國立臺灣大學醫學院護理學系

博士論文

Department of Nursing
College of Medicine
National Taiwan University

Doctoral Dissertation

第三妊娠期孕婦下背疼痛強度與疼痛干擾及其相關因素探討之縱貫性研究

Low Back Pain Intensity and Interference and Related Factors in the Third Trimester Pregnant Women: A Longitudinal Study

張皓媛

Hao-Yuan Chang

指導教授：賴裕和 博士

Advisor: Yeur-Hur Lai, Ph.D.

中華民國 100 年 8 月

August, 2011

國立臺灣大學博士學位論文
口試委員會審定書

第三妊娠期孕婦下背疼痛強度與疼痛干擾及其相關因素探討之縱貫性研究

Low Back Pain Intensity and Interference and Related Factors in the Third Trimester Pregnant Women: A Longitudinal Study

本論文係張皓媛君（F94426005）在國立臺灣大學護理學系、所完成之博士學位論文，於民國一百年五月十日承下列考試委員審查通過及口試及格，特此證明

口試委員：賴裕和博士（指導教授）

李建南博士

孫秀卿博士

楊雅玲博士

蕭妃秀博士

Dr. Mark P. Jensen

致謝

成就這本論文的漫長旅程中，我想要感謝許多人。首先，非常感謝我的指導教授賴裕和老師，老師在整個博士班學習過程中，總是循循善誘，引領我找到適合的主題，並且有計畫地深入發展，時時犀利地點出問題所在。雖然在這個學習過程中，壓力真的很大，但也因此學習密度也很大。老師常常告訴我們她在博士班求學過程中努力的事蹟，讓我們從來不敢懈怠。老師有一股神奇的力量，就是一眼就能看出學生報告的深度，並且依照學生的特性，各階段使用不同的方式來教導。更感謝的，雖然我很執著而難以改變，但老師自始至終都沒有放棄我，持續地給我指引和支持，並且帶領我領略研究的精神與藝術，我會記得老師每每教誨的，把研究回饋社會，促進婦女健康。

I fully appreciate Professor *Mark P. Jensen*, University of Washington, Seattle. I admire Mark's kindness and generosity. Mark spent lot of time discussing with me during my dissertation development. Mark has magic abilities that he can always have positive thinking and make people relax (even facing very big stress like this doctoral dissertation). Mark is a role model for me both in his academic achievement and his kindness.

感謝蕭妃秀老師，老師提出的問題每每都給我很大的啟發，去思考探索變項間更深入的關係；而老師身上散發出的那股平靜而愉悅的氛圍，也帶給學生很大的安定。感謝孫秀卿老師，每每在百忙之中抽出時間與我討論論文的統計分析，並且提供許多資料作為依據和參考，感謝孫老師對於研究的細心與執著，使這份論文遇到的幾個瓶頸關卡得以順利解決通過。感謝楊雅玲老師，在論文成形的過程中給予寶貴的意見，因此收集到更完整的資料，也感謝老師與學生討論此議題在臨床的應用，提點問題並指引可能的方向，學生很感謝老師的付出。感謝李建南主任，在收案過程中給予的大力協助，並且提供臨床上的精闢觀點與建議，使得這本論文有臨床上更高的應用價值。

在這條努力學習創造知識的路上，我由衷地感謝總是相互打氣的同學們：幼婕、嘉玲、惠芬、佩青、雅文，以及時常給予照顧與睿智建議的學姐妹們：薇莉、雨樺、翠媛、菲翎、麗芬、曉玲、承芳、培筠、亭儒、芸湘、彥汝、佩芸。

這條路上有您們的陪伴與幫助，心裡常感到格外溫暖。此外，很感謝系辦公室的李惠玉小姐與邱盈如小姐，在過程中總是細心地說明和提醒各項重要的流程手續，這對當時埋首撰寫論文的我來說，有很大的幫助。還有在這個過程中總是幫助我、為我加油打氣的朋友們：球球(俞玲)、小藍、阿青、芝榕、筱安、亭妤、竹君、子葳、文馨、家玉、小卷、尉雯、柏諺、于甄、秀榕、美琪。

由衷感謝參與這個研究的所有個案，無私地提供您們的寶貴經驗，除了問卷資料，也常有人告訴我她的心情和處境，這些訴說讓我更理解懷孕婦女的心境，也是我寫作的力量。其實撰寫論文的過程中有時感到疲累，但是只要想到您們告訴我的種種話語，就令我更有動力好好寫出這份論文。謝謝您們！

感謝我的公婆，每次返家探望您們，我這個媳婦除了不用做家事，還讓公婆做了很多好吃的大餐給我們補身體，謝謝您們的用心，讓我能夠卸除傳統媳婦面臨的壓力，用心在精進知識的創造與造福社會大眾上。感謝您們給予我們實質與心理上的支持，在打拼的路上，這是支持我的一股強大力量，感謝您們！

感謝我的母親，從小培養我們做事一絲不苟的態度，雖然這也造就了您女兒神經質個性，但一絲不苟便是博士培養過程中必需的要素之一；感謝我的父親，讓我們觀察生活中的智慧，常給我們自己編的新版故事，讓我們有另一個看世界的角度，原來這也是培養博士原創特質的要素之一。未來的日子裡我也會一直支持您們、永遠愛您們喔！感謝我最親愛的妹妹，皓婷，謝謝你在我撰寫博士求學的過程中，常常給我鼓勵和打氣，你的鼓勵也是我很重要的一股支持力量喔。

感謝我肚子裡還未出世的孩子，雖然因為妳，媽媽這條學業之路的馬拉松終點越拉越遠，好像快到了卻又一直到不了，但是也因為有妳，我的人生有了不同的角度與思考，這些波折讓我更能體會懷孕時的酸甜苦辣與延續我倆生命的力量，孩子，謝謝妳。現在我最希望的是，妳健康平安。

最後，要感謝一直陪伴著我的老公，景宜，多年來給我全方位的支持與鼓勵（包含這幾年來求學過程中的經濟支援、協助我面對在這場馬拉松慢跑中的自我懷疑、不厭其煩地聽我訴說我的論文，以及最近因為我們懷孕而面臨的種種驚險考驗），因為有你，在最低潮的時候，讓我有力量走下去。現在，我把獲得這個學位的榮耀與快樂，與你一同分享。取得博士學位是人生中的逗點，未來，我們會一起面對，共同扶持，繼續打造幸福的人生。

摘要

研究背景：懷孕相關下背痛是懷孕時期一個普遍發生的症狀，並且影響婦女的日常生活，特別在第三妊娠期疼痛影響最大。然而現有知識對於疼痛及相關經驗(例如：社會支持、憂鬱、以及疼痛厄運感)的變化、以及影響疼痛變化的相關因素所知仍十分有限。**研究目的：**因此，本研究目的有二：(1) 探討第三妊娠期懷孕婦女下背疼痛強度與疼痛干擾及其相關經驗(社會支持、憂鬱、以及疼痛厄運感)的變化；及 (2) 探討影響第三妊娠期懷孕婦下背疼痛強度與疼痛干擾變化的因素。**方法：**本研究使用縱貫性研究設計，於台灣北部一所醫學中心及一所地區醫院的產前門診以連續性取樣方法收案，本研究收案前均獲得 IRB 同意，本研究使用簡易疼痛量表、病患健康量表、疼痛厄運感量表、以及生理工作負荷量問卷來收集資料，時間點分別為妊娠第 28 週、第 32 週與第 36 週。於第一時間點 (妊娠 28 週) 招募 238 位懷孕婦女，於第三時間點 (妊娠 36 週) 時，有 200 位持續參與。本研究使用描述性統計分析、階層式迴歸分析、以及廣義估計模式分析資料。**結果：**本研究發現疼痛干擾、憂鬱隨時間而增加，社會支持及疼痛厄運感維持穩定。疼痛經驗變化的預測因素方面，疼痛厄運感、妊娠第 24 週的疼痛強度、以及時間(由妊娠第 28 週進行至第 36 週)均可預測懷孕相關下背痛疼痛強度的變化。此外，社會支持、憂鬱、疼痛厄運感、疼痛強度、以及時間(由妊娠第 28 週進行至第 36 週)均可預測疼痛相關下背疼痛干擾的增加。本研究也發現在控制憂鬱對疼痛的影響力之下，疼痛厄運感仍會影響懷孕相關下背痛的疼痛強度與疼痛干擾。**結論：**本研究應用生理-心理-社會模式於第三妊娠期婦女下背痛的型態變化，發現憂鬱與疼痛厄運感在懷孕相關下背痛的發展上扮演重要的角色，以及社會支持可能的風險，本研究找出這些變數，可以協助健康照護人員減緩懷孕婦女的懷孕相關下背痛的強度與干擾他們生活的強度，進一步增進婦女健康。建議未來研究探討憂鬱、疼痛厄運感與社會支持對於持續形成至產後慢性下背痛的可能影響。

關鍵詞：下背痛、疼痛強度、疼痛干擾、相關因素、懷孕婦女、婦女健康

ABSTRACT

Background: Pregnancy-related low back pain (PR-LBP) is a prevalent symptom during pregnancy and interferes with women's daily life, especially during the third trimester. However, knowledge is limited regarding the changes in PR-LBP and the correlates of the changes. **Purpose**: The purposes of this study are: (1) to examine the changes in PR-LBP intensity and interference and related factors (i.e., social support, depression, and pain catastrophizing) and (2) to investigate the correlates of the changes in PR-LBP intensity and interference. **Methods**: A longitudinal design with consecutive sampling was used to collect data in the antenatal care center of a medical center and a regional hospital in the northern Taiwan. This study has been approved by IRB of the involved hospitals. The Brief Pain Inventory-Short Form, the Patient Health Questionnaire, the Pain Catastrophizing Scale, the Physical Workload Questionnaire were used to collect data in three waves: Gestational age (GA) 28, 32, and 36 weeks. The study recruited 238 pregnant women at the first time point and retained 200 of them at the third time point. Descriptive analyses, hierarchical regressions and the generalized estimating equations (GEEs) method were used for analyses. **Results:** This study found that pain interference and depression increase over time in the third trimester. Social support and pain catastrophizing remained stable. Pain catastrophizing, pain intensity at GA 24 weeks, and time (from GA 28 to 36 weeks) were associated with the changes in PR-LBP intensity. Moreover, social support, depression, pain catastrophizing, pain intensity, and time (from GA 28 to 36 weeks) were the correlates for increases in PR-LBP interference. Pain catastrophizing influenced PR-LBP intensity and interference given the influence of depression. **Conclusion:** This study applied biopsychosocial model to the investigation of PR-LBP change patterns in the third trimester. This study found that depression and pain

catastrophizing play critical roles in the development of PR-LBP and also the potential downside of social support. This study identified factors related to the pain changes, assisting management of third-trimester PR-LBP, improving women health. Future research can examine the potential impact of depression, pain catastrophizing, and social support on postpartum persistent PR-LBP.

Key words: Low back pain, pain intensity, pain interference, correlates, pregnant women, women health.

TABLES OF CONTENT

LIST OF FIGURES

LIST OF TABLES

Chapter I Introduction

Background and Significance

Women's health and pain. Women account for 49.5% of the world population (United Nations, 2011), and thus the health of women is critical to the health of global population. Women's health has also been a recent focus in nursing studies (Chen, Wang, Chung, Tseng, & Chou, 2006; Heh, Coombes, & Bartlett, 2004; Hung, 2005). Since nursing goals include health recovery and promotion and women's health is critical to the health of global population, research on issues of women's health is important and current in the nursing discipline.

Among issues of women health, pain is a significant problem threatening women well-being. The different kinds of pain in women has been found 1.5 to 4 times higher than in men (International Association for the Study of Pain, 2007a), demonstrating the significance of pain in women's health. Women's pain includes dysmenorrhea (painful menstrual periods), chronic (nonmenstrual) pelvic pain, vulvodynia, labor pain, and pregnancy-related low back pain (PR-LBP) (International Association for the Study of Pain, 2007a). The variety of women's pain indicates the breadth and relevance of research on women's pain.

When discussing women's pain, we cannot ignore the typical task which women assume: reproduction. The traditional reproduction perspective focused on the fetus and reproductive function of a pregnant woman rather than women's needs and well-being. Thus women's pain during pregnancy has not received sufficient attention. Among pregnant women's pain, low back pain is the most prevalent one (International Association for the Study of Pain, 2007c), motivating this study to investigate PR-LBP.

Definition and significance of PR-LBP. PR-LBP is recurrent or continuous pain, which occurs in the body area for more than one week during pregnancy, and ranges

from the 12th rib to gluteal fold (Malliou, Gioftsidou, Beneka, & Godolias, 2006; Vleeming, Albert, Östgaard, Sturesson, & Stuge, 2008; Wu et al., 2004). PR-LBP is prevalent (50-90%) worldwide (Mogren & Pohjanen, 2005; To & Wong, 2003; Wang et al., 2004). PR-LBP is also highly prevalent (75%) in Taiwan (Chang, Yang, Jensen, Lee, & Lai, in press). The high prevalence of PR-LBP in Taiwan indicates the importance of PR-LBP issues to Taiwanese pregnant women. In addition, among women with PR-LBP in their pregnancy, 25-50% of them still experience PR-LBP for six to twelve months after childbirth (Butler & Fuller, 1998; Loughnan, Carli, Romney, Dore, & Grordon, 2002; Thompson, Roberts, Currie, & Ellwood, 2002), and 5-20% have their pain persist for two to six years after childbirth (Norén, Östgaard, Johansson, & Östgaard, 2002; Östgaard, Zetherström, & Ross-Hansson, 1997; To & Wong, 2003).

The prevalence of PR-LBP poses threats to women health and well-being given that pain seriously interferes with women's life. PR-LBP strongly interferes with women's daily life in terms of reduced sleep and walking ability (Chang, Yang et al., in press; Wang et al., 2004). The degree to which pain interferes with daily life is defined as pain interference. Such pain interference directly degrades women's quality of life (Gutke, Östgaard, & Öberg, 2008; Olsson & Nillson-Wikmar, 2004) and mother-infant attachment (Shepherd, 2005), and is associated with persistent postpartum low back pain (Östgaard et al., 1997). Therefore, interference owing to PR-LBP as well as PR-LBP intensity are important to women health and well-being. Thus this study focused on PR-LBP intensity and interference to understand pregnant women's PR-LBP. Moreover, the literature has indicated a clear correlation between PR-LBP intensity and PR-LBP interference (Gutke, Östgaard, & Oberg, 2006; Kristiansson, Svardsudd, & von Schoultz, 1996). However, none of them were conducted in Taiwan. Research in

Taiwan can provide further evidence supporting the relation between PR-LBP intensity and PR-LBP interference.

Since PR-LBP reaches its peak both in the prevalence and severity in the third trimester (Fast et al., 1987; Östgaard et al., 1997), research is needed to understand the changes of PR-LBP intensity and interference and the related experience (such as social support, depression, and pain catastrophizing) and how to prevent the growth of PR-LBP in the third trimester. One of the first steps is to understand the predictors of the changes in PR-LBP in the third trimester. Predictors of the changes in PR-LBP enables health professionals to implement effective interventions to manage the growth of PR-LBP prior to or in the third trimester, supporting the clinical relevant of research on the predictors of the changes in PR-LBP.

However, previous studies on PR-LBP have mainly focused on risk factors of PR-LBP *prevalence* (to predict whether on has pain), rather than PR-LBP *changes in intensity and interference*. Specifically, the previous studies identified risk factors such as having a LBP history (Björklund, Nordström, & Odlind, 2000; Orlikowski, Dickinson, Paech, McDonald, & Nathan, 2006; To & Wong, 2003), a higher parity (Mogren, 2006a; Turgut, Turgut, & Cetinsahin, 1998), an older age (Gutke et al., 2008; To & Wong, 2003; Turgut et al., 1998), a higher body mass index (BMI, Gutke et al., 2008; Mogren, 2006a), higher depression (Gutke et al., 2008; Webb et al., 2008), and a lower educational level (Mogren & Pohjanen, 2005; Orvieto, Achiron, Ben-Rafael, Gelernter, & Achiron, 1994). The previous studies only indicated that these factors can be used to predict whether one has PR-LBP or not, and did not cover the changes of PR-LBP intensity and interference and the predictors of the changes in PR-LBP intensity and interference in the third trimester. The aforementioned clinical relevance and the lack of knowledge supported the need to have a study on the changes in PR-LBP

intensity and interference and the predictors of changes in PR-LBP intensity and interference. Thus this study aims to investigate the changes in PR-LBP intensity and interference and the predictors of changes in PR-LBP intensity and interference.

Regarding selection of potential predictors, this study assumed that the risk factors which can predict the prevalence of PR-LBP may also predict the changes in PR-LBP intensity and interference. Since pain is a multidimensional phenomenon (Gifford & Butler, 1997), the present study adopted the biopsychosocial model (which posits that pain has biological, psychological, and social predictors) to choose the potential predictors of changes in PR-LBP intensity and interference.

Previous studies have mainly focused on biological factors (e.g., Björklund et al., 2000; Gutke et al., 2008; Orlikowski et al., 2006), and paid less attention on psychological and social factors. However, understanding psychological and social factors may help to identify delayed recovery and also to target appropriate interventions (Chou et al., 2007; Safadi, 2005). Among psychological factors, previous studies identified depression as a prominent predictor of PR-LBP prevalence (Pincus, Burton, Vogel, & Field, 2002). Thus, research is needed to investigate whether depression also heightens the PR-LBP intensity.

Moreover, when pregnant women faced rapid changes during pregnancy, some negative thoughts toward pain may occur. These negative thoughts toward pain may also develop from the previous pain experience. For example, women may show a higher tendency towards learned helplessness than men, because girls and women have experienced uncontrollable events in their early life (Chorpita & Barlow, 1998; Leadbeater, Blatt, & Quinlan, 1995). Such learned helplessness may fuel catastrophizing (exaggerated negative cognitions about pain). Pain catastrophizing may be meaningful to pregnant women having pain, since pain catastrophizing could lead

pregnant women to feel an inability to react or move. Lack of movement can worsen the pain, and further increase pain catastrophizing, forming a positive reinforcing loop which degrades the women's health. Pain catastrophizing can explain pain even when the impact of depression is controlled (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001), indicating the necessity of examining the influence of both depression and catastrophizing on pain outcomes.

Although pregnancy is generally a joyful process, pain catastrophizing can occur during pregnancy. The reason is the same as the pregnancy-related syndromes or sickness that accompanies the good and joyful process of pregnancy; that is, good and joyful things (such as pregnancy) can surely be accompanied with uncomfortable feelings. Women who catastrophize about their pain can interpret pain as a "disaster". Pregnancy itself is not a disaster, but if pregnancy-related pain increases over time and persists for months, and even makes it difficult to work, to walk, to sleep, and to do any daily activity, such pain experience can be regarded as "terrible and intolerable". Furthermore, it would be more appropriate to understand the term *pain catastrophizing* using its three dimensions, rumination, magnification, and helplessness. Magnification, rumination, and helplessness are three core attributes of pain catastrophizing (Sullivan et al., 1995). That is, pain catastrophizing in pregnant women means that the pregnant women frequently think of pain (rumination), amplify the pain perception (magnification), and feel that they cannot do anything to deal with the pain (helplessness). Such a phenomenon can surely exists among some pregnant women, supporting the appropriateness of investigating pain catastrophizing in pregnant women.

When discussing pain catastrophizing, depression may be regarded as a similar concept, because depression and pain catastrophizing have shared a common measurement item; that is, thinking of suicide. Regarding the influence of depression

and pain catastrophizing on pain intensity and interference, researchers have suggested including measures of both of them to determine if they are different and whether they have different impact (i.e., Keefe, Brown, Wallston, & Caldwell, 1989; Sullivan & D'Eon, 1990). Thus the present study included both depression and pain catastrophizing to examine the influence of one of the two concepts when controlling the influence of the other. Such examination is valuable for clinical health professionals to know either depression or pain catastrophizing (or both of them) actually impacts pain intensity and interference, and thus they can correctly make interventions on either depression or pain catastrophizing to improve the pain experiences of their patients. However, previous studies have not examined this issue in the pregnant women population. The clinical relevance and the lack of such research the need to clarify the impact of depression and catastrophizing on pain intensity and interference. Thus this study also aimed to examine the influence of pain catastrophizing on PR-LBP intensity and interference controlling for the influence of depression at the three time points during the third trimester.

Among social factors, social support is one of the most frequently discussed topics. Furthermore, according to the buffering hypothesis of social support (Cohen & Wills, 1985), social support may buffer the impact of pain through increased appraisal that they have resources to manage their pain. Social support can assist pregnant women in managing their pain, and thus social support should also be included.

In addition to the biological, psychological, and social factors, certain demographic variables (such age and educational level) have also been frequently discussed in the pertinent literature. Among the demographic variables studied, age may be associated with muscle strength (Owino, Yang, & Goldspink, 2001) and thus have a possible impact on PR-LBP. Moreover, education level may be associated with knowledge on

how to best utilize resources (such as contact with health caregivers) to manage pain (Wijnhoven, de Vet, & Picavet, 2007), and thus educational level may be associated with pain. Thus this study included age and educational level as potential predictors.

Research Purposes

The overall purpose of this study is to examine the changes in PR-LBP intensity and interference and related factors (i.e., social support, depression, and pain catastrophizing) and to investigate the correlates of the changes in PR-LBP intensity and interference. The specific purposes are: (1) to investigate the changes in pregnant women's PR-LBP intensity and interference and the related experience (i.e., social support, depression, and pain catastrophizing) in the third trimester, (2) to investigate the correlation between PR-LBP intensity and PR-LBP interference in Taiwan and see if they are correlated, (3) to examine the influence of pain catastrophizing on the PR-LBP intensity and interference controlling for the influence of depression, and (4) to investigate the predictors of changes in pregnant women's PR-LBP intensity and interference in the third trimester.

