study, among nulliparous low-risk pregnant women, showed a negative relation between emotion-focused coping in early and mid-pregnancy, and pregnancy complaints in general in late pregnancy (12). However, lumbopelvic pain was not included in the list of pregnancy complaints in this study, which impedes comparison of these results with our study.

Previous studies identified multiparity, a higher body weight, a pre-pregnancy history of low-back pain, and previous lumbopelvic pain as predictors of lumbopelvic pain in pregnancy (8–10). Of the background variables included in our study (parity, age, education, body mass index and back pain before pregnancy), only parity and back pain before pregnancy showed significant correlations with lumbopelvic pain outcomes. Including these background variables as covariates in the regression models did not change the results: after adjustment for background variables, the scores on the total PSS and the total SCL-90 at 12, 24 and 36 weeks of gestation significantly predicted the lumbopelvic pain outcomes; the scores on pregnancy-related anxiety and coping did not.

According to the bio-psychosocial model (23), emotional distress may predispose people to experience pain or may be a moderator that amplifies or inhibits the severity of pain (24). A large study on back pain in the general population, for example, showed that cognitive factors predict later pain intensity and disability (25). The association between psychological factors and lumbopelvic pain outcomes found in this study also points in the direction of a complex interaction between biological, psychological and social factors, as described in the biopsychosocial model (23).

To prevent the development of more severe lumbopelvic pain symptoms, it is important to identify women at risk early in pregnancy. Besides the physical factors mentioned by Albert et al. (8), it can be concluded from this study that scores on psychological measures can be the starting point in the early detection of women at risk of developing lumbopelvic pain. Our longitudinal cohort study allows a comparison of the impact of the scores on the PSS and the SCL-90 measured in any of the three pregnancy trimesters. Based on the standardized regression coefficients for each of the independent predictors, the second pregnancy trimester seems to be the best period to detect high levels of distress. The strongest prediction of lumbopelvic pain outcomes at 36 weeks was the combination of physical factors (PMI scores) and psychological factors (PSS scores) at 24 weeks of gestation. Based on these results, screening pregnancy at mid-term on both physical complaints and psychological distress seems to offer the best opportunity to detect women at risk for pelvic girdle complaints in later pregnancy. However, our results could be distorted by the high number of drop-outs at 24 weeks, due to the limited questionnaire administration by three of the midwifery practices. These drop-outs at T2 scored higher on the PSS, the SCL-90 and the PRAQ at T1 and T3, compared with the women who did respond at T2. If these drop-outs had answered the questionnaires at T2, it is expected that the mean scores on these measurements, as well as their variations, would have been higher. The scores on the SCL-90 in our pregnant population were higher than in the general population of mothers (26), but lower than in patients diagnosed with peripartum pelvic pain syndrome (21). Scores on the PSS in our sample seemed to be somewhat lower than in samples from the general population (17). The scores on lumbopelvic pain outcomes were also rather low in our study, as compared with, for example, the study of Röst et al. (16). However, women in the study of Röst et al. already experienced pelvic pain before selection, whereas our study was performed on a general low-risk pregnancy population. In other studies, lumbopelvic pain is treated as a categorical variable; women reporting pelvic pain during pregnancy were compared with other groups with either "no pain" or other pain symptoms. We chose to use graded scales to differentiate the severity of lumbopelvic pain symptoms, as recommended by Croft (27).

Although a lot of women experience lumbopelvic pain during late pregnancy (1–3), many of them quickly recover after delivery (1,28). A minority of women still experience lumbopelvic pain up to 2 years postpartum (28). Remaining lumbopelvic pain after pregnancy can have a huge impact on functioning in daily life (29). Future studies should, therefore, pay more attention to prediction and early detection of remaining lumbopelvic pain after pregnancy.

Future studies should also address the most efficient way to detect women at risk. The questionnaires used in our study are complex to use in clinical practice. As the strongest prediction of lumbopelvic pain outcomes at 36 weeks of gestation was the combination of the PMI and the scores on the PSS, measurements in clinical practice may be limited to these two questionnaires of 27 and 14 items, respectively; either in combination with physical examination or not (2,30).

Finally, future studies should aim to develop strategies for prevention of lumbopelvic pain. The associations found in this study, show that these preventive strategies should not only be focused on physical strain, but should also include psychological determinants, especially stress. Psychological interventions can address stress management, coping strategies, psychoeducation and social support, and may be included in antepartum care. Such interventions may also help to prevent other adverse pregnancy outcomes related to distress, such as maternal depressive symptoms and behavioral or emotional problems in the offspring.