Chapter II Literature Review

Pain has been defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (International Association for the Study of Pain, 2007b)." Pain is a multidimensional phenomenon (Gifford & Butler, 1997), indicating the necessity of investigating pain using multiple perspectives. Multiple perspectives of pain can include biological, psychological, and social perspectives. Such perspectives are regarded as necessary in the biopsychosocial model. Previous studies using the biopsychosocial model posit that pain should be understood using all of the biological, psychological, and social perspectives or factors (Jensen et al., 2002; O'Sullivan & Beales, 2007; Stanos, 2007).

The Biopsychosocial Model of Pain

The biopsychosocial model has been a recent focus in the pain literature (Hirsh, Dillworth, Ehde, & Jensen, 2010; Miro et al., 2009; Mitchell et al., 2009). This model has also been frequently applied to the LBP patients (Campbell, Clauw, & Keefe, 2003; O'Sullivan & Beales, 2007; Waxman, Tripp, & Flamenbaum, 2008) and postpartum women having preterm birth (Gungor, Oskay, & Beji, 2011). The wide application, frequent utilization, and conceptual comprehensiveness of the biopsychosocial model indicates its potential applicability to PR-LBP in pregnant women. Thus this study adopted the biopsychosocial model to investigate the PR-LBP in pregnant women in the third trimester.

Pregnancy-Related Low Back Pain (PR-LBP)

Definition. Pregnancy-related low back pain (PR-LBP) is recurrent or continuous pain, which occurs in the body area for more than one week during pregnancy, and ranges from the 12th rib to gluteal fold (Malliou et al., 2006; Vleeming et al., 2008; Wu et al., 2004). Similar to the pelvic-girdle pain, the location of PR-LBP contains the back

area from 12th rib to gluteal fold, but the PR-LBP does not include symphasis surrounding area (Vleeming et al., 2008). PR-LBP consists of (a) posterior pelvic pain located in gluteal area and (b) lumbar back pain located above sacrum in lumbar spine area (Östgaard, 1996). The definition of PR-LBP includes the pregnancy-related pelvic girdle pain. Furthermore, symphysis pubis dysfunction was also used, but it was considered as the secondary or coexisting problem of PR-LBP (International Association for the Study of Pain, 2007c), supporting this study to use the term PR-LBP and the current definition.

Mechanism. There are two main biological theories explaining the etiology of PR-LBP: (a) mechanical strain and (b) pelvic ligament laxity (Borg-Stein & Dugan, 2007; Vleeming, Volders, Snijders, & Stoeckart, 1990a, 1990b). First, during pregnancy, the enlarging gravid uterus moves the body center of gravity forward, increasing the tendency of anterior pelvic tilt. However, the sacroiliac joints resist such forward rotation. As the pregnancy progresses, the sacroiliac ligaments become loose. These factors increase the mechanical strain on the low back (Borg-Stein & Dugan, 2007; Vleeming et al., 1990a, 1990b).

The endocrine system also releases relaxin during pregnancy. The relaxin softens the collagen and looses the ligaments (Hainline, 2002), and thus starts to widen the Symphysis pubis at the 10th to the 12th week (Young, 1940). Then the relaxin levels reach the peak at the 12th week, start to decline at the 17th week, and remain stable at half of the peak level thereafter (Mantle, Greenwood, & Currey, 1977). The relaxin softens ligaments that surround the pelvic girdle and thus decreases the stability of pelvic girdle, inducing the low back pain on the sacroiliac joint area (Hainline, 2002; Kristiansson et al., 1996; Östgaard, 1996).

In pain research, both pain intensity and pain interference have been frequently used as the outcome variables (Demmelmaier, Lindberg, Asenlof, & Denison, 2008; Hanley, Raichle, Jensen, & Cardenas, 2008; Jensen et al., 2011), because they are influential to health and well-being. Pain intensity impacts health and well-being since severe pain directly contributes to physical suffering. Moreover, pain interference hinders one's ability to engage in daily activities, lowering an individual's well-being. Thus, both pain intensity and pain interference should be considered when discussing PR-LBP.

Pain intensity of PR-LBP. Pain intensity is the magnitude of pain perceived by patients. The average PR-LBP intensity is 50 to 60 mm on 100 mm visual analog scale (Kristiansson et al., 1996; Östgaard, Zetherström, Roos-Hansson, & Svanberg, 1994; Wang et al., 2004). Mogren (2005, 2006a) considered pain intensity higher than 70 mm as severe pain and had found that 23% of pregnant women with PR-LBP have severe pain. PR-LBP intensity, including the worst pain and pain now, increases through gestational age (Östgaard & Andersson, 1991). The underlying reason is the enlarging uterus increases the strain on the muscles and tendons around low back and pelvic girdle through the proceeding of gestation (Borg-Stein, Dugan, & Gruber, 2005; Vleeming et al., 1990a, 1990b). Among women who experience PR-LBP, pain intensity is related to disability or pain interference (Kristiansson et al., 1996; Wu et al., 2004). Pain intensity is one of the key pain outcomes in pain studies (Turk & Gatchel, 2002), and thus this study adopts pain intensity as one key pain outcome variable.

Pain interference of PR-LBP. In addition to pain intensity, whether or not pain interferes with daily life is also critical in maintaining women's well-being. PR-LBP impacts women's daily life in terms of sleep and walking ability (Chang, Yang et al., in press; Wang et al., 2004). Wang et al. (2004) indicated that 58% of the pregnant

women with PR-LBP have sleep disturbance and 57% of them have impaired daily activities. In Taiwan, pregnant women with PR-LBP rated the level of pain interference on "sleep" as 5.56 (*SD* = 2.92) and "walking ability" as 4.21 (*SD* = 2.74) using a 0-10 numerical rating scale (Chang, Yang et al., in press). Such pain interference affects women's quality of life (Gutke et al., 2008; Olsson & Nillson-Wikmar, 2004) and mother-infant attachment (Shepherd, 2005). Furthermore, PR-LBP is the main reason of sick leave among working pregnant women (DeJoseph & Cragin, 1998). Among pregnant women, 11% to 31% have sick leave due to PR-LBP (Kærlev, Jacobsen, & Bonde, 2004; Wang et al., 2004). The significance of the interference of PR-LBP warrants its role as the other key pain outcome variable.

Experience related to PR-LBP. Moreover, this study included social support, depression, and pain catastrophizing, because they are important concepts related to pain. First, social support is the perception of support from family, friends, and significant others (Cheng, 2004) and thus social support can represent a force supporting pregnant women. Second, depression is defined as "a common mental disorder that presents with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration" (World Health Organization, 2009). Depression has been frequently discussed together with pain (e.g., van de Pol, van Brummen, Bruinse, Heintz, & van der Vaart, 2007), indicating that it has strong relation with pain and possible relation with PR-LBP. Third, pain catastrophizing has been defined as "exaggerated negative cognition toward pain" (Rosenstiel & Keefe, 1983; Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998; Turner, Jensen, & Romano, 2000). Such a definition on pain catastrophizing indicates that pain catastrophizing is a cognitive style related to pain. Thus, pain catastrophizing should be a correlate or a predictor of pain intensity and interference. Since these concepts are

also part of life experience among pregnant women with PR-LBP, this study also discusses these experience later.

Risk Factors of PR-LBP Prevalence

The literature reviewed above lays the foundation for understanding PR-LBP. Since the literature to date has not addressed the changes in PR-LBP pain intensity and pain interference the correlates of the changes, this study reviewed the literature on risk factors of PR-LBP prevalence to identify a list of candidate factors that may predict changes in PR-LBP pain intensity and pain interference.

Since pain is an experience with biological, psychological, and social aspects (Turk & Gatchel, 2002, pp. 3-29), this study categorized factors to these three domains. Furthermore, demographic data are highly available to health professionals and likely have influences on pain outcomes. Thus this study also included demographic variables as the additional category of domains to consider.

Demographics factors. Previous studies on PR-LBP have mixed findings on the relation between age and PR-LBP prevalence. Some studies found positive relations (Mantle et al., 1977; Wang et al., 2004), but some found negative relations (Endresen, 1995; Östgaard & Andersson, 1991; Silman, Ferry, Papageorgiou, Jayson, & Croft, 1995; Wu et al., 2002). The mixed findings support this study and the need for biological theories that can explain PR-LBP. The center of gravity theory (Borg-Stein & Dugan, 2007; Vleeming et al., 1990a, 1990b) posits that during pregnancy the center of gravity moves forward, and thus strong muscles are needed to maintain the stability of lumbar spine and the pelvic girdle. Such mechanism hypothesizes that low back pain is related to muscle strength. Age likely decreases muscle strength (Owino et al., 2001). The decreased muscle strength accounts for LBP. Thus this study hypothesizes that age is likely positively related to changes in pain intensity.

Age. Age has also been associated with muscle strength (Owino et al., 2001). This association can also be used to develop the hypothesis on the relation between age and pain interference. A higher age likely indicates lower muscle strength, which is related to lower ability to do daily activities. Thus, when encountering pain, a higher age is likely associated with a lower ability to do daily activities, increasing the perception of pain interference. Such association suggests a hypothesis for a positive relation between age and changes in pain interference.

Educational level. A lower educational level is known as a risk factor for PR-LBP prevalence (Mogren & Pohjanen, 2005; Orvieto et al., 1994). A lower education level can also predict back pain in a general population (Latza, Kohlmann, Deck, & Raspe, 2000) and severe chronic pain (Smith et al., 2001). Moreover, a lower educational level is also associated with women's work disability owing to musculoskeletal pain (Wijnhoven et al., 2007) and associated with a lower health-related quality of life in patients with low back pain (Horng et al., 2005). The reason may be that higher educational level increases pregnant women's knowledge about managing pain. A higher educational level may also increase pregnant women's ability to seek out additional knowledge that can help them prevent or alleviate their PR-LBP, reducing their pain intensity. Thus this study hypothesized a negative relation between educational level and changes in pain intensity.

Furthermore, a high educational level is related to knowledge to overcome difficulties owing to pain. Thus a high education level can help retain the ability to do daily activities even encountering pain, reducing the feeling of pain interference. Thus this study hypothesized a negative relation between educational level and changes in pain interference.

Biological factors. ***LBP history.*** Among biological factors, LBP history has been frequently discussed, including experience of LBP before pregnancy (Albert, Godskesen, Korsholm, & Westergaard, 2006; Bastiaanssen et al., 2005; Mogren & Pohjanen, 2005) and during previous pregnancy (Mogren & Pohjanen, 2005; To & Wong, 2003). The underlying mechanism may be the unstable pelvic girdle, the weakened ligaments, or the long-lasting reasons triggering LBP. Thus, it is reasonable to hypothesize a positive relation between previous LBP history and changes in pain intensity. Furthermore, the weakened ligaments and unstable pelvic girdle easily trigger pain and thus restrains pregnant women's ability to engage in daily activities. Thus, this study also hypothesized a positive relation between previous LBP history and increases in PR-LBP interference.

Parity. Biological risk factors for PR-LBP prevalence also include higher parity (Albert et al., 2006; Gürel & Gürel, 1997; Mogren & Pohjanen, 2005). Higher parity is related to times of pregnancy that increased the relaxin exposure. Relaxin softens the ligaments and make the pelvic girdle unstable, triggering PR-LBP (Hainline, 2002; Kristiansson et al., 1996; Östgaard, 1996). Thus, this study hypothesized a positive relation between parity and changes in pain intensity.

Amniotic fluid index (AFI). One biological account for PR-LBP is the theory of shifted center of gravity, which decreases the muscle tone and increases the mechanical strain on the low back (Borg-Stein & Dugan, 2007; Vleeming et al., 1990a, 1990b), triggering PR-LBP. Amniotic fluid index (AFI) indicates the increased fluid weight in the front of the pregnant women's bodies, shifting their center of gravity forward. AFI indicates the summation of the length of the four dimensions using ultrasound. Moreover, the increased AFI enlarged the uterus and hinders vein blood flow (Hainline,

1994). Thus it is intuitive to infer that the high AFI is associated with changes in PR-LBP intensity.

Furthermore, a higher AFI is related to increased physical burden, which reduces ability to perform daily activities, leading to a high level of pain interference. Thus, this study hypothesized a positive relation between AFI and changes in PR-LBP intensity.

Estimated fetus body weight (EBW). Similarly, the estimated fetus body weight (EBW) also represents the increased weight in the front of the pregnant women's bodies. Increased weight in the front moves the center of gravity forward, which increases the mechanical strain on the low back (Borg-Stein & Dugan, 2007; Vleeming et al., 1990a, 1990b). The strain on the low back directly fuels PR-LBP, and thus this study hypothesized a positive relation between EBW and changes in PR-LBP intensity. Furthermore, a higher EBW is related to increased physical burden, which reduces ability to do daily activities, leading to a high level of pain interference. Thus, this study hypothesized a positive relation between EBW and changes in pain interference.

Body mass index (BMI). Body mass index (BMI) is defined as the weight (kg) divided by height square (m^2) (Mogren, 2006a). A higher BMI was identified as a risk factor for PR-LBP prevalence (Leboeuf-Yde, Kyvik, & Bruun, 1999; Mogren & Pohjanen, 2005; Orvieto et al., 1994). The underlying mechanism may be the increased body burden on muscles. The increased burden likely boosts the possibility that the burden exceeds what muscles can afford, increasing pain intensity. Thus, this study hypothesized a positive relation between BMI and change in pain intensity.

Moreover, a high BMI is related to a high physical load or burden for muscles to perform daily activities. When encountering pain, which can limit activity and therefore the use of muscles, a high BMI and its associated high physical load hinders one's

ability to do daily activities, increasing the perception of pain interference. Thus, this study hypothesized a positive relation between BMI and changes in pain interference.

Physical workload. Intuitively, physical workload is a risk factor for PR-LBP prevalence. A heavy physical workload has predicted the presence of PR-LBP (Hartvigsen, Kyvik, Leboeuf-Yde, Lings, & Bakketeig, 2003; Mogren, 2005; Mogren & Pohjanen, 2005). When pregnant woman work with frequent rotation of their body (Endresen, 1995), strong work stress (Albert et al., 2006), or uncomfortable environment (Larsen et al., 1999), they are likely to have PR-LBP, indicating that work environment is associated with PR-LBP prevalence. Physical workload has been defined as the degree to which individuals maintain the same posture or body movement when working, including intensive labor, frequent lifting objects, long-time standing, long-time walking, or bending their body that give pressure to their body (Leboeuf-Yde et al., 1999; Mogren, 2005; To & Wong, 2003). Such activities pose a threat to the muscular system that has a shifted center of gravity during pregnancy (Borg-Stein & Dugan, 2007; Vleeming et al., 1990a, 1990b), likely boosting PR-LBP intensity. Thus, this study hypothesized a positive relation between physical workload and changes in PR-LBP intensity.

A high level of physical workload is also related to a high physical burden for muscles. Since pain reduces one's ability to use muscles, a high physical workload and its associated high physical burden can further hinder one's ability to perform daily activities, increasing the perception of pain interference. Thus, this study hypothesized a positive relation between physical workload and changes in pain interference.

Moreover, the literature has designed exercise programs and identified some effects on reducing PR-LBP intensity (Garshasbi & Faghih Zadeh, 2005). The findings on the effect of exercise program is associated with muscle strength and stability of

lumbar spine and pelvic girdle that helps prevent incidence of PR-LBP (Mens, Snijders, & Stam, 2000). Muscle strength and stability of lumbar spine is associated with a low risk of PR-LBP incidence (Hainline, 2002).

Regular exercise. Regular exercise can help strengthen muscles (Mens et al., 2000), and thus regular exercise may help prevent PR-LBP or reduce PR-LBP intensity even when it occurs. Thus, this study hypothesized a negative relation between regular exercise and changes in pain intensity. Previous studies have defined regular exercise as engaging in exercise at least once per week for three years prior to pregnancy (Larsen et al., 1999; Östgaard et al., 1994). This definition emphasizes on habitual exercise prior to pregnancy. However, previous studies on exercise programs for pregnant women have durations of three months (Garshasbi & Faghih Zadeh, 2005; Mørkved, Salvesen, Schei, Lyderesen, & Bø, 2007), indicating that regularly engaging in exercise for three months may likely help alleviate PR-LBP. Thus the present study defines regular exercise as engaging in exercise at least once per week for three months prior to the date they fill the questionnaires.

Engaging in regular exercise is also related to increased muscle strength (Mens et al., 2000), which is related to an increased ability to perform daily activities. Thus, regular exercise can increase an individual's ability to perform daily activities even when pain impacts the ability, reducing the perception of pain interference. Thus, this study hypothesized a negative relation between regular exercise and changes in pain interference.

Social factors. ***Social support.*** Social support is a well-known social factor related to various health indicators. Social support is related to physical well-being (Holtzman, Newth, & Delongis, 2004). Social support was found a correlate with pain intensity in various patient populations. In patients with chronic pain, social support is

related to better psychological functioning (Miro et al., 2009; Raichle, Hanley, Jensen, & Cardenas, 2007). Moreover, social support is also associated with muscle strength, psychological health, and self-efficacy in arthritis patients (van Dijk, Dekker, Veenhof, & van den Ende, 2006). In addition to other populations, social support is also an important issue among pregnant women (Tseng, Hsu, Liu, & Chen, 2008).

The mechanism underlying the relation between social support and health indicators may be that the stable and positive experiences offered by social support alleviate the negative impact of stressors and thus social can improve well-being and individual health. Such a mechanism has been labeled the buffering hypothesis (Cohen & Wills, 1985). However, the relation between social support and PR-LBP intensity remains unknown and warrants investigation.

Since pregnant women typically receive strong social support, the relation between social support and pain intensity in other populations (Holtzman et al., 2004; Lopez-Martinez, Esteve-Zarazaga, & Ramirez-Maestre, 2008) may also be applicable to pregnant women with PR-LBP. This study hypothesized that more social support is related to decreases in PR-LBP intensity. However, there is no direct evidence supporting such relation in pregnant women. Thus, this hypothesis is new to the literature and worth of investigation. Furthermore, higher social support is related to a higher level of others' assistance that might reduce the need to do daily activities, reducing their pain interference perceptions. Thus, this study hypothesized that a high level of social support is related to decreases in PR-LBP interference.

Psychological factors. ***Depression.*** Van de Pol et al. (2007) identified depression as an important risk factor of PR-LBP prevalence. Depression is "a common mental disorder that presents with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration"

(World Health Organization, 2009). Depression was also characterized by: (1) negative attitude toward the self; (2) performance impairment; and (3) somatic disturbance (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

The prevalence of antenatal depressive disorder ranged from 4.4% (Bunevicius et al., 2009) to 25% (Pottinger, Trotman-Edwards, & Younger, 2009) and 33% (Gausia, Fisher, Ali, & Oosthuizen, 2009) in the third trimester. Pregnant women might have depression because of low quality of sleep (Skouteris, Germano, Wertheim, Paxton, & Milgrom, 2008), unplanned and unwanted pregnancy, high neuroticism, and psychosocial stressors (Bunevicius et al., 2009), including unemployment and insufficient support from physician and family (Pottinger et al., 2009). Depression during pregnancy is important given its influence on self-harm (Gausia et al., 2009).

Regarding the relation between depression and PR-LBP, depression is a possible risk factor of persistent LBP in the general population (Carroll, Cassidy, & Cote, 2004). Pregnant women with PR-LBP also demonstrated higher depressive symptom than those without PR-LBP (van de Pol et al., 2007). Even after childbirth, postpartum depression is associated with postpartum PR-LBP (Gutke, Josefsson, & Oberg, 2007; Webb et al., 2008). All the above findings indicate the strong relation between depression and PR-LBP. Therefore, this study includes depression as a potential correlate of PR-LBP outcomes.

The relation between depression and PR-LBP pain intensity and pain interference can be supported by a biological theory, that is, the pain modulation model (Field, Basbaum, & Heinricher, 2005), which posits that peripheral pain signals could be modulated along the descending pathway which from frontal cortex, limbic system, periaqueductal gray (PAG) to on/off cells in the rostral-ventromedial medulla (RVM). The RVM contains serotonin and norepinephrine which can suppress the pain signals.

However, depression is associated with deficits of neurotransmitters such as serotonin and norepinephrine (Bair, Robinson, Katon, & Kroenke, 2003), limiting the suppression of pain signals. Thus depression is likely positively related to pain intensity.

Moreover, depression is associated with negative expectancies (Bair et al., 2003; Brown & Beck, 1989). Negative expectancies activate the pain-related brain area (i.e., anterior cingulate gyrus and periaqueductal gray, PAG and on/off cells) and can lead individuals to focus on peripheral pain stimuli or amplify the rating of pain intensity (Bair et al., 2003). Also, individuals with negative affect are more sensitive to pain intensity (Watson & Pennebaker, 1989). Thus, this study hypothesized that depression is positively associated with pain intensity.

Depression is associated with amplified negative evaluation (Campbell et al., 2003). Since pain interference is a negative evaluation about pain, depression is likely to magnify pain interference, creating the positive relation between depression and pain interference. Thus, this study hypothesized depression is positively associated with pain interference.

Pain catastrophizing. Pain catastrophizing is an exaggerated negative cognitive set about pain (Rosenstiel & Keefe, 1983; Sullivan et al., 1998; Turner et al., 2000). Pain catastrophizing is also a disposition developed from previous pain experience (Bédard, Reid, McGrath, & Chambers, 1997; Keefe et al., 2000; Martorella, Côté, & Choinière, 2008; Sullivan et al., 2001). Since almost everyone has experienced pain to some various degree, it is reasonable to expect some variable levels of pain catastrophizing in the general population, supporting the importance of investigating pain catastrophizing among pregnant women in this study.

Pain catastrophizing, unlike depression, is neither a disease nor a disorder. Pain catastrophizing is a set of cognitions about pain, which can range from non-existent to

very high. Pregnancy itself is generally a joyful process, but such a joyful process is frequently accompanied with prevalent PR-LBP (Mogren & Pohjanen, 2005; To & Wong, 2003; Wang et al., 2004). Previous experiences of pain can fuel pain catastrophizing (Bédard et al., 1997; Keefe et al., 2000; Martorella et al., 2008; Sullivan et al., 2001), and thus it is possible that a substantial proportion of pregnant women have pain catastrophizing. However, the exact proportion of pregnant women in the third trimester having pain catastrophizing remains unknown, and thus research is needed to investigate the proportion.

Since pain catastrophizing is a new research concept to the pregnant women population, prevalence data are lacking. However, recent evidence (Olsson, Buer, Holm, & Nilsson-Wikmar, 2009) found that pregnant women having low back pain reported a mean score of 15.9 (standard error = 0.8) on pain catastrophizing. Although the mean score is not high, this study (Olsson et al., 2009) provides empirical data supporting the existence of pain catastrophizing in at least some pregnant women.

In addition to depression, pain catastrophizing is one of the most frequently discussed psychological factors related to pain outcome. The stress coping model (Lazarus & Folkman, 1984) can be used to understand the relation between pain catastrophizing and PR-LBP intensity. When individuals with high levels of pain catastrophizing encounter pain (a stressor), magnification and rumination can be the primary appraisal (individual regards pain as negative and threatening stressor) while helplessness as the secondary appraisal (individual consider that she/he is unable to manage pain effectively) (Sullivan et al., 2001). Applying the stress coping model to pregnant women with PR-LBP, pregnant women who catastrophize are likely to regard PR-LBP as negative and threatening, and feel an inability to react or move. The lack of body movements weakens muscles and further boosts the PR-LBP intensity, creating

the positive link between pain catastrophizing and changes in PR-LBP intensity. Furthermore, the weakened muscles limit the pregnant women's ability to perform daily activities, increasing their perception of pain interference and creating the relation between pain catastrophizing and changes in PR-LBP interference.

Pain catastrophizing in pregnant women: reasons, explanations, and justifications. Since pain catastrophizing is a relatively new concept to the field of research on pregnant women's pain, this study devoted substantial space to explaining why it is important to consider pain catastrophizing in pregnant women and explaining how pain catastrophizing is meaningful and relevant to pregnant women.

Pain catastrophizing may be present both in postpartum women and in pregnant women. Indeed, pain catastrophizing contains items "I worry all the time about whether it will end" and "It's terrible and I think it's never going to get any better". Intuitively, some pregnant women may expect that their pain will end or greatly reduce immediately following childbirth, no matter whether such expectation is reasonable, and thus these pregnant women may give low scores on these two items. However, the Pain Catastrophizing Scale (PCS, Sullivan et al., 1995) contains 13 items, that is, 11 items in addition to the aforementioned two items. There is no reason to anticipate that all pregnant women would give low or zero score to the rest 11 items that include "I keep thinking about how badly I want the pain to stop" and "There is nothing I can do to reduce the intensity of the pain". Thus, pain catastrophizing can exist in pregnant women and can be measured by the PCS.

Even when pregnant women may give low scores on two out of 13 items measuring pain catastrophizing, pain catastrophizing is as critical as pain intensity to the well-being of pregnant women. This can be explained using the three characteristics of pain catastrophizing. When pregnant women frequently think of pain and hope that the

pain can go away (rumination), such thoughts reflect their discomfort. When pregnant women amplify the influence and magnitude of the pain they actually perceived (magnification), such amplification reflects their fear of pain. When pregnant women feel helpless (helplessness) in dealing with their pain, the feeling of helplessness reflects their despair. The underlying meanings (discomforts, fears, and despair) of pain catastrophizing clearly demonstrate its relevance and importance to the well-being of the pregnant women.

Pain catastrophizing in pregnant women: influences, evidence, and applications. PR-LBP is likely to create negative thoughts and perception of threats among pregnant women, influencing their pain catastrophizing. Recent evidence confirms that pain catastrophizing exists in early pregnant women with PR-LBP (Olsson et al., 2009). In one preliminary research (Chang, Jensen, Yang, Lee, & Lai, in press), pregnant women reported a substantial level of pain catastrophizing (average 1.3 using a scale ranging from 0 to 5), further supporting the importance of investigating pain catastrophizing among pregnant women. That pilot study (Chang, Yang et al., in press) is a cross-sectional one and thus did not investigate the changes in PR-LBP intensity and interference. Thus, a longitudinal design, such as the present study, is needed to understand PR-LBP intensity and interference in the third trimester.

Qualitative evidence also suggests that women with PR-LBP likely have substantial pain catastrophizing. Our pilot qualitative study (Chang & Lai, 2008) interviewed 11 pregnant women with PR-LBP. Pain can be severe so that each step triggers pain, hindering their walking ability. Even when there is no pain, they still expected that severe pain occurs with their next step. That is a kind of *magnification* of pain. Moreover, back muscles are frequently involved with body movements, such as standing-up, walking, or even teeth-brushing, and face-washing. Thus these body

movements likely evoke PR-LBP, increasing the frequency that pregnant women experience pain. The frequency of PR-LBP make pregnant women frequently think of pain, which is *rumination* about pain. Furthermore, only 32% of pregnant women discussed their PR-LBP with clinical health professionals and among these only one fourth had answers (Wang et al., 2004). Such a low proportion indicates that pregnant women do not obtain sufficient assistance from clinical health professionals, increasing their perceived *helplessness*. The feelings of *magnification*, *rumination*, and *helplessness* are the three core domains of pain catastrophizing (Sullivan et al., 1995). Thus pregnant women with PR-LBP likely have substantial pain catastrophizing.

In recent years, the concept pain catastrophizing has also been applied to women with pain or other symptoms, such as PR-LBP (Olsson et al., 2009), dysmenorrhea (Walsh, LeBlanc, & McGrath, 2003), and hot flashes (Reynolds, 2000). The level of pain catastrophizing in pregnant women with PR-LBP significantly exceeded those without PR-LBP (Olsson et al., 2009), further supporting that pain catastrophizing exists in pregnant women with PR-LBP.

Numerous studies have shown that pain catastrophizing influences key pain-related domains in many populations, including pain behavior (Keefe et al., 2000; Thibault, Loisel, Durand, Catchlove, & Sullivan, 2008), pain intensity (Buer & Linton, 2002; Peters, Vlaeyen, & Weber, 2005), pain interference (Peters et al., 2005), and disability (Severeijns, Vlaeyen, van den Hout, & Weber, 2001; Sullivan et al., 2001). Such influences across populations supports the possibility that pain catastrophizing is likely associated with pain pain intensity and pain interference among pregnant women. Pain catastrophizing predicts pain intensity and pain interference in patients with spinal cord injury (Hanley et al., 2008). In the population with mixed pain complaints (including spinal cord injury and LBP), change in pain catastrophizing during six months predicts

greater pain intensity, pain interference, and psychological functioning (Hanley et al., 2008; Severeijns et al., 2001). One preliminary study (Chang, Jensen et al., in press) further showed that pain catastrophizing is significantly associated with the level of pain interference among pregnant women with PR-LBP, supports the need for studies such as the present one to investigate the relation between pain catastrophizing and PR-LBP outcomes, such as pain intensity and pain interference.

Pain catastrophizing as a trait or a cognitive style. Since girls receive more physical comfort from adults than boys when expressing distress toward pain, providing excessive physical comfort for girls may increase the "alarmist reactions to pain experience" (Sullivan et al., 2001). In the long-term, alarmist reactions to pain experience may lead to pain catastrophizing. In adults, pain catastrophizing is relatively stable, but decreases with age (Sullivan et al., 2001). Furthermore, pain catastrophizing is changeable (Turk & Gatchel, 2002), indicating that pain catastrophizing is a cognitive style rather than an unchangeable trait.

Differences between pain catastrophizing and depression. Although the relation between pain catastrophizing and depression is still in debate, pain catastrophizing and depression are two similar but different concepts. Their differences can be elaborated in two aspects: conceptual (concept definition and concept attributes) and methodological aspects.

Conceptual differences. Pain catastrophizing is negative emotional, cognitive, and attitudinal response to pain and expectation of negative outcomes (Sullivan et al., 2001). Pain catastrophizing is also a type of negative cognition, such as expecting or worrying about major negative consequences from a situation, even one of minor importance (Turner et al., 2000). The core attributes of pain catastrophizing are (1) rumination, (2) magnification, and (3) helpfulness (Sullivan et al., 1995).

However, depression refers to "a common mental disorder that presents with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration (World Health Organization, 2009)." The core attributes of depression are (1) negative attitude toward the self; (2) performance impairment; and (3) somatic disturbance (Beck et al., 1961).

Pain catastrophizing is negative thoughts toward the *pain* rather than negative thoughts toward the *self*. Depression has more somatic aspect than catastrophizing, while pain catastrophizing contains over-expectations for negative pain outcomes, depression does not contain this phenomena. Such conceptual differences between pain catastrophizing and depression support a conclusion that they are distinct concepts.

Methodological difference. In the methodological aspect, pain catastrophizing and depression are NOT the same concept. Sullivan and D'Eon (1990) indicated the moderate correlation (r = .25- .51) between pain catastrophizing and depression that is not very high. A study by Keefe, Brown, Wallston, and Caldwell (1989) has demonstrated that pain catastrophizing assessed during the first month predicts depression six months later, even controlling for depression at the first month. Additionally, Geisser, Robinson, and Henson (1994) found that pain catastrophizing is positively related to negative affect when controlling for depression. Their results demonstrate that pain catastrophizing and depression are similar but unique concepts.

Furthermore, most items measuring catastrophizing are distinct from those measuring depression, except one item: "Thinking that you would be better off dead or that you want to hurt yourself in some way (in PHQ-9)" is similar to "I feel my life isn't worth living (in CSQ-CATA)." However, the Pain Catastrophizing Scale (Sullivan et al., 1995) has solved this problem, since PCS dropped the item, making pain

catastrophizing and depression distinct from each other with respect to their measurement.

Chapter III Methods

Based on the research purpose and the literature review, this study proposed the following research frameworks and the study hypotheses. The frameworks were constructed by a biopsychosocial model (the perspective that biological, psychological, and social factors are needed for explaining pain outcomes), which has been frequently used in studies involving patients with LBP (Campbell et al., 2003; Mitchell et al., 2009; O'Sullivan & Beales, 2007) and postpartum women having preterm birth (Gungor et al., 2011).

Research Framework

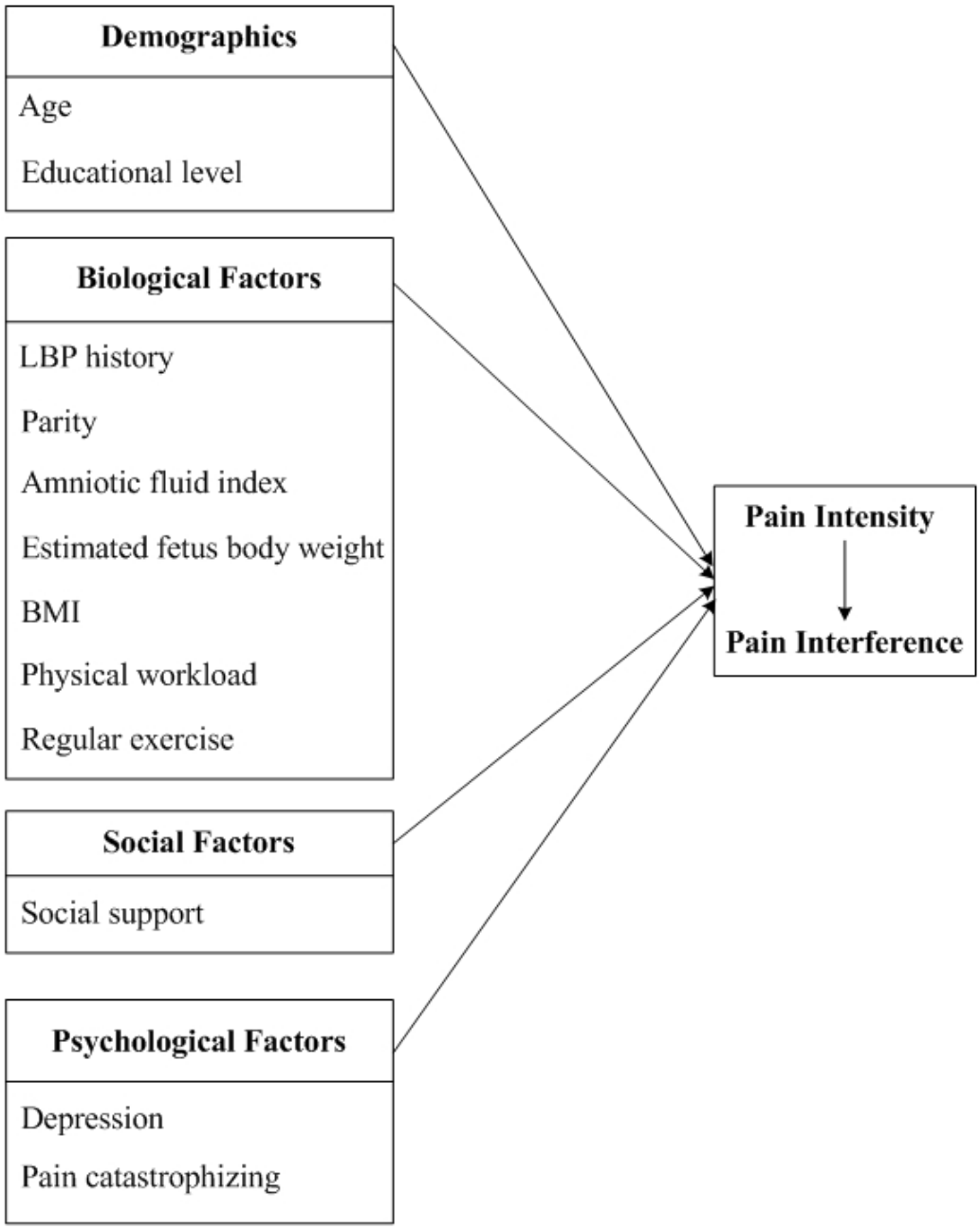

Figure 1 Research Framework

Note. LBP denotes low back pain and BMI denotes body mass index.

Research Aims

Based on the study purposes, this study has the following specific aims:

1. To investigate the changes in PR-LBP intensity and interference and the changes in related experience (social support, depression, and pain catastrophizing) in the third trimester.
2. To investigate whether PR-LBP intensity and PR-LBP interference are correlated.
3. To investigate whether pain catastrophizing can influence PR-LBP intensity and interference controlling for the influence of depression.
4. To investigate whether the interested demographic, biological, social, and psychological factors can predict the changes (increases or decreases) in PR-LBP intensity in the third trimester.
5. To investigate whether these factors can predict the changes (increases or decreases) in PR-LBP interference in the third trimester.

Research hypotheses.

Hypothesis 1: Age is positively associated with changes in pain intensity.

Hypothesis 2: Educational level is negatively associated with changes in pain intensity.

Hypothesis 3: LBP history is positively associated with changes in pain intensity.

Hypothesis 4: Parity is positively associated with changes in pain intensity.

Hypothesis 5: AFI is positively associated with changes in pain intensity.

Hypothesis 6: EBW is positively associated with changes in pain intensity.

Hypothesis 7: BMI is positively associated with changes in pain intensity.

Hypothesis 8: Physical workload is positively associated with changes in pain intensity.

Hypothesis 9: Regular exercise is negatively associated with changes in pain intensity.

Hypothesis 10: Social support is negatively associated changes in with pain intensity.

Hypothesis 11: Depression is positively associated with changes in pain intensity.

Hypothesis 12: Pain catastrophizing is positively associated with changes in pain intensity.

Hypothesis 13: Age is positively associated with changes in pain interference.

Hypothesis 14: Educational level is negatively associated with changes in pain interference.

Hypothesis 15: LBP history is positively associated with changes in pain interference.

Hypothesis 16: Parity is positively associated with changes in pain interference.

Hypothesis 17: AFI is positively associated with changes in pain interference.

Hypothesis 18: EBW is positively associated with changes in pain interference.

Hypothesis 19: BMI is positively associated with changes in pain interference.

Hypothesis 20: Physical workload is positively associated with changes in pain interference.

Hypothesis 21: Regular exercise is negatively associated with changes in pain interference.

Hypothesis 22: Social support is negatively associated changes in with pain interference.

Hypothesis 23: Depression is positively associated with changes in pain interference.

Hypothesis 24: Pain catastrophizing is positively associated with changes in pain interference.

Research Design

Consecutive sampling was used to collect data at three time points with two weeks interval in late pregnancy (i.e., the third trimester): Gestational age (GA) 28±2 weeks, GA 32±2 weeks, and GA 36±2 weeks. Typically, a participant filled out the questionnaires at GA 28 weeks, GA 32 weeks, and GA 36 weeks.

Participants and Setting

To increase the representativeness of subjects, this study enrolled pregnant women in two Out-Patient Department (OPD) of the National Taiwan University Hospital and its Bei-Hu Branch Hospital. Whatever the pregnant women have pain or not, the inclusion criteria were (1) pregnant women, (2) at least 18 years of age, (3) able to communicate with researcher by Mandarin or Taiwanese, and (4) willing to participate in this study continuously.

In order to control potential confounding factors, this study excluded women with high-risk pregnancy, such as gestational diabetes mellitus (GDM), pregnancy-induced hypertension (PIH), eclampsia, or pre-eclampsia, and also excluded pregnant women with other severe physical disease.

Sample size. Using the equation of sample size calculation developed by Liu and Liang (1997), if we set α (Type I error) = 0.05, β (Type II error) = 0.20, number of time points (n) = 3, correlation coefficient of dependent variable between two time points (ρ) = 0.70, the estimated sample size would be 107. If we elevate the power to 90% (or β = 0.10), then the sample size required could be 140.

According to the attrition rates of previous studies ranging from 6.8% to 27.4% (Björklund et al., 2000; Gutke et al., 2008; Mogren, 2006b; To & Wong, 2003), this study primarily estimated the attrition rate as 25%, that is, an estimated retained rate = 75%. In order to collect enough responses at the third time point with consideration of such attrition rate, we should enroll 249 (140 divided by 0.75 twice) participants at the first time point. After data collection, the actual attrition rate was 7.1% between the first and second time points. Moreover, the attrition rate was also low (9.5%) between the second and the third time points. Because of the low attrition rate (7.1% and 9.5%), this study only enrolled 238 participants (including those who have PR-LBP and those who do not) at the first time point. Eventually, this study retained 221 participants at

the second time point and 200 participants at the third time point. The 200 participants in number exceeded the study aim of collecting 140 participants at T3 point, indicating a sufficient retention rate and a sufficient sample size at all time points.

Measures

Brief Pain Inventory-Taiwanese version (BPI-T). The Brief Pain Inventory-Taiwanese version (BPI-T) was used to measure pregnant women's low back pain location, pain intensity and pain interference (Ger, Ho, Sun, Wang, & Cleeland, 1999). The BPI was developed in 1983 (Daut, Cleeland, & Flanery, 1983). The BPI-T contains four items that assess current pain intensity, worst, least, and average pain intensity over the past week using 0-10 numerical rating scales from 0 (*no pain at all*) to 10 (*worst possible pain I can image*). Pain interference is measured using seven items that ask respondents to rate the extent to which pain interfered during the past week with seven domains of daily activities (general activity, mood, walking ability, normal work, relationship, sleep, and enjoyment of life) on 0-10 numerical rating scales from 0 (*does not interfere*) to 10 (*completely interferes*). The responses to the BPI-T interference items were averaged to create a composite score for pain interference. Ger et al. (1999) examined the psychometric properties of the BPI in cancer patients. Regarding the reliability of pain intensity, the test-retest reliability (intra-class correlation, ICC) and the internal consistency (Cronbach's alpha) is 0.79 and 0.81 (Ger et al., 1999), respectively. Regarding the reliability of pain interference, the test-retest reliability (ICC) and the internal consistency (Cronbach's alpha) is 0.81 and 0.89 (Ger et al., 1999), respectively. Moreover, numerous studies have indicated the adequate reliability and validity of the BPI across numerous samples and cultures (Cleeland & Ryan, 1994) and the validity of the BPI-T (Ger et al., 1999). In the present study, Cronbach's alpha for items measuring pain interference were 0.94, 0.96, and 0.97 at the three time points.