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## References

1. Bastiaanssen JM, de Bie R, Bastiaenen CHG, Heuts A, Kroese MEAL, Essed GGM, et al. Etiology and prognosis of pregnancy-related pelvic girdle pain: design of a longitudinal study. BMC Public Health. 2005;5:1.
2. Robinson HS, Veierød MB, Mengshoel AM, Vøllestad NK. Pelvic girdle pain – associations between risk factors in early pregnancy and disability or pain intensity in late pregnancy: a prospective cohort study. BMC Musculoskelet Disord. 2010;11:91.
3. Wu WH, Meijer OG, Uegaki K, Mens JMA, van Dieën JH, Wuisman PIJM, et al. Pregnancy-related pelvic girdle pain (PPP), I: terminology, clinical presentation and prevalence. Eur Spine J. 2004;13:575–89.
4. Gutke A, Ostgaard HC, Oberg B. Pelvic girdle pain and lumbar pain in pregnancy: a cohort study of the consequences in terms of health and functioning. Spine. 2006;31:E149–55.
5. 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 Gynaecol Scand. 2004;83:351–7.
6. Robinson HS, Eskild A, Heiberg E, Eberhard-Gran M. Pelvic girdle pain in pregnancy: the impact on function. Acta Obstet Gynaecol Scand. 2006;85:160–4.
7. Bjelland EK, Eskild A, Johansen R, Eberhard-Gran N. Pelvic girdle pain in pregnancy: the impact of parity. Am J Obstet Gynecol. 2010;203:146. e1–6.
8. Albert HB, Godskesen M, Korsholm L, Westergaard JG. Risk factors in developing pregnancy-related pelvic girdle pain. Acta Obstet Gynaecol Scand. 2006;85:539–44.
9. Larsen EC, Wilken-Jensen C, Hansen A, Jensen DV, Johansen S, Minck H, et al. Symptom-giving pelvic girdle relaxation in pregnancy. I: prevalence and risk factors. Acta Obstet Gynaecol Scand. 1999;78:105–10.
10. Mogren IM, Pohjanen AI. Low back pain and pelvic pain during pregnancy: prevalence and risk factors. Spine. 2005;30:983–91.
11. 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.
12. Huizink AC. Robles de Medina, PG, Mulder EJH, Visser, GHA, Buitelaar JK. Coping in normal pregnancy. Ann Behav Med. 2002;24:132–40.
13. Huizink AC, Mulder EJH, Robles de Medina PG, Visser GHA, Buitelaar JK. Is pregnancy anxiety a distinctive syndrome? Early Hum Dev. 2004;79:81–91.
14. van de Pol G, de Leeuw JRJ, van Brummen HJ, Bruinse HW, Heintz APM, van der Vaart CH. The Pregnancy Mobility Index: a mobility scale during and after pregnancy. Acta Obstet Gynaecol Scand. 2006;85:786–91.
15. Kopec JA, Esdaile JM, Abrahamowicz M. The Quebec back pain disability scale. Spine. 1995;20:341–52.
16. Röst CCM, Kaiser JA, Verhagen AP, Koes BW. Pelvic pain during pregnancy: a descriptive study of signs and symptoms of 870 patients in primary care. Spine. 2004;29:2567–72.
17. Cohen S, Kamarc T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24:385–96.
18. Vingerhoets AJJM, van Tilburg MAL. The Dutch translation of the Perceived Stress Scale. Tilburg: Katholieke Universiteit Brabant, Department of Psychology, 1987.
19. van den Bergh B. The influence of maternal emotions during pregnancy on fetal and neonatal behavior. Pre- Peri- Psychol J. 1990;5:119–30.
20. Arrindell WA, Ettema JHM. Klachtenlijst Symptom Check List (SCL-90). Lisse: Swetz & Zeitlinger B.V, 1986.
21. Arrindell WA, Barelds DPH, Janssen ICM, Buwalda FM, van der Ende J. Invariance of SCL-90-R dimensions of symptom distress in patients with peri partum pelvic pain (PPPP) syndrome. Br J Clin Psychol. 2006;45:377–91.
22. Schreurs P, van de Willige G, Brosschot J, Tellegen B, Graus G. De Utrechtse Coping Lijst: UCL Handleiding. Lisse: Swets & Zeitlinger, 1993.
23. Engel GL. The need for a new medical model: a challenge for biomedicine. Science. 1977;196:129–36.

24. Gatchel RJ, Peng YB, Peters ML, Fuchs PN, Turk DC. The biopsychosocial approach to chronic pain: scientific advances and future directions. Psychol Bull. 2007;133:581–624.

25. Demmelmaier I, Åsenlöf P, Lindberg P, Denison E. Biopsychosocial predictors of pain, disability, health care consumption, and sick leave in first-episode and long-term back pain: a longitudinal study in the general population. Int J Behav Med. 2010;17:79–89.

26. Müller JM, Postert C, Beyer T, Funiss T, Achtergarde S. Comparison of eleven short versions of the Symptom Checklist 90-Revised (SCL-90-R) for use in the assessment of general psychopathology. J Psychopathol Behav Assess. 2010;32:246–54.

27. Croft P. The question is not "have you got it"? But "how much of it have you got"? Pain. 2009;141:6–7.

28. Albert H, Godskesen M, Westergaard J. Prognosis in four syndromes of pregnancy-related pelvic pain. Acta Obstet Gynecol Scand. 2001;80:505–10.

29. Nielsen LL. Clinical findings, pain descriptions and physical complaints reported by women with post-natal pregnancy-related pelvic girdle pain. Acta Obstet Gynecol Scand. 2010;89:1187–91.

30. Vleeming A, Albert HE, Ostgaard HC, Sturesson B, Stuge B. European guidelines for the diagnosis and treatment of pelvic girdle pain. Eur Spine J. 2008;17:794–819.

## Supporting information

Additional Supporting Information may be found in the online version of this article:

**Data S1.** Material and methods.