Pain Catastrophizing Scale (PCS). Pain catastrophizing is defined as an exaggerated negative thoughts and ideation toward actual or expected pain (Rosenstiel & Keefe, 1983; Sullivan et al., 2001). In this study, pain catastrophizing was measured by the Pain Catastrophizing Scale (PCS), which was developed by Sullivan et al. (1995). Sullivan et al. (1995) identified three factors of pain catastrophizing: rumination, magnification, and helplessness. The PCS contains 13 items that assess the cognitive disposition of pain catastrophizing, scores ranged from 0 (*not at all*) to 4 (*all the time*). Furthermore, the PCS is a reliable and validated questionnaire since the factor structure, reliability, and validity of the PCS have been examined by several studies (Osman et al., 2000; Turner, Mancl, & Aaron, 2004; Yap et al., 2008). The internal consistency (Cronbach's alpha) of overall scale, rumination, magnification, and helplessness were 0.87, 0.87, 0.60, and 0.79 in the literature (Sullivan et al., 1995), respectively. The test-retest reliability (six weeks and 10 weeks) is 0.75 and 0.70 (Sullivan et al., 1995), respectively, showing the good stability of the PCS. Regarding the criterion validity, the PCS significantly correlated with anxiety ($r = 0.32$) and negative affectivity ($r = 0.32$). The PCS has been utilized widely (Buer & Linton, 2002; Flink, Mroczek, Sullivan, & Linton, 2009; Swinkels-Meewisse, Roelofs, Oostendorp, Verbeek, & Vlaeyen, 2006; Turner et al., 2004). It has also been applied in pregnant women (Olsson et al., 2009) that supported the applicability of this scale to pregnant women. In the present study, Cronbach's alpha for PCS were 0.94, 0.95, and 0.96, at the three time points, respectively.

Patient Health Questionnaire (PHQ-9). The Patient Health Questionnaire (PHQ-9) is a short, self-administrated screening instrument for depression, which is scored from 0 (*not at all*) to 3 (*nearly every day*). Kroenke, Spitzer, and Williams (2001) developed the PHQ-9 based on the nine definitive characteristics of depression in the

Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). The PHQ-9 Scores can be used to classify respondents' severity of depression (5 = mild depression; 10 = moderate depression; 15 = moderately severe depression; 20 = severe depression). Results were similar in primary care and OBGY clinics (Kroenke et al., 2001). The cutoff value of PHQ-9 was 15 or greater in a Chinese version of PHQ-9 (Yeung et al., 2008). The PHQ-9 has demonstrated excellent internal consistency. For example, Cronbach's alpha was from 0.83 to 0.91 (Bombardier, Richards, Krause, Tulsky, & Tate, 2004; Carballeira et al., 2007; Dum, Pickren, Sobell, & Sobell, 2008; Kroenke et al., 2001), and test-retest reliability was 0.86 during 48 hours (Kroenke et al., 2001) and 0.76 during two weeks (Fann et al., 2005). The PHQ-9 also demonstrated good construct validity (Bombardier et al., 2004; Kroenke et al., 2001) and criterion validity (Fann et al., 2005; Lowe, Unutzer, Callahan, Perkins, & Kroenke, 2004; Martin, Rief, Klaiberg, & Braehler, 2006). Furthermore, the PHQ-9 can also detect the minimal clinically important difference (Lowe et al., 2004). In ROC analysis, the area under curve is high as 0.95 (Kroenke et al., 2001). The sensitivity and specificity were 0.88-0.93 and 0.88-0.92, respectively (Fann et al., 2005; Kroenke et al., 2001; Watnick, Wang, Demadura, & Ganzini, 2005).

In the present study, the Cronbach's alpha for PHQ-9 were 0.78, 0.82, and 0.85 at the three time points, respectively. This study observed that certain items intended to measure depression overlapped with items associated pregnancy-related syndrome. For example, "Poor appetite or overeating" was intended to measure depression at PHQ-9, but pregnant women sometimes encounter such situations with no relation with depression. For another example, "Trouble falling asleep, staying asleep, or sleeping too much" may also occur in pregnant women because pregnant women may encounter

trouble falling asleep owing to their heavy burden on their bodies, rather than owing to depression.

This instrument has been applied to many populations, including obstetric and gynecology clients (Kroenke et al., 2001), HIV/AIDS patients (Monahan et al., 2009), head and neck cancer patients (Omoro, Fann, Weymuller, Macharia, & Yueh, 2006), heterogeneous sample of cancer patients (Smith et al., 2009), ischemic heart disease patients (Esler, Johnston, Thomas, & Davis, 2008), coronary artery disease patients (Stafford, Berk, & Jackson, 2007), chronic elderly with DM and COPD (Lamers et al., 2008), substance use disorder (Dum et al., 2008), dialysis patients (Watnick et al., 2005), spinal cord injury patients (Bombardier et al., 2004), and traumatic brain injury patients (Fann et al., 2005). In addition to English version, there are also many language versions of PHQ-9, such as Chinese American or Chinese Bilingual version (Yeung et al., 2008), Korean American (Donnelly & Kim, 2008), Korean (Han et al., 2008), French version (Carballeira et al., 2007), Swahili version (Omoro et al., 2006).

Physical Workload Questionnaire (PWQ). Physical workload was measured by the 7-item Physical Workload Questionnaire (PWQ, Leijon, Wiktorin, Harenstam, Karlqvist, & MOA Research Group, 2002). Respondents respond to each item on 0-4 or 0-5 point Likert scales. According to cut-off points in the original PWQ, each item can be recoded to 0-1 to reflect the incumbent physical workload and summate into one variable. Higher score refers to higher physical workload. The PWQ is a reliable and valid instrument with Cohen's kappa 0.38 to 0.81 and test-retest reliability for each item 0.74 to 0.92 in the original development study. In the preliminary study, the internal consistency coefficient was 0.75, which also showed this instrument was reliable. In the present study, items measuring physical workload had Cronbach's alphas of 0.71, 0.74, and 0.75 at the three time points.

Multidimensional Scale of Perceived Social Support (MSPSS). The Multidimensional Scale of Perceived Social Support (MSPSS, Zimet, Dahlem, Zimet, & Farley, 1988) was used to assess social support. The MSPSS contains 12 items assessing three dimensions of social support: family, friends, and significant others, scores ranged from 1 (*very strongly disagree*) to 5 (*very strongly agree*). Higher scores indicate higher social support. The MSPSS has been applied to various populations including adolescents, elders, and pregnant women (Kazarian & McCabe, 1991; Stanley, Beck, & Zebb, 1988; Zimet, Powell, Farley, Werkman, & Berkoff, 1990). In the present study, the Cronbach's alphas for MSPSS were 0.94, 0.95, and 0.96 at the three time points, respectively.

Demographic data. All participants provided demographic information including age, educational level, gestational week, parity, pre-pregnancy BMI and LBP history. LBP history was evaluated by asking participants to indicate the average low back pain intensity before pregnancy using a numerical rating scale ranging from 0-10. If the score was 0, then the code "no LBP history" was used, while if the score was ≥ 1 then the code "having LBP history" was used. The researcher also obtained data regarding amniotic fluid index (AFI), estimated fetus body weight (EBW) and birth body weight (BBW) from the participants' medical records. Moreover, pain intensity at GA 24 weeks (in the second trimester) was used as an important control variable, since it can be considered as the baseline pain intensity in the third trimester.

Data collection procedure. Data collection began after the proposal was approved by the institutional review boards (IRB) of National Taiwan University Hospital. The researcher approached eligible pregnant women in the waiting area in the antenatal care center. First, the researcher introduced herself and then explained the research purpose, and the potential risk and potential benefits, the right to refuse any

questions which she does not want to answer at anytime without any impact on her antenatal care. Then, the researcher asked the pregnant woman's intention to participate. If the pregnant women indicate that she would like to participate in this research, a written informed consent form was filled out by the participant before filling out the questionnaires.

Consecutive sampling is the best choice of non-probability sampling techniques where each potential participant is selected in the study during a reasonable period of time to represent the overall population (Lunsford & Lunsford, 1995). The study kept collecting data until the estimated sample size (at least 140 usable repeated responses at the third time points) was reached.

Ethical consideration. This study used the following means to ensure research ethics and the participants' rights. First, prior to data collection, the research was approved by the institutional review boards (IRB) of the involved hospitals. Second, the researcher has registered nurse certification and has professional career in obstetric clinical settings, including 520 hours nursing practice in bachelor training, 720 hours nursing practice in master training, and 16 months clinical nursing care in a postpartum ward. Third, potential participants were informed that they have the right to refuse any unwanted questions at any time. Participants who agreed to participate in this study signed written consent forms. Finally, all the data were kept confidential and used only for research.

Data Analysis

Descriptive statistics. Regarding the descriptive statistics, this study computed means and standard deviations for pain intensity, pain interference, age, LBP history, parity, body mass index (BMI), physical workloads, regular exercise, amino fluid index (AFI), estimated fetus body weight (EBW) of fetus, birth body weight (BBW) of

newborns, educational level, family income, social support, depression, and pain catastrophizing.

Univariate analyses: Prior to conducting the GEE method, the correlates for pain intensity and interference should be identified. Notably, the univariate analyses only serve as a filter for picking out the potential correlates, rather than testing the hypotheses directly.

This study identified the correlates using correlational analyses (involving the Spearman's rho [ρ]) and *t* tests in an univariate approach. Such an univariate approach can help identify relevant correlates for entering the GEE models, rather than putting all relevant and irrelevant variables in the GEE models. Univariate correlational analyses or *t* tests were therefore used as filters for selecting the relevant correlates, and thus the significance level was set at .10 in order to avoid eliminating any potentially relevant correlates. Moreover, this univariate correlation analyses or *t* tests served a predictive function. The T1 data were used for the univariate analyses.

Hierarchical regressions. The influence of pain catastrophizing is likely confounded with that of depression, and thus examination on distinguishing their influences can clarify whether pain catastrophizing contributes to prediction of pain intensity and interference controlling for the influence of depression. Since the GEE method cannot be conducted using a hierarchical approach, this study chose to use three cross-sectional hierarchical regressions to implement such examination at the three time points, respectively. The dependent variables are pain intensity and pain interference. The independent variables are depression, pain catastrophizing, and the screened correlates of pain intensity and interference from the univariate analyese. The correlates were identified using univariate analyses at each time point. The independent variables enter the regressions in a hierarchical approach, that is, all identified independent

variables (except for depression and pain catastrophizing) enter the regressions first (block 1), and then the depression enters (block 2), followed by pain catastrophizing (block 3). Such an approach enables examination on the influence of pain catastrophizing on pain intensity and interference controlling for the influence of depression.

The GEE method. In the above process, the variables that correlated with the dependent variables (pain intensity or pain interference) were used as the independent variables in the GEE model. The GEE model was used to test the study hypotheses. The dependent variables in the two GEE models were pain intensity and pain interference, respectively. Specifically, in the first GEE model, the dependent variable was pain intensity. According to the univariate analytical results, independent variables were pain intensity at GA 24 weeks, LBP history, social support, depression, pain catastrophizing, and time (i.e., T1, T2, or T3). The coefficients of independent variables were used to test H1-H12.

In the second GEE model, the dependent variable was pain interference. The independent variables were pain intensity at GA 24 weeks, LBP history, physical workload, AFI, depression, pain catastrophizing, and time (i.e., T1, T2, and T3). Due to the high correlation between pain intensity and pain interference identified in this study, pain intensity was also included in the GEE model to reflect its influence on pain interference. The coefficients of independent variables were used for testing H13-H24.

GEE is a variation of generalized linear model (GLM). When dealing with the longitudinal data, correlated errors generally bias the estimations. Thus the GEE method was invented for providing the unbiased estimation in such situation. The GEE method has two strengths. The first strength is that GEE can deal with the within-subject correlation among responses to dependent variables at multiple time points

(Ballinger, 2004). Thus GEE has been frequently used to analyze longitudinal data (Liang & Zeger, 1986). The capability for dealing with complex longitudinal data supports the use of GEE in this study. Second, GEE enables analyses on dependent variables that do not conform to normal distributions (McCullagh & Nelder, 1989). The reason is that GEE uses link functions to transform the data distributions. For example, binary data can be transformed to binomial distribution via using the log link function, while counted data having Poisson's distributions can be transformed using the logit link function.

However the weakness of the GEE technique comes from its assumptions. First, GEE assumes a population-average model, which was also called marginal model. The population-average model assumes that cases in a single sub-group shares a common average. If researchers observed that cases did not share a common average, researchers may need to determine if they need to categorize cases into a certain number of groups, in which cases for the same group share a common average. Such a categorization process ensures conformance to the assumption. Second, GEE assumes a "missing at random" phenomenon, that is, the missing data occur at random. To examine the missing at random assumption, this study compared the differences between attrition cases and retained cases. If there is no significant difference in this analysis, then it can be asserted the missing at random assumption is supported in this study. However, if any significant differences emerge, then this study needs to explore and discuss the meaning of the differences. This study conducted tests on the missing at random assumption. Attrition cases were compared with retention cases in terms of age, educational level, , T1 pain intensity, and T1 pain interference. At T2, no significant differences were observed between the two groups ($p > .12$). Similarly, at T3, there is

still no significant differences observed between the two groups ($p > .39$), supporting a conclusion that the missing data owing to attrition are not systematic.

Data type. In this study, categorical data included having LBP history (yes or no) and whether doing regular exercise (yes or no). Ordinal data included educational level, family income, and time point (T1, T2, and T3). Continuous data included pain intensity, pain interference, age, parity, AFI, EBW, BMI, physical workload, social support, depression, and pain catastrophizing.

Missing data. Regarding the missing data, if only one item is missed for a single concept, this study used the averaged response for replacement. Otherwise, no replacement was done in order to ensure the accuracy of the data.

Chapter IV Results

Sample Description

The sample comprised of 238 pregnant women in Taiwan. Table 1 lists the sample characteristics with fixed variables in this study. Table 2 lists the sample characteristics that *changed* across by time in this study. Table 1 and Table 2 were separated to avoid repetition on reporting the unchanged variables at the three time points.

As shown in Table 1, the participants had a mean age of 33.5 years (*SD* = 4.1 year) with the majority (50.0%) being between 30 and 34 years. The majority (66.0%) of the participants had attended college. Most (83.2%) of them had a monthly family income between 40,000 and 100,000 NTD.

Nearly all of them (98.7%) were married. The majority of them (61.3%) were primipara; that is, the majority of them did not have childbirth before. Most (93.7%) of them had a single fetus in the current pregnancy. The majority (61.3%) of them did not have low back pain prior to the current pregnancy.

As shown in Table 2, the mean BMI among these respondents increased from 24.6 to 25.8 (*SD* ranged from 3.1 to 3.2) in their third trimester (i.e., the three time points). The majority (66.0% – 74.4%) of the participants did not engage in regular exercise. The participants had light physical workloads (Mean 2.4/ 0-7 scale with *SD* ranging from 1.3 to 1.4). Moreover, the mean AFI ranged from 134.2 to 151.6 mm. The EBW ranged from 1177.3 to 2383.5. The participants' all AFI and EBW data were used to find the data occurred closest to T1, T2, and T3. The small number of cases (n = 40 – 90) reflects the phenomenon that the majority of the participants had used ultrasound once or less.

Table 3 lists the internal consistency (Cronbach's α) for instruments used across the three time points. Information on the reliability coefficients has also been presented in the Methods section. To avoid redundancy, these coefficients are not repeated here.

Table 1 Sample description (Variables assumed unchanged in this study) (N = 238)

Variables	*n*	%	*M*	*SD*	Range
Age			33.5	4.1	21-44
20-24	8	3.4			
25-29	21	8.8			
30-34	119	50.0			
35-39	75	31.5			
40-45	15	6.3			
Educational level					
High school	27	11.3			
College	157	66.0			
Graduate	54	22.7			
Family income (unit: NTD)					
19,999 or below	1	0.4			
20,000~39,999	20	8.4			
40,000~59,999	45	18.9			
60,000~79,999	40	16.8			
80,000~99,999	38	16.0			
100,000 or above	75	31.5			
Missing	19	8.0			
Marriage					
Unmarried	3	1.3			
Married	235	98.7			
Parity					
0 (primipara)	146	61.3			

Variables	*n*	%	*M*	*SD*	Range
1	79	33.2			
2	10	4.2			
Missing	3	1.3			
Fetus number					
1	223	93.7			
2 (Twin)	15	6.3			
LBP history					
With LBP history	87	36.6			
No LBP history	146	61.3			
Missing (forget)	5	2.1			

Table 2 Sample description (Variables assumed changed in this study, $N = 238$)

	T1 (N =238)		T2 (N =221)		T3 (N =200)	
	M (SD)	n (%)	M (SD)	n (%)	M (SD)	n (%)
BMI	24.6 (3.1)		25.2 (3.2)		25.8 (3.1)	
Regular exercise						
Yes		61 (25.6%)		67 (30.3%)		68 (34.0%)
No		177 (74.4%)		154 (69.7%)		132 (66.0%)
Physical workload	2.4 (1.3)		2.4 (1.4)		2.4 (1.3)	
Amniotic fluid index (AFI)	151.6 (32.9)	(n = 40)	136.7 (32.2)	(n = 73)	134.2 (30.8)	(n = 65)
Estimated fetus body weight (EBW)	1177.3 (484.8)	(n = 40)	1809.2 (462.1)	(n = 90)	2383.5 (420.0)	(n = 67)

Note. The Bei-Hu Branch Hospital only marked “moderate” to represent the normal AFI, creating the difference between the number of cases having AFI data and that having EBW data.

Table 3 Internal consistency of instruments (Cronbach's α)

	T1	T2	T3
Pain Interference (BPI-T)	.94	.96	.97
Pain Catastrophizing (PCS)	.94	.95	.96
Depression (PHQ-9)	.78	.82	.85
Physical Workload (PWQ)	.71	.74	.75
Social Support (MSPSS)	.94	.95	.96

Changes in Pain Intensity, Pain Interference, and Related Experience

In all of the participants. One research purpose of this study is to investigate the changes in pain intensity and interference and the changes in the related experience (i.e., social support, depression, and pain catastrophizing).

Table 4 presents the changes in pain intensity and interference and the related experience. First, average pain intensity was 2.6 (*SD* = 2.1), 2.8 (*SD* = 2.1), and 2.8 (*SD* = 2.4) across the three time points, respectively. They indicated an increasing tendency for the average pain intensity. The three other measures (i.e., the worse pain, the least pain, and the pain now) of pain intensity also demonstrated a similar pattern over time. However, the repeated measures ANOVA (RM-ANOVA) showed that only trend significance (p = .10), as shown in Table 5.

Second, overall pain interference had a mean of 2.2 (*SD* = 2.2), 2.4 (*SD* = 2.3), and 2.6 (*SD* = 2.6) at each time point, respectively. The results demonstrated a constantly increasing tendency of pain interference in the third trimester. The all aspects of pain interference also consistently increased throughout the third trimester, demonstrating the same pattern as overall pain interference. With regard to the individual aspects of the pain interference scale, sleep disturbance (2.8, 2.9, and 3.2, *SD* = 2.9, 2.8, and 3.1) ranked as the most interfering aspect. Walking ability (2.4, 2.7, and 2.9, *SD* = 2.7, 2.7, and 2.9) and normal work (2.5, 2.5, and 2.8, *SD* = 2.6, 2.6, and 2.9) ranked the second and the third at the three time points. When looking at the changes between T1 and T3, all aspects of pain interference demonstrated a consistent increase (with a magnitude from 0.3 to 0.6). The RM-ANOVA also supposed that pain interference at T1 significantly exceeded pain interference at T3 (p = .00).

Third, the scores for social support were very stable (4.2, 4.2, and 4.2, *SD* = 0.7, 0.8, and 0.8) across the three time points. When looking at the individual aspects of

social support, all aspects demonstrated the same pattern, i.e., very stable, across the three time points. The social support from family (4.3, 4.3, and 4.3, *SD* = 0.7, 0.8, and 0.8) and the social support from significant others (4.3, 4.3, and 4.3, *SD* = 0.8, 0.8, and 0.8) were slightly higher than the support from friends (4.1, 4.1, and 4.1, *SD* = 0.8, 0.9, and 0.9). The numbers support the consistently high social support received by pregnant women in Taiwan. The RM-ANOVA also indicated that the social support at each time point does not differ significantly ($p = .85$).

Fourth, for the all participants, depression increased from 6.0 (at T1, *SD* = 3.8) to 6.6 (at T2, *SD* = 4.0) and 6.8 (at T3, *SD* = 4.3), demonstrating an obvious increase. With a diagnosis criterion of PHQ-9 (the scale used for assessing depression in this study), the score of 15 and above would be used to judge that a participant has depressive disorder. The proportions of depression (had a PHQ-9 $\geq$ 15) slightly increased across the three time points from 5.0% to 5.9% and 8.0%. The increased tendency of depression during the third trimester was also supported by RM-ANOVA ($p = .00$).

Fifth, the scores of pain catastrophizing were 11.7, 11.4, and 10.8 (*SD* = 10.7, 11.0, and 11.4) at the three time points, indicating a slightly decreasing tendency of pain catastrophizing in the third trimester of pregnant women. When looking at the three aspects of pain catastrophizing, rumination (repetitively thinking of pain, 5.4, 5.2, and 4.8, *SD* = 4.5, 4.4, and 4.5) and magnification (amplifying the pain, 2.6, 2.5, and 2.3, *SD* = 2.6, 2.8, and 2.7) demonstrated a similar pattern as the overall pain catastrophizing. However, the aspect of helplessness (feel that they cannot do anything to deal with the pain, 3.8, 3.7, and 3.6, *SD* = 4.5, 4.6, and 5.0) did not show an obvious decreasing pattern. The RM-ANOVA also supported that pain catastrophizing does not decrease significantly ($p = .64$).

Since the study sample comprised of the pregnant women both with and without PR-LBP, the pain intensity and interference and its related experience of the pregnant women having PR-LBP may be diluted by those not having PR-LBP. Thus this study selected the cases of participants who had PR-LBP at each time point and investigated the changes in their pain intensity and interference and its related experience.

In the participants who have PR-LBP. Table 6 lists the pain intensity and interference and its related experience of the pregnant women having PR-LBP at each time point, respectively. That is, the data under the label "T1" were reported by pregnant women who had PR-LBP at T1 and so on. This study called the pregnant women having PR-LBP as the "pain group" in the following to be concise.

The pain group has an average pain intensity that increased from 3.4 (at T1) to 3.6 (at T2) and 3.8 (at T3) with a *SD* increased from 1.7 (at T1) and 1.7 (at T2) to 2.0 (at T3). The worst pain, the least pain, and the pain now all shared the same pattern. Notably, the mean of the worst pain at T3 can reach 5.1, which is within the moderate range of the scale.

The pain group also reported an increased pain interference pattern. The overall pain interference for the pain group increased from 2.9 to 3.1 and 3.9 with a *SD* that increased from 2.1 and 2.1 to 2.5. The seven aspects of pain interference all shared the same pattern. When looking at the individual aspects of pain interference, sleep disturbance, walking ability, and the normal work ranked in the top three. The ranking of the seven pain interference aspects for the pain group was the same as the ranking for all of the participants.

The pain group reported that they received stable overall social support (4.2, 4.2, and 4.2, *SD* = 0.7, 0.8, and 0.8) as well as individual aspects of social support. Specifically, the pain group receive stable social support from family (4.3, 4.3, and 4.3,

SD = 0.8, 0.8, and 0.8), friends (4.0, 4.0, and 4.0, *SD* = 0.8, 0.9, and 0.9), and significant others (4.2, 4.3, and 4.3, *SD* = 0.8, 0.9, and 0.8). The social support scores for the pain group are very close to the social support scores for all of the participants.

The pain group reported an increased score on depression (6.5, 7.0, and 7.5, *SD* = 3.8, 4.2, and 4.5). Using the cutoff point (≥ 15) suggested in the literature (Yeung et al., 2008), the proportion of women having depressive disorder increased in the third trimester (5.5%, 8.4%, and 11.2%). Such an increase (11.2% - 5.5% = 5.7%) for the pain group is seemingly larger than the increase for all of the participants (8.2% - 5.2% = 3.0%). The score of pain catastrophizing for the pain group also showed a decreasing tendency (15.4, 14.7, and 14.5, *SD* = 9.7, 10.4, and 11.1). When looking into the subscales of pain catastrophizing, it is necessary to compute the average score for one item, since the subscales contain different numbers of items. On average, pregnant women having PR-LBP reported the highest score (≥ 1.6, using a 0-4 option) for one item measuring rumination among subscales of pain catastrophizing.

Since there is no clear cut off reported in the literature for determining what is "a high level of pain catastrophizing", this study used the half (26) of the maximum score (52) as a temporary reference point. This study found that 34 (19.8%), 26 (16.4%), and 20 (14.6%) of the pregnant women who have PR-LBP reported a higher score than the reference point. Moreover, in the pain group, 171 (97.7%), 148 (93.1%), and 130 (94.9%) of the participants reported non-zero scores on pain catastrophizing. The substantial proportions (≥ 14.6%) indicated that pain catastrophizing was present in pregnant women having PR-LBP in the third trimester.

Table 7 compared depression and social support levels between those who have pain and those who do not have pain at each time points. The scores on depression for those who have pain significantly exceeded those who do not have pain at all time

points (p = .00 – .01). On the contrary, social support for those who do not have pain exceeded that for those who have pain only at T1 (p = .01), but not at T2 and T3 (p ≥ .40).

This study is also interested in understanding the proportion of pregnant women having severe PR-LBP among the pain group. As defined by studies using the BPI scale, the score of seven or more (≥ 7) should be regarded as severe. Table 8 lists the analytical results. The results indicated that in terms of the worst pain, the proportions were 22.1%, 20.4%, and 28.2% at the three time points, respectively. In terms of the average pain, the proportions were 4.4%, 3.7%, and 8.5%.

Relationship between Pain Intensity and Pain Interference

This study found that pain intensity and pain interference are highly correlated with each other at the three time points (.87, .85, and .89). The high correlations indicated that pain intensity and pain interference are closely related.

Table 4 Mean scores of changes in pain-related experience (*N* = 238)

	T1 (*N* =238)		T2 (*N* =221)		T3 (*N* =200)	
	Mean (*SD*)/ *n* (%)	Range	Mean (*SD*)/ *n* (%)	Range	Mean (*SD*)/ *n* (%)	Range
Pain intensity						
Worst	3.8 (2.7)	0-10	3.7 (2.6)	0-9	3.8 (2.9)	0-10
Least	1.0 (1.5)	0-8	1.3 (1.7)	0-7	1.4 (1.9)	0-8
Average	2.6 (2.1)	0-8	2.8 (2.1)	0-8	2.8 (2.4)	0-9
Now	1.7 (2.0)	0-7	2.1 (2.1)	0-7	2.2 (2.3)	0-8
Pain interference	2.2 (2.2)	0.0-8.6	2.4 (2.3)	0.0-8.4	2.6 (2.6)	0.0-10.0
Sleep	2.8 (2.9)	0-10	2.9 (2.8)	0-10	3.2 (3.1)	0-10
Walking ability	2.4 (2.7)	0-10	2.7 (2.7)	0-10	2.9 (2.9)	0-10
Normal work	2.5 (2.6)	0-10	2.5 (2.6)	0-9	2.8 (2.9)	0-10
General activity	2.3 (2.5)	0-10	2.5 (2.5)	0-9	2.8 (2.8)	0-10
Enjoyment of life	2.2 (2.5)	0-10	2.6 (2.7)	0-10	2.7 (2.9)	0-10
Mood	2.2 (2.5)	0-10	2.4 (2.4)	0-10	2.5 (2.5)	0-10
Relationship	1.2 (1.8)	0-7	1.6 (2.1)	0-8	1.8 (2.3)	0-10
Social support	4.2 (0.7)	1.0-5.0	4.2 (0.8)	1.0-5.0	4.2 (0.8)	1.2-5.0
Family	4.3 (0.7)	1.0-5.0	4.3 (0.8)	1.0-5.0	4.3 (0.8)	1.3-5.0
Friends	4.1 (0.8)	1.0-5.0	4.1 (0.9)	1.0-5.0	4.1 (0.9)	1.0-5.0
Significant others	4.3 (0.8)	1.0-5.0	4.3 (0.8)	1.0-5.0	4.3 (0.8)	1.3-5.0
Depression	6.0 (3.8)	0-18	6.6 (4.0)	0-21	6.8 (4.3)	0-21
Yes (PHQ-9 ≥ 15)	12 (5%)		13 (6%)		16 (8%)	
No (PHQ-9 < 15)	226 (95%)		207 (94%)		183 (92%)	
Missing	0 (0%)		1 (1%)		1 (1%)	
Pain catastrophizing	11.7 (10.7)	0-42	11.4 (11.0)	0-42	10.8 (11.4)	0-51
Rumination (4 items)	5.4 (4.5) 1.4/item	0-16	5.2 (4.4) 1.3/item	0-16	4.8 (4.5) 1.2/item	0-16
Magnification (3 items)	2.6 (2.6) 0.9/itme	0-10	2.5 (2.8) 0.8/item	0-12	2.3 (2.7) 0.8/item	0-11
Helplessness (6 items)	3.8 (4.5) 0.6/item	0-19	3.7 (4.6) 0.6/item	0-22	3.6 (5.0) 0.6/item	0-24

Table 5 Analysis of pain-related experience levels by repeated measures ANOVA (N = 238)

	T1	T2	T3	p	Difference
Pain intensity	2.54	2.87	2.83	.10	T2 > T1 (p = .07)
	(2.16)	(2.10)	(2.35)		
Pain interference	2.12	2.42	2.71	.00	T3 > T1 (p = .00)
	(2.17)	(2.28)	(2.63)		
Social support	4.25	4.23	4.24	.85	—
	(0.67)	(0.76)	(0.78)		
Depression	5.87	6.45	6.80	.00	T2 > T1 (p = .03)
	(3.76)	(3.89)	(3.35)		T3 > T1 (p = .00)
Pain catastrophizing	11.06	11.42	10.74	.64	—
	(10.61)	(10.71)	(11.11)		

Table 6 Mean scores of changes in pain-related experience (Participants with PR-LBP) (*N* = 181)

	T1 (*N* =181)		T2 (*N* =162)		T3 (*N* =142)	
	Mean (*SD*)/ *n* (%)	Range	Mean (*SD*)/ *n* (%)	Range	Mean (*SD*)/ *n* (%)	Range
Pain intensity						
Worst	5.0 (1.9)	1-10	4.8 (1.9)	1-9	5.2 (2.2)	1-10
Least	1.2 (1.6)	0-8	1.7 (1.8)	0-7	1.8 (2.0)	0-8
Average	3.4 (1.7)	0-8	3.6 (1.7)	0-8	3.8 (2.0)	0-9
Now	2.2 (2.1)	0-7	2.7 (2.0)	0-7	3.0 (2.2)	0-8
Pain interference	2.9 (2.1)	0.0-8.6	3.1 (2.1)	0.0-8.4	3.6 (2.5)	0-10
Sleep	3.6 (2.8)	0-10	3.8 (2.6)	0-10	4.3 (2.9)	0-10
Walking ability	3.1 (2.7)	0-10	3.4 (2.5)	0-10	3.9 (2.8)	0-10
Normal work	3.2 (2.5)	0-10	3.2 (2.5)	0-9	3.9 (2.8)	0-10
General activity	3.0 (2.4)	0-10	3.2 (2.3)	0-9	3.8 (2.6)	0-10
Enjoyment of life	2.8 (2.5)	0-10	3.3 (2.6)	0-10	3.7 (2.9)	0-10
Mood	2.8 (2.5)	0-10	3.0 (2.3)	0-10	3.3 (2.4)	0-10
Relationship	1.5 (2.0)	0-7	2.0 (2.2)	0-8	2.4 (2.4)	0-10
Social support	4.2 (0.7)	1.0-5.0	4.2 (0.8)	1.0-5.0	4.2 (0.8)	1.6-5.0
Family	4.3 (0.8)	1.0-5.0	4.3 (0.8)	1.0-5.0	4.3 (0.8)	1.5-5.0
Friends	4.0 (0.8)	1.0-5.0	4.0 (0.9)	1.0-5.0	4.0 (0.9)	1.0-5.0
Significant others	4.2 (0.8)	1.0-5.0	4.3 (0.9)	1.0-5.0	4.3 (0.8)	1.3-5.0
Depression	6.5 (3.8)	0-18	7.0 (4.2)	0-21	7.5 (4.5)	0-21
Yes (PHQ-9 ≥ 15)	10 (5.5%)		12 (7.4%)		16 (11.3%)	
No (PHQ-9 < 15)	171 (94.5%)		149 (92.0%)		126 (88.7%)	
Missing	—		1 (0.6%)		—	
Pain catastrophizing	15.4 (9.7)	0-42	14.7 (10.4)	0-42	14.5 (11.1)	0-51
Rumination (4 items)	7.0 (3.9) 1.8/item	0-16	6.8 (3.9) 1.7/item	0-16	6.5 (4.0) 1.6/item	0-16
Magnification (3 items)	3.5 (2.5) 1.2/item	0-10	3.2 (2.8) 1.1/item	0-12	3.0 (2.7) 1.0/item	0-11
Helplessness (6 items)	4.9 (4.5) 0.8/item	0-19	4.8 (4.7) 0.8/item	0-22	4.8 (5.3) 0.8/item	0-24

Table 7 Comparison of depression and social support between pain and non-pain groups

	T1 (*N* =181)			T2 (*N* =162)			T3 (*N* =142)		
	No pain	Pain	*p*	No pain	Pain	*p*	No pain	Pain	*p*
Depression	4.49	6.51	.00	5.49	7.00	.01	5.05	7.51	.00
	(3.50)	(3.79)	***	(3.46)	(4.16)	*	(3.29)	(4.47)	***
Yes (PHQ-9 ≥ 15)	2	10	.74[a]	1	12	.19[a]	0	16	.01[a]
	(3.5%)	(5.5%)	*ns*	(1.7%)	(7.5%)	*ns*	(0.0%)	(11.3%)	**
No (PHQ-9 < 15)	55	171		58	149		57	126	
	(96.5%)	(94.5%)		(8.3%)	(92.5%)		(100.0%)	(88.7%)	
Social support									
Total	4.5	4.2	.01	4.3	4.2	.50	4.2 (0.79)	4.2	.85
	(0.54)	(0.71)	**	(0.74)	(0.80)	*ns*		(0.80)	*ns*
Family	4.5	4.2	.03	4.3	4.2	.57	4.2 (0.87)	4.3	.53
	(0.60)	(0.76)	*	(0.76)	(0.84)	*ns*		(0.76)	*ns*
Friend	4.54	4.0	.00	4.2	4.0	.40	4.1 (0.83)	4.0	.76
	(0.59)	(0.80)	**	(0.88)	(0.95)	*ns*		(0.91)	*ns*
Significant others	4.5	4.2	.03	4.4	4.3	.64	4.3 (0.80)	4.3	.60
	(0.65)	(0.80)	*	(0.75)	(0.88)	*ns*		(0.82)	*ns*

[a] denotes Fisher's Exact Test

Table 8 Pain intensity distribution (Participants with PR-LBP) (N = 181)

		Worst pain intensity		Average pain intensity	
		n	%	*n*	%
T1	No pain (0)	0	0.0%	4	2.2%
(N = 181)	Mild (1-3)	46	25.4%	96	53.0%
	Moderate (4-6)	92	50.8%	67	37.0%
	Severe (7-10)	40	22.1%	8	4.4%
	Missing	3	1.7%	6	3.3%
T2	No pain (0)	0	0.0%	1	0.6%
(N = 162)	Mild (1-3)	42	25.9%	76	46.9%
	Moderate (4-6)	84	51.9%	75	46.3%
	Severe (7-10)	33	20.4%	6	3.7%
	Missing	3	1.9%	4	2.5%
T3	No pain (0)	0	0.0%	1	0.7%
(N = 142)	Mild (1-3)	38	26.8%	68	47.9%
	Moderate (4-6)	64	45.1%	61	43.0%
	Severe (7-10)	40	28.2%	12	8.5%
	Missing	0	0.0%	0	0.0%

Univariate analyses: Identifying correlates of pain intensity and interference. Prior to conducting the GEE models to test the study hypotheses, this study conducted univariate analyses to identify the potential correlates. Since the independent variables were chosen with a prediction purpose, the T1 correlation coefficients were used to pick out correlates. The significance level of .10 was used to avoid filtering out potentially important correlates.

Table 9 lists the analytical results using univariate analyses. Regarding the correlations with T1 pain intensity, pain intensity at GA 24 weeks ($\rho = .84$, $p < .001$), social support ($\rho = -.17$, $p < .05$), depression ($\rho = .39$, $p < .001$), and pain catastrophizing ($\rho = .74$, $p < .001$) were identified as potential correlates for pain intensity.

Moreover, regarding the correlations with T1 pain interference, pain intensity at GA 24 weeks ($\rho = .73$, $p < .001$), physical workload ($\rho = .15$, $p < .05$), social support ($\rho = -.17$, $p < .05$), depression ($\rho = .47$, $p < .001$), and pain catastrophizing ($\rho = .78$, $p < .001$) were identified as potential correlates for pain interference.

Due to the data type and its suitability for using the Spearman's rho correlation coefficients, the correlation between categorical variables (i.e., LBP history and regular exercise) and pain intensity and interference should be examined using *t* tests. Table 10 lists the analytical results. First, pain intensity at T1 for pregnant women having LBP history (3.09) significantly exceeded those not having LBP history (2.39) ($t = 2.48$, $p = .01$). Moreover, pain interference at T1 for pregnant women having LBP history (2.63) also significantly exceeded those not having LBP history (2.02) ($t = 2.08$, $p = .04$). The results of *t* tests indicated that LBP history should be included in the subsequent GEE analyses.

Second, pain intensity at T1 did not differ between pregnant women who exercise regularly (2.04) and those who do not (2.68) (t = -1.42, p = .16). Pain interference also did not differ between pregnant women who do and do not exercise regularly (1.80 vs. 2.27, t = -1.02, p = .31). Thus the variable "having regular exercise or not" should not be included in the GEE model.

Table 9 Correlation coefficients among pain intensity, pain interference, and other variables

	T1		T2		T3	
	Intensity	Interference	Intensity	Interference	Intensity	Interference
Pain intensity	1.00	.87***	1.00	.85***	1.00	.89***
Pain intensity at GA24wk	.84***	.73***	.43***	.37***	.38***	.33***
Age	-.08	-.06	-.09	-.06	-.02	-.04
Educational level	-.04	-.03	-.06	-.03	-.06	-.05
Parity	.09	.07	-.01	.08	.06	.03
AFI	.14	-.07	.09	.02	.16	.10
EBW	.12	.06	-.04	.06	-.07	-.06
BMI	.05	.06	.04	.09	.07	-.08
Physical workload	.10	.15*	.28***	.27***	.10	.16*
Social support	-.17*	-.17*	-.12†	-.13†	-.02	.00
Depression	.39***	.47***	.40***	.48***	.42***	.53***
Pain catastrophizing	.74***	.78***	.76***	.81***	.78***	.83***

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, Intensity denotes “Average pain intensity”, Interference denotes “Pain interference”, AFI denotes “amniotic fluid index”, EBW denotes “estimated fetus body weight”, BMI denoted “body mass index”.

Table 10 Pain intensity and pain interference differences between participants with LPB history or not and participants having regular exercise or not

	Mean	*SD*	*t*	*p*
Pain intensity				
LBP history				
Yes	3.09	2.04	2.48	.01*
No	2.39	2.07		
Regular exercise				
Yes	2.04	2.31	-1.42	.16
No	2.68	2.07		
Pain interference				
LBP history				
Yes	2.63	2.33	2.08	.04*
No	2.02	2.05		
Regular exercise				
Yes	1.80	2.34	-1.02	.31
No	2.27	2.16		

* $p < .05$.

Influence of Depression and Pain Catastrophizing

Prior to testing the influence of pain catastrophizing controlling for the influence of depression, this study computed the correlations between depression and pain catastrophizing at the three time points. If they measure the same domain, they would have very high correlations. The correlations were .42, .46, and .50, respectively. Such moderate correlations indicated that the two concepts are distinct. Furthermore, this study proceeded to conduct the hierarchical regressions.

Hierarchical regressions were used to test the influence of pain catastrophizing controlling for the influence of depression. Prior to constructing the regressions, the correlates for T1 pain intensity, T1 pain interference, T2 pain intensity, T2 pain interference, T3 pain intensity, and T3 pain interference should be identified first. Univariate analyses were conducted using correlational analyses involving Spearman' rho and *t* tests to identify the correlates. The correlates to be tested also include the pain intensity at the GA 24 week because the pain intensity at GA 24 week is one month ahead of the study period and can serve as a good baseline for pain intensity.

For each of pain intensity and interference at each time point, three blocks (i.e., block 1, block 2, and block 3) were used. Block 1 was used to include all the correlates for the pain intensity and interference except for depression and pain catastrophizing. Block 2 was used to additionally include depression as an independent variable. Block 3 was used to additionally include pain catastrophizing as an independent variable. Such a hierarchical approach can help examine the additional influence of pain catastrophizing controlling for the influence of depression on pain intensity and interference.

Table 11 and Table 12 list the results of hierarchical regressions at the three time points, respectively. The analytical results are interesting in consistently (across the

three time points) disclosing that pain catastrophizing is a good predictor for predicting PR-LBP intensity and interference, even controlling the influence of depression. This study also observed that the R^2 change due to addition of pain catastrophizing is significant at all time points in regressions in both Table 11 and Table 12, indicating that pain catastrophizing can explain variance of pain intensity and pain interference in addition to depression and other included variables.

Table 11 Results of hierarchical regression predicting pain intensity

Time	Block	Variable	Beta	Total R^2	R^2 change	F change
T1	Block 1	Pain intensity (24wk)	.81***	.65	—	134.1***
		LBP history	-.01			
		Social support	-.02			
	Block 2	Depression	.08	.66	.01	3.5
	Block 3	Pain catastrophizing	.28***	.71	.05	32.6***
T2	Block 1	Pain intensity (24wk)	.35***	.26	—	17.4***
		LBP history	.16*			
		Physical workload	.23*			
		Social support	-.03			
	Block 2	Depression	.30**	.34	.08	23.1***
	Block 3	Pain catastrophizing	.58***	.55	.21	87.4***
T3	Block 1	Pain intensity (24wk)	.35***	.14	—	14.6***
		LBP history	.08			
	Block 2	Depression	.37***	.27	.13	32.1***
	Block 3	Pain catastrophizing	.63***	.53	.26	96.1***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, LBP denotes “low back pain”, Numbers in the table are standardized beta coefficients.

Table 12 Results of hierarchical regression predicting pain interference

Time	Block	Variable	Beta	Total R^2	R^2 change	F change
T1	Block 1	Pain intensity	.80***	.66	—	100.5***
		LBP history	-.01			
		Physical workload	.07			
		Social support	-.01			
	Block 2	Depression	.21***	.69	.03	23.7***
	Block 3	Pain catastrophizing	.22***	.72	.03	19.2***
T2	Block 1	Pain intensity	.77***	.63	—	84.1***
		LBP history	.03			
		Physical workload	.06			
		Social support	.02			
	Block 2	Depression	.28***	.69	.06	38.9***
	Block 3	Pain catastrophizing	.29***	.73	.04	26.2***
T3	Block 1	Pain intensity	.84**	.73	—	159.7***
		LBP history	.02			
		Physical workload	.07			
	Block 2	Depression	.30***	.80	.07	62.7***
	Block 3	Pain catastrophizing	.19***	.82	.02	14.5***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, LBP denotes “low back pain”, Numbers in the table are standardized beta coefficients, and F denotes the F value of R^2 change.

Correlates of the Changes in Pain Intensity and Pain interference

Table 13 lists the GEE analytical results of correlates of changes in pain intensity. The results indicated that pain intensity at GA 24 weeks (in the second trimester) can significantly predict changes in pain intensity in the third trimester ($\beta = .33$, $p < .001$). Pain catastrophizing can also predict changes in pain intensity in the third trimester ($\beta = .11$, $p < .001$). The analytical results also indicated time (from T1 to T2 and T3) can predict changes in pain intensity ($\beta = .19$, $p < .01$). Such analytical results support H12, while they do not provide support for H1 to H11.

Table 14 lists the GEE analytical results of correlates of changes in pain interference. Pain intensity significantly predict changes in pain interference across the third trimester ($\beta = .59$, $p < .001$). Social support predicts increases in pain interference ($\beta = .12$, $p < .10$). Depression predicts increases in pain interference ($\beta = .10$, $p < .001$). Pain catastrophizing also predicts increases in pain interference ($\beta = .06$, $p < .001$). The analytical results also indicated that the time (from T1 to T3) predicts changes in pain interference ($\beta = .15$, $p < .01$). Such analytical results supported H22, H23, and H24, while other hypotheses were not supported.

Table 13 Changes in pain intensity by GEE

Variables	Beta	S.E.	95% C.I. Lower	95% C.I. Upper	χ^2	*p*
Pain intensity at GA24wk	.33***	.05	.24	.42	53.4	.00
LBP history	.06 (Reference)	.16	-.26	.37	0.1	.72
Social support	.08	.09	-.09	.25	0.9	.34
Depression	.01	.02	-.03	.05	0.3	.58
Pain catastrophizing	.11***	.01	.09	.13	165.4	.00
Time	.19**	.06	.06	.31	8.7	.00

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Working correlation matrix structure: AR(1)

Goodness of fit:

Quasi Likelihood under Independence Model Criterion (QIC) = 1273.1

Corrected Quasi Likelihood under Independence Model Criterion (QICC) = 1267.3

Table 14 Changes in pain interference by GEE

Variables	Beta	S.E.	95% C.I. Lower	95% C.I. Upper	χ^2	*p*
Pain intensity	.59***	.04	.51	.67	204.1	.00
LBP history	.02 (Reference)	.14	-.24	.29	0.3	.87
Physical workload	.07	.04	-.02	.15	2.3	.13
Social support	.12	.07	-.02	.27	2.8	.09
Depression	.10***	.02	.07	.13	36.3	.00
Pain catastrophizing	.06***	.01	.04	.08	53.5	.00
Time	.15**	.05	.05	.25	9.2	.00

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Working correlation matrix structure: AR(1)

Goodness of fit:

Quasi Likelihood under Independence Model Criterion (QIC) = 837.1

Corrected Quasi Likelihood under Independence Model Criterion (QICC) = 830.7

Chapter V Discussion

This study explored course and predictors of pain intensity and interference during the third trimester. It is the first study to investigate predictors of PR-LBP intensity and interference change during the third trimester. The results support the use of biopsychosocial model for understanding PR-LBP. That is, pain intensity and interference are not only predicted by biological factors, but also psychological and social factors. This study also found that several risk factors of PR-LBP prevalence identified in the literature cannot predict changes in PR-LBP intensity and interference in the third trimester.

Changes in Pain Intensity, Pain Interference, and Related Experience

Regarding changes in pain intensity, this study observed that PR-LBP intensity increased in the third trimester, although its increase is restrained and of little clinical significance. Such an increasing tendency of PR-LBP intensity indicated the importance of PR-LBP management in the third trimester. When PR-LBP maintains in intensity and slightly increases over time, pregnant women having PR-LBP suffer more with increased PR-LBP. Such increased PR-LBP and the associated suffering can be reduced. The literature (Garshasbi & Faghih Zadeh, 2005; Suputtitada, Wacharapreechanont, & Chaisayan, 2002) has provided effective exercise programs that can help alleviate PR-LBP. Specifically, a well-designed exercise program (Garshasbi & Faghih Zadeh, 2005) or "sitting pelvic tilt exercise" (Suputtitada et al., 2002) can help reduce the PR-LBP intensity during pregnancy. The present study indicated that PR-LBP intensity can increase in the third trimester and thus health professionals may consider encouraging pregnant women having PR-LBP to participate in well-designed and managed exercise programs.

Moreover, this study found that the scores of pain interference had a stable increase in the third trimester. Such a finding indicated that the pregnant women experiencing PR-LBP encountered increased problems in doing their daily activities. One of the possible solutions is to prevent or manage PR-LBP prior to the third trimester. The literature has designed exercise programs and identified some effects on reducing PR-LBP (Garshasbi & Faghih Zadeh, 2005). A low level of pain interference at the beginning of the third trimester may help pregnant women experience a very high level of pain interference by the end of the third trimester. Furthermore, the finding on the increasing PR-LBP interference in the third trimester provides the insight to the health professionals that PR-LBP not only means biological suffering but also hinders pregnant women's daily activities. The increased impact of PR-LBP on women health (pain intensity) and well-being (ability to do daily activities) indicates that PR-LBP needs attention and proper management during pregnancy.

This study also observed a constant high level of scores on social support in the third trimester. Such an observation indicates that pregnant women have strong and consistent social support to deal with their PR-LBP. The underlying reason may be the meaning of pregnancy to the family and the significant others (e.g. husband). Another reason can be that when pregnant women filled the questionnaires, either their husbands or their family members stay with them, motivating the pregnant women to report consistently high scores on social support. Pregnancy usually means the expectation for a newborn baby which is highly valued by the family and the significant others, and thus family and the significant others would likely provide very strong support for the pregnant women. Regarding the social support from the friends, pregnancy is an event to invoke blessing by friends, and thus social support from the friends is also high for the pregnant women. The high levels of social support can provide health professionals

means for alleviating PR-LBP. Health professionals can invite pregnant women to participate in exercise programs with their husbands and family members. Their husbands and family members can help pregnant women practice what they learn in the exercise programs at home, further increasing the muscle strength and consequently can alleviate PR-LBP.

The scores on depression increased over time. The reason for the increases in depression may be the approached estimated childbirth date, which triggers anxiety and fuels depression. Additionally, other syndromes associated with pregnancy are likely becoming intensive in the third trimester, increasing discomfort and depression. The increasing tendency of depression in the pregnant women should be noted, because depression is associated with the tendency to self-harm (Gausia et al., 2009) and the self-harm in the pregnancy may also pose threats to the health of the fetus. Since previous depression is a risk factor for depression during pregnancy (Bunevicius et al., 2009), health professionals should note the pregnant women have a history of depression. Antecedents of depression during pregnancy include unwanted pregnancy (Golbasi, Kelleci, Kisacik, & Cetin, 2009) and a low level of marital satisfaction (Records & Rice, 2007). Therefore, health professionals should also be aware when the pregnancy is unwanted or the pregnant women have low levels of martial satisfaction. When pregnant women with high risks of depression are identified, health professionals can consider means for reducing the changeable risk factors of depression, including negative mood states, a low level of marital satisfaction (Records & Rice, 2007), and a low level of sleep quality in the first trimester of pregnancy (Skouteris et al., 2008).

Regarding the level of pain catastrophizing scores in this study, Sullivan et al. (1995) found that women's responses to the PCS scale have an average of 19.5 with a standard deviation of 8.5 in pain research subjects. Moreover, Olsson et al. (2009)

found that pregnant women having lumbopelvic pain have a score of 15.9. In the present study, the pregnant women's (the pain group's) responses to the PCS scale had a score of 15.4 with a standard deviation of 10.00 (at T1). Such an average level is lower than that reported by Sullivan et al. (1995), while the standard deviation exceeded that reported by Sullivan et al. (1995). One potential reason for the lower average and higher standard deviation on pain catastrophizing in the present study is that pregnant women in their trimester understand that they are close to childbirth and they are convinced that their PR-LBP will disappear soon after childbirth, reducing their average pain catastrophizing. Pregnant women are likely convinced to a variable degree, increasing the standard deviation on pain catastrophizing. Furthermore, the difference in scores of pain catastrophizing may also come from the study population. Sullivan et al. (1995) used a sample of undergraduates and the present study used a sample of pregnant women in their third trimester. Since pregnancy is a joyful process, any catastrophizing (including pain catastrophizing) may be lower in pregnant women than in the general population.

With regard to the scores to subscale of pain catastrophizing, pregnant women having PR-LBP reported a relatively higher score on rumination, which is repetitive thinking of pain. This finding indicated that pregnant women having PR-LBP would repetitively think of pain (rumination) more often than amplify the pain (magnification) or feel hopeless (helplessness). This finding supports rumination as an appropriate target for treatment.

This study also found that in the pregnant women having PR-LBP, most of them (≥ 93.1%) reported non-zero scores on pain catastrophizing, indicating that at least some pain catastrophizing often accompanies PR-LBP. This study also found that substantial proportions (≥ 14.6%) of the pregnant women having PR-LBP reported a score on pain

catastrophizing higher than the half of the maximum score (≥ 26 points). Such proportions indicated the necessity and relevance to examine the influence of pain catastrophizing in pregnant women with PR-LBP. Such a proportion may come from the severe influence of PR-LBP on some pregnant women that change their cognition toward PR-LBP.

This study did not observe a significant change of pain catastrophizing in the third trimester, although pregnant women may expect that PR-LBP would end soon after the childbirth. This study also provided the scores (11.5, 11.4, and 10.8 for all of the participants and 15.4, 14.7, and 14.5 for the pain group) of pain catastrophizing in the third trimester. Such numbers are new to the literature, since only one study (Olsson et al., 2009) has investigated the scores of pain catastrophizing in the early pregnancy, i.e., the GA 20 weeks. However, the present study provided the scores of pain catastrophizing in the late pregnancy, i.e., the GA 28 to 36 weeks. Compared with the score (15.9) of pain catastrophizing reported by Olsson et al. (2009), the score (14.5 to 15.4) reported by the present study is relatively low. Consistent with Olsson (2009), this study found that pain catastrophizing exists in pregnant women with PR-LBP although the score of PCS was also not high (between 14.5 and 15.4). Compared with the literature on pain catastrophizing (e.g., Garnet et al., 2011; Jensen et al., 2011), the present study is unique in applying the concept to the pregnant women population. The reason may be that pregnant women in GA 28-36 weeks expect that PR-LBP would end soon after childbirth.

Relationship between Pain Intensity and Pain Interference

This study observed strong relations between PR-LBP intensity and PR-LBP interference in the third trimester of the pregnant women. Such strong relations are consistent with the previous PR-LBP studies (i.e., Gutke et al., 2006; Kristiansson et al.,

1996). This study provided the evidence supporting the relation in Taiwan, an Asian country. The evidence is meaningful to Taiwanese health professionals that PR-LBP intensity is relevant to pregnant women, since PR-LBP intensity is highly related the degree PR-LBP interferes with pregnant women in their trimester. Successful management of PR-LBP intensity can be expected to reduce the PR-LBP interference and consequently increase the well-being of pregnant women in Taiwan.

Influence of Depression and Pain Catastrophizing

This study obtained evidence supporting a conclusion that depression and pain catastrophizing are distinct concepts and have independent influences on pain intensity and interference. First, this study observed that the correlations between depression and pain catastrophizing are only moderate in magnitude. Second, when controlling for the influence of depression, pain catastrophizing still has significant impact on PR-LBP in terms of pain intensity and pain interference. Previous studies (i.e., Keefe et al., 1989; Sullivan & D'Eon, 1990) on depression and pain catastrophizing had investigated their influences in chronic pain populations. Compared with these studies, the present study is new in investigating depression and pain catastrophizing in the pregnant women population, contributing the evidence in the debate on the relationship between depression and pain catastrophizing. Such uniqueness enables the present study to observe that pain catastrophizing predicts increases in PR-LBP intensity when considering the influence of depression. Such a finding suggests the potential for helping pregnant women deal with PR-LBP by using cognitive therapy, which was known as an effective treatment for reducing pain catastrophizing (Thorn et al., 2007). That is, the finding of this study can help health professionals reduce pregnant women's pain, contributing to women health.

This study observed that the R^2 change due to addition of pain catastrophizing robustly increases in regressions using pain intensity as the dependent variables. One potential explanation is that when pregnant women are approaching childbirth, PR-LBP becomes more and more severe. The intolerance of PR-LBP for pregnant women may reinforce the influence of pain catastrophizing on PR-LBP intensity.

The following then discusses the GEE analytical results regarding each factor, respectively. To clarify the contributions and implications of the present study findings, the factors that exhibited certain significant relations with PR-LBP are discussed first in each sub-section, followed by the general discussion on why other factors did not explain PR-LBP as well.

Correlates of the Changes in Pain Intensity and Pain Interference

Pain intensity at GA 24 week. This study considered pain intensity at GA 24 weeks (that are within the second trimester) as a control variable, that is, a variable may or may not impact pain intensity and interference in the third trimester but originally out of the research focus. However, this study obtained consistent evidence regarding its influence on changes in PR-LBP intensity and interference. This study found that pain intensity at GA 24 week can predict the increases in PR-LBP intensity during late pregnancy, i.e., from 28 week to 36 week. Such a finding is striking and indicates that pregnant women with higher PR-LBP intensity in the second trimester will encounter larger increases in their PR-LBP. Lack of interventions on severe PR-LBP can therefore result in more problematic PR-LBP during late pregnancy.

Previous research (i.e., Gutke et al., 2008) has found that LBP at GA 12-18 weeks can predict the prevalence of persistent postpartum LBP. Compared with Gutke et al. (2008), the present study also found evidence supporting the predictive power of LBP by the third trimester can predict LBP later. The present study is different from Gutke

et al. (2008) in identifying that PR-LBP at GA 24 weeks can predict the PR-LBP during 28-36 weeks. Both the findings of the present study and findings of the study of Gutke et al. (2008) support the potential importance of early intervention or reduction of LBP as a way to help reduce LBP afterwards.

Pain catastrophizing. This study showed that pain catastrophizing can predict increases in PR-LBP intensity and interference in the third trimester. This finding indicates that when pregnant women exaggerate pain, they experience worse pain afterwards. Such an awful pain experience should be noticed and improved, and in fact, such experience can be improved. Other LBP studies (i.e., Smeets, Vlaeyen, Kester, & Knottnerus, 2006; Somers, Keefe, Carson, Pells, & Lacaille, 2008) has identified a direct relation between pain catastrophizing and low back pain intensity. However, the LBP studies have not investigated whether pain catastrophizing is related to *increases* in LBP intensity. The present study thus provides evidence for the novel relation between pain catastrophizing and LBP intensity in the population of pregnant women in their third trimester. Such a strong relation between a high level of pain catastrophizing and increases in PR-LBP intensity is identified for the first time in this study, indicating one of the academic contributions of this study.

Moreover, the relation between a high level of pain catastrophizing and increases in PR-LBP intensity and interference provides clinical health professionals insights into how they might alleviate PR-LBP and manage PR-LBP development during late pregnancy of their patients. Specifically, pain catastrophizing is a changeable thinking mode (Turk & Gatchel, 2002). Cognitive therapy can effectively reduce pain catastrophizing (Thorn et al., 2007). Thus, the clinical health professional can consider utilizing cognitive therapy to reduce pain catastrophizing among pregnant women.

According to the finding of the present study, the reduced pain catastrophizing may help to limit increases of PR-LBP intensity and interference among pregnant women.

This study found that pain catastrophizing is positively related to pain intensity in the third trimester. Although pain catastrophizing showed a slightly (and insignificantly) decreasing trend and pain intensity showed a slightly increasing trend, the positive relation between pain catastrophizing and pain intensity is reasonable in several aspects. First, the decreasing trend of pain catastrophizing is insignificant and the increasing trend of pain intensity is also insignificant. Second, the positive correlation between pain catastrophizing and pain intensity can indicate that some pregnant women have high levels of pain catastrophizing and pain intensity at every time point, but the levels may slightly change.

Time. This study used a longitudinal design and the GEE method to conduct the analyses. The GEE method enables the examination on the time effects, i.e., whether the *time* (from GA 28 to 36 weeks) is related to changes in pain intensity and interference. This study observed that time is related to changes in both PR-LBP intensity and PR-LBP interference. Specifically, the changes indicate that PR-LBP intensity and interference would increase over time. This finding reflects the PR-LBP experience of pregnant women. If pregnant women having PR-LBP did not receive proper pain management, they will likely experience stronger PR-LBP and higher interference due to PR-LBP. Such pain experience of pregnant women likely contributes to the suffering and frustration of pregnant women. In practice, this finding indicates that even with consideration of all other demographic, biological, social, and psychological factors, and unless otherwise treated PR-LBP intensity and interference will go up naturally and consistently. Such an increasing trend supports the urgency of intervening PR-LBP in an early stage during pregnancy.

Social support. This study found that a high level of social support is marginally related to *increases* in PR-LBP interference. Feldman, Downey, and Schaffer-Neitz (1999) found a buffering effect of social support on the relation between pain and depressed mood, indicating that social support is beneficial psychologically. However, social support has also been found as a predictor for *increases* in pain interference (Jensen et al., 2002), although in another pain population. The underlying mechanism for the relation between social support and increases in pain interference may be its effects on coping strategies. In the short term, social support could alleviate the impact of pain. However, in the long term, pregnant women with pain may become more dependent, such as using the "asking for assistance" coping strategy. Raichle et al. (2007) found that social support is related to the coping strategies of resting and asking for assistance. Such coping strategies reduce the use of back muscles. The reduced use of back muscle at the beginning of pregnancy could further increase disability throughout pregnancy (Sihvonen, Huttunen, Makkonen, & Airaksinen, 1998), reducing the ability to do daily activities (i.e., increasing the pain interference). Such mechanism can thus explain why a high level of social support is marginally related to *increases* in PR-LBP interference, as found in the present study. Clinically, the finding poses the potential threat of social support in the sense of disabling pregnant women to engage in daily activities. This finding indicated that family, friends, and significant others may provide psychological support to pregnant women, but should be cautious about hindering the physical abilities of pregnant women.

Depression. The analytical results of this study supported a clear significant relation between depression and increases in PR-LBP interference. Such a finding echoes the findings in the literature (Gutke et al., 2007; van de Pol et al., 2006; Webb et al., 2008) that depression is highly associated with PR-LBP before and after childbirth.

However, this finding makes an additional contribution to the literature by indicating that a high level of depression is related to *increases* in PR-LBP interference, further demonstrating the important role of depression among pregnant women.

PR-LBP interference is critical to pregnant women's well-being, since PR-LBP interference comprised indicators concerning sleep and walking ability (Chang, Yang et al., in press; Wang et al., 2004). Thus the present finding can help clinical health professionals to indirectly increase pregnant women's well-being by helping them reduce their depression. Increased self-control was related to a lower level of depression (Rudy, Kerns, & Turk, 1988). More potential means for reducing depression can be found in the study of Leis, Mendelson, Tandon, and Perry (2009).

Factors that were not found related to changes in pain intensity and interference. This study did not find any relation between age and pain intensity and interference. Such an insignificant relation is understandable, as the literature has identified a mixed relation between age and PR-LBP (Endresen, 1995; Mantle et al., 1977; Östgaard & Andersson, 1991; Wang et al., 2004). This study also did not observe any significant relation between educational level and changes in PR-LBP intensity and interference. The lack of evidence may come from the wide-spread knowledge on the Internet, which may assist less knowledgeable pregnant women to understand how to improve their pain experience. Moreover, this study did not find a relation between LBP history and pain intensity and interference. Although LBP history has been frequently identified as a predictor for pain prevalence (Björklund et al., 2000; Orlikowski et al., 2006; To & Wong, 2003), this study did not find evidence that LBP history can predict *changes* in pain intensity and interference.

This study did not observe a significant relation between a higher parity, AFI, EBW, and BMI and changes in PR-LBP intensity and interference, indicating a

limitation for the ability of parity, AFI, EBW, and BMI in predict the changes in PR-LBP intensity and interference. The explanation may be that a higher parity is related to the frequency of experiencing shifted center of gravity and thus related to the likelihood of occurring PR-LBP, as identified in the literature (Albert et al., 2006; Gürel & Gürel, 1997; Mogren & Pohjanen, 2005). However, the shifted center of gravity may be shifted back to the correct position to a various degree after childbirth. The various degree of shifting back may be a factor mediating the parity and increases in PR-LBP experience. Such a theory needs further studies by researchers who can measure the correctness of the center of gravity. The potential reason for the lack of evidence supporting the hypothesized relation between AFI and EBW and the changes in PR-LBP experience may be that pregnant women having a relatively heavy uterus may be accustomed to the weight, offsetting the hypothesized relation. Although pregnant women with higher body height (BH) may be capable of bearing higher amniotic fluid weight and fetus body weight (AFI and EBW), the additional analytical results showed no significant correlation between PR-LBP outcomes (i.e., pain intensity and pain interference) and AFI/BH or EBW/BH at all three time points ($p > .10$). An alternative explanation is that pregnant women carrying heavier fetus (or amniotic fluid) may use maternity support belts more frequently than those carrying lighter fetus (or amniotic fluid), potentially alleviating the severity of PR-LBP. However, the types and effectiveness of the maternity support belts vary widely (Ho et al., 2009). Future studies are suggested to control the types, usage frequency, and subjective effectiveness when examining the relationships between PR-LBP and AFI and EBW.

Moreover, A higher BMI indicates a higher body mass compared to the height. Thus BMI may be related to mechanical strain, yielding the positive relation between a higher BMI and a higher occurrence of PR-LBP, as observed by the literature (Leboeuf-

Yde et al., 1999; Mogren & Pohjanen, 2005; Orvieto et al., 1994). The present study examined the relation between a higher BMI and increases in PR-LBP experience and did not find a positive relation. The reason may be that the higher body mass compared to the height may not always create overly strain on muscles, since height does not always increase muscle power. That is, some pregnant women, although short with a high body mass, may have strong muscle power to manage the mechanical strains owing to pregnancy, minimizing the link between a higher BMI and increases in PR-LBP intensity.

This study also did not obtain evidence supporting the relation between a high physical workload and increases in PR-LBP intensity and interference. The reason may be that although a heavy physical workload is related to a stronger LBP (Bjorck-van Dijken, Fjellman-Wiklund, & Hildingsson, 2008), pregnant women in the present study did not experience a heavy physical workload (M = 2.4, SD = 1.3-1.4, with a scale of 0-6 points). This study did not find a relation between regular exercise and changes in PR-LBP intensity and interference. The reason may be that exercise can effectively reduce PR-LBP when adequate advice (from health professionals) is given (Vleeming et al., 2008). The regular exercise reported by the pregnant women in this study is mainly strolling without adequate advice from health professionals. Numerous previous studies on the effects of exercise in reducing PR-LBP had exercise programs that were specifically designed to alleviate PR-LBP (e.g., Garshasbi & Faghih Zadeh, 2005; Shim, Lee, Oh, & Kim, 2007), thus health professionals may consult these studies to encourage pregnant women to engage in exercise that can effectively alleviate PR-LBP.

Implications

Consistent with previous pain studies, this study identified biological, psychological, and social factors as predictors of changes in pregnant women's pain

intensity and interference. Compared with the biopsychosocial study of Gungor et al. (2011), this study applied the biopsychosocial model to a general pregnant population rather than those who have preterm birth in their studies. Restated, this study provides the evidence that the biopsychosocial model may be applied to a more general pregnant women population to a limited degree, because some of the study hypotheses were supported while others were not. However, this study used the sample of pregnant women in only one country (i.e., Taiwan). More studies examining the applicability of biopsychosocial model in pregnant women in other countries can increase its global impact on women health. The findings from this study support the potential utility of the biopsychosocial model for helping health professionals understand pregnant women's pain using a multidimensional perspective.

This study found that pain catastrophizing has strong power in predicting increases in PR-LBP intensity in the third trimester. Such a finding is new to the pain catastrophizing literature, given that no studies have examined the importance of pain catastrophizing in the same population. Previous studies (i.e., Keefe et al., 1989; Sullivan & D'Eon, 1990) on depression and pain catastrophizing investigated their influences in chronic pain populations. Compared with these studies, the present study is new in investigating depression and pain catastrophizing in a pregnant women population. Although Olsson et al. (2009) investigated pain catastrophizing in early pregnancy, Olsson et al. (2009) did not control for or consider the influence of depression in their study. Compared with Olsson et al. (2009), the present study is unique in considering both depression and pain catastrophizing in pregnant women in their third trimester (rather than in early pregnancy). Such uniqueness enables the present study to observe that pain catastrophizing predicts increases in PR-LBP intensity when considering the influence of depression. Such a finding supports the

potential for helping pregnant women deal with their pain by using cognitive therapy, which is known as effective treatment for reducing pain catastrophizing (Thorn et al., 2007). That is, the new findings of this study help health professionals reduce pregnant women's pain, contributing to the healthcare practices and women health.

Moreover, this study found that pregnant women with high levels of depression or high levels of pain catastrophizing are likely to experience increasing interference owing to PR-LBP during the third trimester. Depression and pain catastrophizing have been investigated by numerous previous studies that were designed to investigate risk factors of LBP prevalence (e.g., Gutke et al., 2007; Olsson et al., 2009; van de Pol et al., 2007). Compared with these studies, the present study is new in discovering that depression and pain catastrophizing are positively related to *increases* in PR-LBP interference during pregnancy (i.e., the third trimester). In addition to the academic contribution, this finding is also relevant to practitioners. Based on this finding, clinical health professionals can potentially prevent the increasing PR-LBP interference perceived by their clients by using known effective treatments for depression and pain catastrophizing. With the new finding, clinical health professionals can help reduce or restrain the development of PR-LBP interference perceived by pregnant women, increasing women health and well-being.

Overall, the pain experience of pregnant women was characterized by increasing pain intensity, pain interference, depression, but with stable social support and pain catastrophizing. The evidence suggests that although pregnancy is a joyful process which generally attracts strong social support, in the third trimester, the newborn is going to come to the world and the pregnant women may believe that the physical burden reaches the maximum in the pregnancy. Such burden continuously makes pregnant women experience stronger and stronger PR-LBP, and experience lower and

lower ability to do daily activities owing to PR-LBP. Moreover, pregnant women in the third trimester also experience increasing depression and substantial pain catastrophizing. Such findings provided the evidence that pregnant women in the third trimester experience strong physical and psychological stressors that cannot be relieved by social support. Even worse, social support may fuel increases in pain interference in the third trimester. Overall, such a painful and stressful experience of pregnant women is contradictory to the common thought that PR-LBP is harmless, natural, and need not be managed. This study describes the painful and stressful experience of pregnant women which may have been previously unknown to or overlooked by health professionals, supporting the importance for health professionals to assess and mange PR-LBP of pregnant women in the third trimester.

Research Limitations and Future Research Directions

Since the study sample comprised of pregnant women in their third trimester, this study cannot determine that the present findings are applicable to postpartum PR-LBP. Thus, future studies should investigate correlates of changes in postpartum PR-LBP.

This study was conducted in Taiwan, which is characterized by a low birth rate and the Chinese culture. A low birth rate means that pregnant women are often highly appreciated and protected. Moreover, the Chinese culture emphasizes care-taking of pregnant women. Such factors likely reduce the physical workload of the sampled pregnant women. Furthermore, social support is usually strong for pregnant women. Thus research is needed to replicate this study in other countries where physical workload and social support are perhaps less different between women who are pregnant and women who are not pregnant.

On average, the pain catastrophizing scores reported by the participants in this study were low compared to the literature (Sullivan et al., 2001). However, this study

observed a correlation between pain catastrophizing and increases in PR-LBP intensity and interference. Since certain cognitive therapy can effectively reduce pain catastrophizing in a chronic pain context (Thorn et al., 2007), intervention studies are needed to examine the influence of cognitive therapy in reducing pain catastrophizing in pregnant women. Such intervention studies can provide evidence on whether the cognitive therapy can effectively reduce PR-LBP intensity and interference of pregnant women, and is therefore urgently needed.

This study observed that the pregnant women averagely reports low scores on depression, indicating that pregnant women are not characterized by strong depression. Such a finding indicates the possibility that anxiety compared with depression can be an important issue. Thus future studies can investigate anxiety in pregnant women and how their anxiety may be related to their pain catastrophizing.

This study collected the ultrasonic data as complete as possible, that is, collected all ultrasonic data of all participants in the study hospital. However, pregnant women in the third trimester usually only have ultrasonic examination once. Although hospital can provide ultrasonic examination at pregnant women's own expense across the third trimester, pregnant women, not all pregnant women were willing to pay for the non-necessary examination and some pregnant women would be worry about the potential risk of the ultrasonic examination. Thus most of the participants did not have ultrasonic data at all the three time points (GA28, 32, 36 weeks), comprising the limitation of this study. Although there was a limitation, this study has presented the actual phenomenon as it is and collected more than 30 ultrasonic data entries at each time point, supporting the dependentability of this study finding. Future studies with sufficient fund can adopt another approach, that is, financially support all their participants to have ultrasonic examination at each time point, increasing the data completeness.

Moreover, this study did not aim to construct a comprehensive structural relationship among all potential links between variables used in this study. Such a comprehensive structural relationship would enable examinations of the mediator role of pain intensity and the potential moderating effects of the biopsychosocial factors. However, such a framework would encounter several methodological difficulties. First, the GEE method currently cannot examine mediation effects using the longitudinal data. Second, the structural equation modeling (SEM) technique requires a framework containing all variables at all time points. In this study, there were twelve predictors and two aspects of pain (intensity and interference) times three time points, equaling forty two variables in the framework. Furthermore, the SEM technique requires clarification on whether every pair of variables among the forty two variables should have a relation/hypothesis. Such a framework greatly increases the complexity without adding equivalently valuable information for achieving the research purposes; that is, identifying the predictors of the changes in PR-LBP intensity and interference. These methodological difficulties with SEM regard the choice of regression and GEE for addressing the research purposes. Of course, future studies can investigate whether pain intensity mediates the influence of certain predictors on pain interference (not the changes in pain interference, as examined in this study) using a cross-sectional design using the GEE method. Future studies can also aim to investigate the structural relationship of fewer latent variables longitudinally. Since these two approaches cannot be used to achieve the current research purposes, this study did not adopt them. However, these approaches can further clarify the relations among the variables covered in this study, increasing our understanding on their relations.

Chapter VI Conclusion

Pregnancy-related low back pain (PR-LBP) is a prevalent and significant problem during pregnancy and interferes with women's daily life. PR-LBP intensity and interference increase during the third trimester of pregnancy. Among the components of pain interference, pregnant women scored highest in sleep disturbance, walking ability, and normal working. Pregnant women receive stable social support, but report increased depression over time. This study also observed that when considering the influence of depression, pain catastrophizing still has significant impact on PR-LBP in terms of pain intensity and pain interference. This study used the GEE method to identify pain catastrophizing, depression, social support, pain intensity at the GA 24 week, and time as the predictors of the increases in pain intensity and interference. Regarding the theoretical contributions, this study is the first to apply the biopsychosocial model to PR-LBP change and also the first to investigate pain catastrophizing among pregnant women having PR-LBP during the third trimester. Furthermore, this study innovatively found the role of pain catastrophizing on PR-LBP intensity and interference development during the third trimester and the potential risk of depression and social support in increasing PR-LBP. Future researchers are needed to investigate the effect of pain catastrophizing, depression, and social support on persistent PR-LBP among postpartum women. Knowledge on PR-LBP among postpartum women can improve our understanding about chronic pain due to pregnancy. Regarding the clinical contribution, this study indicated that it is important to prevent PR-LBP prior to the third trimester (e.g., provide prevention program which may combine effective exercise and cognitive-behavioral therapy by GA 24 weeks), consequently improving women health.

References

Albert, H. B., Godskesen, M., Korsholm, L., & Westergaard, J. G. (2006). Risk factors in developing pregnancy-related pelvic girdle pain. *Acta Obstetricia et Gynecologica Scandinavica, 85*(5), 539-544.

Bédard, G. B., Reid, G. J., McGrath, P. J., & Chambers, C. T. (1997). Coping and selfmedication in a community sample of junior high school students. *Pain Research & Management, 2*(3), 151-156.

Bair, M. J., Robinson, R. L., Katon, W., & Kroenke, K. (2003). Depression and pain comorbidity: A literature review *Archives of Internal Medicine, 163*, 2433-2445.

Ballinger, G. A. (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational Research Methods, 7*(2), 127-150.

Bastiaanssen, J. M., de Bie, R. A., Bastiaenen, C. H. G., Heuts, A., Kroese, M. E. A. L., Essed, G. G. M., et al. (2005). Etiology and prognosis of pregnancy-related pelvic girdle pain: Design of a longitudinal study. *BMC Public Health, 5*(1), 1-8.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561-571.

Björklund, K., Nordström, M.-L., & Odlind, V. (2000). Combined oral contraceptives do not increase the risk of back and pelvic pain during pregnancy or after delivery. *Acta Obstetricia et Gynecologica Scandinavica, 79*(11), 979-983.

Bjorck-van Dijken, C., Fjellman-Wiklund, A., & Hildingsson, C. (2008). Low back pain, lifestyle factors and physical activity: A population based-study. *Journal of Rehabilitation Medicine, 40*(10), 864-869.

Bombardier, C. H., Richards, J. S., Krause, J. S., Tulsky, D., & Tate, D. G. (2004). Symptoms of major depression in people with spinal cord injury: Implications for screening. *Archives of Physical Medicine and Rehabilitation, 85*(11), 1749-1756.

Borg-Stein, J., & Dugan, S. A. (2007). Musculoskeletal disorders of pregnancy, delivery and postpartum. *Physical Medicine and Rehabilitation Clinics of North America, 18*(3), 459-476.

Borg-Stein, J., Dugan, S. A., & Gruber, J. (2005). Musculoskeletal aspects of pregnancy. *American Journal of Physical Medicine and Rehabilitation, 84*(3), 180-192.

Brown, G., & Beck, A. T. (1989). The role of imperatives in psychopathology: A reply to Ellis. *Cognitive Therapy and Research, 13*(4), 315-321.

Buer, N., & Linton, S. J. (2002). Fear-avoidance beliefs and catastrophizing: Occurrence and risk factor in back pain and ADL in the general population. *Pain, 99*(3), 485-491.

Bunevicius, R., Kusminskas, L., Bunevicius, A., Nadisauskiene, R. J., Jureniene, K., & Pop, V. J. (2009). Psychosocial risk factors for depression during pregnancy. *Acta Obstetricia et Gynecologica Scandinavica, 88*(5), 599-605.

Butler, R., & Fuller, J. (1998). Back pain following epidural anaesthesia in labour. *Canadian Journal of Anaesthesia, 45*(8), 724-728.

Campbell, L. C., Clauw, D. J., & Keefe, F. J. (2003). Persistent pain and depression: A biopsychosocial perspective. *Biological Psychiatry, 54*(3), 399-409.

Carballeira, Y., Dumont, P., Borgacci, S., Rentsch, D., de Tonnac, N., Archinard, M., et al. (2007). Criterion validity of the French version of Patient Health Questionnaire (PHQ) in a hospital department of internal medicine. *Psychology and Psychotherapy, 80*(Pt 1), 69-77.

Carroll, L. J., Cassidy, J. D., & Cote, P. (2004). Depression as a risk factor for onset of an episode of troublesome neck and low back pain. *Pain, 107*(1-2), 134-139.

Chang, H.-Y., Jensen, M. P., Yang, Y.-L., Lee, C.-N., & Lai, Y.-H. (in press). Risk factors of pain severity and interference among pregnant women with lumbopelvic pain. *Journal of Clinical Nursing*.

Chang, H.-Y., & Lai, Y.-H. (2008). *Exploration of pain experiences in pregnant women*. Paper presented at the 19th International Nursing Research Congress Focusing on Evidence-Based Practice.

Chang, H.-Y., Yang, Y.-L., Jensen, M. P., Lee, C.-N., & Lai, Y.-H. (in press). The experience and coping of lumbopelvic pain among pregnant women in Taiwan. *Pain Medicine*.

Chen, C. H., Wang, S. Y., Chung, U. L., Tseng, Y. F., & Chou, F. H. (2006). Being reborn: The recovery process of postpartum depression in Taiwanese women. *Journal of Advanced Nursing, 54*(4), 450-456.

Cheng, S. T. (2004). The multidimensional scale of perceived social support: Dimensionality and age and gender differences in adolescents. *Personality and Individual Differences, 37*(7), 1359-1369.

Chorpita, B. F., & Barlow, D. H. (1998). The development of anxiety: The role of control in the early environment. *Psychological Bulletin, 124*(1), 3-21.

Chou, R., Qaseem, A., Snow, V., Casey, D., Cross, J. T. J., Shekelle, P., et al. (2007). Diagnosis and treatment of low back pain: A joint clinical practice guide line from the American College of Physicians and the American Pain Society. *Annals of Internal Medicine, 147*(7), 478-491.

Cleeland, C. S., & Ryan, K. M. (1994). Pain assessment: Global use of the Brief Pain Inventory. *Annals of the Academy of Medicine, Singapore, 23*(2), 129-138.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310-357.

Daut, R. L., Cleeland, C. S., & Flanery, R. C. (1983). Development of the Wisconsin Brief Pain Questionnaire to assess pain in cancer and other diseases. *Pain, 17*(2), 197-210.

DeJoseph, J. F., & Cragin, L. (1998). Biomedical and feminist perspectives on low back pain during pregnancy. *Nursing Clinics of North America, 33*(4), 713-724.

Demmelmaier, I., Lindberg, P., Asenlof, P., & Denison, E. (2008). The associations between pain intensity, psychosocial variables, and pain duration/recurrence in a large sample of persons with nonspecific spinal pain. *Clinical Journal of Pain, 24*(7), 611-619.

Donnelly, P. L., & Kim, K. S. (2008). The Patient Health Questionnaire (PHQ-9K) to screen for depressive disorders among immigrant Korean American elderly. *Journal of Cultural Diversity, 15*(1), 24-29.

Dum, M., Pickren, J., Sobell, L. C., & Sobell, M. B. (2008). Comparing the BDI-II and the PHQ-9 with outpatient substance abusers. *Addictive Behaviors, 33*(2), 381-387.

Endresen, E. H. (1995). Pelvic pain and low back pain in pregnant women - An epidemiological study. *Scandinavian Journal of Rheumatology, 24*(3), 135-141.

Esler, D., Johnston, F., Thomas, D., & Davis, B. (2008). The validity of a depression screening tool modified for use with Aboriginal and Torres Strait Islander people. *Australian and New Zealand Journal of Public Health, 32*(4), 317-321.

Fann, J. R., Bombardier, C. H., Dikmen, S., Esselman, P., Warms, C. A., Pelzer, E., et al. (2005). Validity of the Patient Health Questionnaire-9 in assessing depression following traumatic brain injury. *Journal of Head Trauma Rehabilitation, 20*(6), 501-511.

Fast, A., Shapiro, D., Ducommun, E. J., Friedmann, L. W., Bouklas, T., & Floman, Y. (1987). Low-back pain in pregnancy. *Spine, 12*(4), 368-371.

Feldman, S. I., Downey, G., & Schaffer-Neitz, R. (1999). Pain, negative mood, and perceived support in chronic pain patients: A daily diary study of people with reflex sympathetic dystrophy syndrome. *Journal of Consulting and Clinical Psychology, 67*, 776-785.

Field, H. L., Basbaum, A. I., & Heinricher, M. M. (2005). Central nervous system mechanisms of pain modulation. In S. McMahon & M. Koltzenburg (Eds.), *Wall and Melzack's textbook of pain* (pp. 125-141). London: Churchill Livingstone.

Flink, I. K., Mroczek, M. Z., Sullivan, M. J., & Linton, S. J. (2009). Pain in childbirth and postpartum recovery: The role of catastrophizing. *European Journal of Pain, 13*(3), 312-316.

Gürel, S. A., & Gürel, H. (1997). The effect of grandmultiparity on chronic pelvic pain and sexual discomfort. *International Journal of Gynaecology and Obstetrics, 57*(2), 133-138.

Garnet, B., Beitel, M., Cutter, C. J., Savant, J., Peters, S., Schottenfeld, R. S., et al. (2011). Pain catastrophizing and pain coping among methadone-maintained patients. *Pain Medicine, 12*(1), 79-86.

Garshasbi, A., & Faghih Zadeh, S. (2005). The effect of exercise on the intensity of low back pain in pregnant women. *International Journal of Gynaecology and Obstetrics, 88*(3), 271-275.

Gausia, K., Fisher, C., Ali, M., & Oosthuizen, J. (2009). Antenatal depression and suicidal ideation among rural Bangladeshi women: A community-based study. *Archives of Women's Mental Health, 12*(5), 351-358.

Geisser, M. E., Robinson, M. E., & Henson, C. D. (1994). The Coping Strategies Questionnaire and chronic pain adjustment: A conceptual and empirical reanalysis. *Clinical Journal of Pain, 10*(2), 98-106.

Ger, L. P., Ho, S. T., Sun, W. Z., Wang, M. S., & Cleeland, C. S. (1999). Validation of the Brief Pain Inventory in a Taiwanese population. *Journal of Pain and Symptom Management, 18*(5), 316-322.

Gifford, L. S., & Butler, D. S. (1997). The integration of pain sciences into clinical practice. *Journal of Hand Therapy, 10*(2), 86-95.

Golbasi, Z., Kelleci, M., Kisacik, G., & Cetin, A. (2009). Prevalence and correlates of depression in pregnancy among Turkish women. *Maternal and Child Health Journal, 14*(4), 485-491.

Gungor, I., Oskay, U., & Beji, N. K. (2011). Biopsychosocial risk factors for preterm birth and postpartum emotional well-being: A case–control study on Turkish women without chronic illnesses. *Journal of Clinical Nursing, 20*(5-6), 653-665.

Gutke, A., Josefsson, A., & Oberg, B. (2007). Pelvic girdle pain and lumbar pain in relation to postpartum depressive symptoms. *Spine, 32*(13), 1430-1436.

Gutke, A., Östgaard, H. C., & Oberg, B. (2006). Pelvic girdle pain and lumbar pain in pregnancy: A cohort study of the consequences in terms of health and functioning. *Spine, 31*(5), E149-155.

Gutke, A., Östgaard, H. C., & Öberg, B. (2008). Predicting persistent pregnancy-related low back pain. *Spine, 33*(12), E386-E393.

Hainline, B. (1994). Low-back pain in pregnancy. *Advances in Neurology, 64*, 65-76.

Hainline, B. (2002). Low back pain. *Advances in Neurology, 90*, 9-23.

Han, C., Jo, S. A., Kwak, J. H., Pae, C. U., Steffens, D., Jo, I., et al. (2008). Validation of the Patient Health Questionnaire-9 Korean version in the elderly population: The Ansan Geriatric study. *Comprehensive Psychiatry, 49*(2), 218-223.

Hanley, M. A., Raichle, K., Jensen, M., & Cardenas, D. D. (2008). Pain catastrophizing and beliefs predict changes in pain interference and psychological functioning in persons with spinal cord injury. *The Journal of Pain, 9*(9), 863-871.

Hartvigsen, J., Kyvik, K. O., Leboeuf-Yde, C., Lings, S., & Bakketeig, L. (2003). Ambiguous relation between physical workload and low back pain: A twin control study. *Occupational and Environmental Medicine, 60*(2), 109-114.

Heh, S. S., Coombes, L., & Bartlett, H. (2004). The association between depressive symptoms and social support in Taiwanese women during the month. *International Journal of Nursing Studies, 41*(5), 573-579.

Hirsh, A. T., Dillworth, T. M., Ehde, D. M., & Jensen, M. P. (2010). Sex differences in pain and psychological functioning in persons with limb loss. *The Journal of Pain, 11*(1), 79-86.

Ho, S. S. M., Yu, W. W. M., Lao, T. T., Chow, D. H. K., Chung, J. W. Y., & Li, Y. (2009). Effectiveness of maternity support belts in reducing low back pain during pregnancy: A review. *Journal of Clinical Nursing, 18*(11), 1523-1532.

Holtzman, S., Newth, S., & Delongis, A. (2004). The role of social support in coping with daily pain among patients with rheumatoid arthritis. *Journal of Health Psychology, 9*(5), 677-695.

Horng, Y. S., Hwang, Y. H., Wu, H. C., Liang, H. W., Mhe, Y. J., Twu, F. C., et al. (2005). Predicting health-related quality of life in patients with low back pain. *Spine, 30*(5), 551-555.

Hung, C. H. (2005). Women's postpartum stress, social support, and health status. *Western Journal of Nursing Research, 27*(2), 148-159.

International Association for the Study of Pain (2007a, September). Epidemiology of pain in women. Retrieved Oct 11, 2007, from http://www.iasp-pain.org

International Association for the Study of Pain (2007b). IASP pain terminology. Retrieved July 6, 2009, from http://www.iasp-pain.org/AM/Template.cfm?Section=General_Resource_Links&Template=/CM/HTMLDisplay.cfm&ContentID=3058#Pain

International Association for the Study of Pain (2007c, September). Pain during pregnancy. Retrieved April 30, 2011, from http://www.iasp-pain.org/AM/Template.cfm?Section=Home&Template=/CM/ContentDisplay.cfm&ContentID=4641

Jensen, M. P., Ehde, D. M., Gertz, K. J., Stoelb, B. L., Dillworth, T. M., Hirsh, A. T., et al. (2011). Effects of self-hypnosis training and cognitive restructuring on daily pain intensity and catastrophizing in individuals with multiple sclerosis and chronic pain. *International Journal of Clinical and Experimental Hypnosis, 59*(1), 45-63.

Jensen, M. P., Ehde, D. M., Hoffman, A. J., Patterson, D. R., Czerniecki, J. M., & Robinson, L. R. (2002). Cognitions, coping and social environment predict adjustment to phantom limb pain. *Pain, 95*(1-2), 133-142.

Kærlev, L., Jacobsen, L. B., & Bonde, J. P. (2004). Long-term sick leave and its risk factors during pregnancy among Danish hospital employees. *Scandinavian Journal of Public Health, 32*(2), 111-117.

Kazarian, S. S., & McCabe, S. B. (1991). Dimensions of social support in the MSPSS: Factorial structure, reliability, and theoretical implications. *Journal of Community Psychology, 19*, 150-160.

Keefe, F. J., Brown, G. K., Wallston, K. A., & Caldwell, D. S. (1989). Coping with rheumatoid arthritis pain: Catastrophizing as a maladaptive strategy. *Pain, 37*(1), 51-56.

Keefe, F. J., Lefebvre, J. C., Egert, J. R., Affleck, G., Sullivan, M. J., & Caldwell, D. S. (2000). The relationship of gender to pain, pain behavior, and disability in osteoarthritis patients: The role of catastrophizing. *Pain, 87*(3), 325-334.

Kristiansson, P., Svardsudd, K., & von Schoultz, B. (1996). Back pain during pregnancy: A prospective study. *Spine, 21*(6), 702-709.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606-613.

Lamers, F., Jonkers, C. C., Bosma, H., Penninx, B. W., Knottnerus, J. A., & van Eijk, J. T. (2008). Summed score of the Patient Health Questionnaire-9 was a reliable and valid method for depression screening in chronically ill elderly patients. *Journal of Clinical Epidemiology, 61*(7), 679-687.

Larsen, E. C., Wilken-Jensen, C., Hansen, A., Jensen, D. V., Johansen, S., Minck, H., et al. (1999). Symptom-giving pelvic girdle relaxation in pregnancy I: Prevalence and risk factors. *Acta Obstetricia et Gynecologica Scandinavica, 78*(2), 105-110.

Latza, U., Kohlmann, T., Deck, R., & Raspe, H. (2000). Influence of occupational factors on the relation between socioeconomic status and self-reported back pain in a population-based sample of German adults with back pain. *Spine, 25*(11), 1390-1397.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.

Leadbeater, B. J., Blatt, S. J., & Quinlan, D. M. (1995). Gender-linked vulnerabilities to depressive symptoms, stress, and problem behaviors in adolescents. *Journal of Research on Adolescence, 5*(1), 1-29.

Leboeuf-Yde, C., Kyvik, K. O., & Bruun, N. H. (1999). Low back pain and lifestyle. Part II-Obesity: Information from a population-based sample of 29,424 twin subject. *Spine, 24*(8), 779-784.

Leijon, O., Wiktorin, C., Harenstam, A., Karlqvist, L., & MOA Research Group (2002). Validity of a self-administered questionnaire for assessing physical work loads in a general population. *Journal of Occupational and Environmental Medicine, 44*(8), 724-735.

Leis, J. A., Mendelson, T., Tandon, S. D., & Perry, D. F. (2009). A systematic review of home-based interventions to prevent and treat postpartum depression. *Archives of Women's Mental Health, 12*(1), 3-13.

Liang, K.-Y., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika, 73*(1), 13-22.

Liu, G., & Liang, K.-Y. (1997). Sample size calculations for studies with correlated observations. *Biometrics, 53*(3), 937-947.

Lopez-Martinez, A. E., Esteve-Zarazaga, R., & Ramirez-Maestre, C. (2008). Perceived social support and coping responses are independent variables explaining pain adjustment among chronic pain patients. *The Journal of Pain, 9*(4), 373-379.

Loughnan, B. A., Carli, F., Romney, M., Dore, C. J., & Grordon, H. (2002). Epidural analgesia and backache: A randomized controlled comparison with intramuscular meperidine for analgesia during labour. *British Journal of Anaesthesia, 89*(3), 466-472.

Lowe, B., Unutzer, J., Callahan, C. M., Perkins, A. J., & Kroenke, K. (2004). Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Medical Care, 42*(12), 1194-1201.

Lunsford, T., & Lunsford, B. R. (1995). Research forum--The research sample, Part I: Sampling. *Journal of Prosthetics and Orthotics, 7*(3), 105-112.

Mørkved, S., Salvesen, K. Å., Schei, B., Lyderesen, S., & Bø, K. (2007). Does group training during pregnancy prevent lumbopelvic pain? A randomized clinical trial. *Acta Obstetricia et Gynecologica Scandinavica, 86*(3), 276-282.

Malliou, P., Gioftsidou, A., Beneka, A., & Godolias, G. (2006). Measurements and evaluations in low back pain patients. *Scandinavian Journal of Medicine and Science in Sports, 16*(4), 219-230.

Mantle, M., Greenwood, R. M., & Currey, H. L. F. (1977). Back pain in pregnancy. *Rheumatology and Rehabilitation, 16*(2), 95-101.

Martin, A., Rief, W., Klaiberg, A., & Braehler, E. (2006). Validity of the Brief Patient Health Questionnaire Mood Scale (PHQ-9) in the general population. *General Hospital Psychiatry, 28*(1), 71-77.

Martorella, G., Côté, J., & Choinière, M. (2008). Pain catastrophizing: A dimensional concept analysis. *Journal of Advanced Nursing, 63*(4), 417-426.

McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models* (2nd ed.). London: Chapman and Hill.

Mens, J. M. A., Snijders, C. J., & Stam, H. J. (2000). Diagonal trunk muscle exercises in peripartum pelvic pain: A randomized clinical trial. *Physical Therapy, 80*(12), 1164-1173.

Miro, J., Raichle, K. A., Carter, G. T., O'Brien, S. A., Abresch, R. T., McDonald, C. M., et al. (2009). Impact of biopsychosocial factors on chronic pain in persons with myotonic and facioscapulohumeral muscular dystrophy. *American Journal of Hospice and Palliative Care, 26*(4), 308-319.

Mitchell, T., O'Sullivan, P. B., Smith, A., Burnett, A. F., Straker, L., Thornton, J., et al. (2009). Biopsychosocial factors are associated with low back pain in female nursing students: A cross-sectional study. *International Journal of Nursing Studies, 46*(5), 678-688.

Mogren, I. M. (2005). Previous physical activity decreases the risk of low back and pelvic pain during pregnancy. *Scandinavian Journal of Public Health, 33*(4), 300-306.

Mogren, I. M. (2006a). BMI, pain and hyper-mobility are determinants of long-term outcome for women with low back pain and pelvic pain during pregnancy. *European Spine Journal, 15*(7), 1093-1102.

Mogren, I. M. (2006b). Does caesarean section negatively influence the post-partum prognosis of low back pain and pelvic pain during pregnancy? *European Spine Journal, 16*(1), 115-121.

Mogren, I. M., & Pohjanen, A. I. (2005). Low back pain and pelvic pain during pregnancy: Prevalence and risk factors. *Spine, 30*(8), 983-991.

Monahan, P. O., Shacham, E., Reece, M., Kroenke, K., Ong'or, W. O., Omollo, O., et al. (2009). Validity/reliability of PHQ-9 and PHQ-2 depression scales among adults living with HIV/AIDS in western Kenya. *Journal of General Internal Medicine, 24*(2), 189-197.

Norén, L., Östgaard, S., Johansson, G., & Östgaard, H. C. (2002). Lumbar back and posterior pelvic pain during pregnancy: A 3-year follow-up. *European Spine Journal, 11*(3), 267-271.

O'Sullivan, P. B., & Beales, D. J. (2007). Diagnosis and classification of pelvic girdle pain disorders--Part 1: A mechanism based approach within a biopsychosocial framework. *Manual Therapy, 12*(2), 86-97.

Olsson, C., Buer, N., Holm, K., & Nilsson-Wikmar, L. (2009). Lumbopelvic pain associated with catastrophizing and fear-avoidance beliefs in early pregnancy. *Acta Obstetricia et Gynecologica Scandinavica, 88*(4), 378-385.

Olsson, C., & Nillson-Wikmar, L. (2004). Health-related quality of life and physical ability among pregnant women with and without back pain in late pregnancy. *Acta Obstetricia et Gynecologica Scandinavica, 83*(4), 351-357.

Omoro, S. A., Fann, J. R., Weymuller, E. A., Macharia, I. M., & Yueh, B. (2006). Swahili translation and validation of the Patient Health Questionnaire-9 depression scale in the Kenyan head and neck cancer patient population. *International Journal of Psychiatry in Medicine, 36*(3), 367-381.

Orlikowski, C. E. P., Dickinson, J. E., Paech, M. J., McDonald, S. J., & Nathan, E. (2006). Intrapartum analgesia and its association with post-partum back pain and headache in nulliparous women. *Australian and New Zealand Journal of Obstetrics and Gynaecology, 46*(5), 395-401.

Orvieto, R., Achiron, A., Ben-Rafael, Z., Gelernter, I., & Achiron, R. (1994). Low-back pain of pregnancy. *Acta Obstetricia et Gynecologica Scandinavica, 73*(3), 209-214.

Osman, A., Barrios, F. X., Gutierrez, P. M., Kopper, B. A., Merrifield, T., & Grittmann, L. (2000). The Pain Catastrophizing Scale: Further psychometric evaluation with adult samples. *Journal of Behavioral Medicine, 23*(4), 351-365.

Östgaard, H. C. (1996). Assessment and treatment of low back pain in working pregnant women. *Seminars in Perinatology, 20*(1), 61-69.

Östgaard, H. C., & Andersson, G. B. J. (1991). Previous back pain and risk of developing back pain in a future pregnancy. *Spine, 16*(4), 432-436.

Östgaard, H. C., Zetherström, G., Roos-Hansson, E., & Svanberg, B. (1994). Reduction of back and posterior pelvic pain in pregnancy. *Spine, 19*(8), 894-900.

Östgaard, H. C., Zetherström, G., & Ross-Hansson, E. (1997). Back pain in relation to pregnancy: A 6 year follow up. *Spine, 22*(24), 2945-2950.

Owino, V., Yang, S. Y., & Goldspink, G. (2001). Age-related loss of skeletal muscle function and the inability to express the autocrine form of insulin-like growth factor-1 (MGF) in response to mechanical overload. *FEBS Letters, 505*(2), 259-263.

Peters, M. L., Vlaeyen, J. W. S., & Weber, W. E. J. (2005). The joint contribution of physical pathology, pain-related fear and catastrophizing to chronic back pain disability. *Pain, 113*(1), 45-50.

Pincus, T., Burton, A. K., Vogel, S., & Field, A. P. (2002). A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *Spine, 27*(5), E109-120.

Pottinger, A. M., Trotman-Edwards, H., & Younger, N. (2009). Detecting depression during pregnancy and associated lifestyle practices and concerns among women in a hospital-based obstetric clinic in Jamaica. *General Hospital Psychiatry, 31*(3), 254-261.

Raichle, K. A., Hanley, M., Jensen, M. P., & Cardenas, D. D. (2007). Cognitions, coping, and social environment predict adjustment to pain in spinal cord injury. *The Journal of Pain, 8*(9), 718-729.

Records, K., & Rice, M. (2007). Psychosocial correlates of depression symptoms during the third trimester of pregnancy. *JOGNN: Journal of Obstetric, Gynecologic, & Neonatal Nursing, 36*(3), 231-242.

Reynolds, F. (2000). Relationships between catastrophic thoughts, perceived control and distress during menopausal hot flushes: Exploring the correlates of a questionnaire measure. *Mauritas, 36*(2), 113-122.

Rosenstiel, A. K., & Keefe, F. J. (1983). The use of coping strategies in chronic low back pain patients: Relationship to patient characteristics and current adjustment. *Pain, 17*(1), 33-44.

Rudy, T. E., Kerns, R. D., & Turk, D. C. (1988). Chronic pain and depression: Toward a cognitive-behavioral mediation model. *Pain, 35*(2), 129-140.

Safadi, R. (2005). Jordanian women: Perception and practices of first-time pregnancy. *International Journal of Nursing Practice, 11*, 269-276.

Severeijns, R., Vlaeyen, J. W., van den Hout, M. A., & Weber, W. E. (2001). Pain catastrophizing predicts pain intensity, disability, and psychological distress independent of the level of physical impairment. *Clinical Journal of Pain, 17*(2), 165-172.

Shepherd, J. (2005). Symphysis pubis dysfunction: A hidden cause of morbidity. *British Journal of Midwifery, 13*(5), 301-307.

Shim, M.-J., Lee, Y.-S., Oh, H.-E., & Kim, J.-S. (2007). Effects of a back-pain-reducing program during pregnancy for Korean women: A non-equivalent control-group pretest-posttest study. *International Journal of Nursing Studies, 44*(1), 19-28.

Sihvonen, T., Huttunen, M., Makkonen, M., & Airaksinen, O. (1998). Functional changes in back muscle activity correlate with pain intensity and prediction of low back pain during pregnancy. *Archives of Physical Medicine and Rehabilitation, 79*(10), 1210-1212.

Silman, A. J., Ferry, S., Papageorgiou, A. C., Jayson, M. I. V., & Croft, P. R. (1995). Number of children as a risk factor for low back pain in men and women. *Arthritis and Rheumatism, 38*(9), 1232-1235.

Skouteris, H., Germano, C., Wertheim, E. H., Paxton, S. J., & Milgrom, J. (2008). Sleep quality and depression during pregnancy: A prospective study. *Journal of Sleep Research, 17*(2), 217-220.

Smeets, R. J. E. M., Vlaeyen, J. W. S., Kester, A. D. M., & Knottnerus, J. A. (2006). Reduction of pain catastrophizing mediates the outcome of both physical and cognitive-behavioral treatment in chronic low back pain. *The Journal of Pain, 7*(4), 261-271.

Smith, A. B., Rush, R., Wright, P., Stark, D., Velikova, G., & Sharpe, M. (2009). Validation of an item bank for detecting and assessing psychological distress in cancer patients. *Psycho-Oncology, 18*(2), 195-199.

Smith, B. H., Elliott, A. M., Chambers, W. A., Smith, W. C., Hannaford, P. C., & Penny, K. (2001). The impact of chronic pain in the community. *Family Practice, 18*(3), 292-299.

Somers, T. J., Keefe, F. J., Carson, J. W., Pells, J. J., & Lacaille, L. (2008). Pain catastrophizing in borderline morbidly obese and morbidly obese individuals with osteoarthritic knee pain. *Pain Research & Management, 13*(5), 401-406.

Stafford, L., Berk, M., & Jackson, H. J. (2007). Validity of the Hospital Anxiety and Depression Scale and Patient Health Questionnaire-9 to screen for depression in patients with coronary artery disease. *General Hospital Psychiatry, 29*(5), 417-424.

Stanley, M. A., Beck, J. G., & Zebb, B. J. (1988). Psychometric properties of the MSPSS in older adults. *Aging and Mental Health*(2), 186-193.

Stanos, S. P. (2007). Biopsychosocial assessment for chronic opioid use. *Pain Management Nursing, 8*(3, Suppl 1), S14-S22.

Sullivan, M. J., & D'Eon, J. L. (1990). Relation between catastrophizing and depression in chronic pain patients. *Journal of Abnormal Psychology, 99*(3), 260-263.

Sullivan, M. J., Stanish, W., Waite, H., Sullivan, M., & Tripp, D. A. (1998). Catastrophizing, pain, and disability in patients with soft-tissue injuries. *Pain, 77*(3), 253-260.

Sullivan, M. J. L., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: Development and validation. *Psychological Assessment, 7*(4), 524-532.

Sullivan, M. J. L., Thorn, B., Haythornthwaite, J. A., Keefe, F., Martin, M., Bradley, L. A., et al. (2001). Theoretical perspectives on the relation between catastrophizing and pain. *Clinical Journal of Pain, 17*(1), 52-64.

Suputtitada, A., Wacharapreechanont, T., & Chaisayan, P. (2002). Effect of the "sitting pelvic tilt exercise" during the third trimester in primigravidas on back pain. *Journal of the Medical Association of Thailand, 85 Suppl 1*, S170-179.

Swinkels-Meewisse, I. E., Roelofs, J., Oostendorp, R. A., Verbeek, A. L., & Vlaeyen, J. W. (2006). Acute low back pain: Pain-related fear and pain catastrophizing influence physical performance and perceived disability. *Pain, 120*(1-2), 36-43.

Thibault, P., Loisel, P., Durand, M.-J., Catchlove, R., & Sullivan, M. J. L. (2008). Psychological predictors of pain expression and activity intolerance in chronic pain patients. *Pain, 139*(1), 47-54.

Thompson, J. F., Roberts, C. L., Currie, M., & Ellwood, D. A. (2002). Prevalence and persistence of health problem after childbirth: Associations with parity and method of birth. *Birth, 29*(2), 83-94.

Thorn, B. E., Pence, L. B., Ward, L. C., Kilgo, G., Clements, K. L., Cross, T. H., et al. (2007). A randomized clinical trial of targeted cognitive behavioral treatment to reduce catastrophizing in chronic headache sufferers. *Journal of Pain, 8*, 938-949.

To, W. W. K., & Wong, M. W. N. (2003). Factors associated with back pain symptoms in pregnancy and the persistence of pain 2 years after pregnancy. *Acta Obstetricia et Gynecologica Scandinavica, 82*(12), 1086-1091.

Tseng, Y. F., Hsu, C. M., Liu, Y. H., & Chen, C. H. (2008). The experiences of prenatal depression among Taiwanese women. *Journal of Advanced Nursing, 64*(5), 495-503.

Turgut, F., Turgut, M., & Cetinsahin, M. (1998). A prospecitve study of persistent back pain after pregnancy. *European Journal of Obstetrics & Gynecology, 80*(1), 45-48.

Turk, D. C., & Gatchel, R. J. (2002). *Psychological approaches to pain management: A practitioner's handbook*. New York: The Guilford Press.

Turner, J. A., Jensen, M. P., & Romano, J. M. (2000). Do beliefs, coping, and catastrophizing independently predict functioning in patients with chronic pain? *Pain, 85*(1), 115-125.

Turner, J. A., Mancl, L., & Aaron, L. A. (2004). Pain-related catastrophizing: A daily process study. *Pain, 110*(1), 103-111.

United Nations (2011, 24 January 2011). World population prospects: The 2008 revision. Retrieved March 21, 2011, from http://esa.un.org/unpd/wpp2008/JS-Charts/pop-tot_0.htm

van de Pol, G., de Leeuw, J. R. J., van Brummen, H. J., Bruinse, H. W., Heintz, A. P. M., & van der Vaart, C. H. (2006). The Pregnancy Mobility Index: A mobility scale during and after pregnancy. *Acta Obstetricia et Gynecologica Scandinavica, 85*(7), 786-791.

van de Pol, G., van Brummen, H. J., Bruinse, H. W., Heintz, A. P. M., & van der Vaart, C. H. (2007). Pregnancy-related pelvic girdle pain in the Netherlands. *Acta Obstetricia et Gynecologica Scandinavica, 86*(4), 416-422.

van Dijk, G. M., Dekker, J., Veenhof, C., & van den Ende, C. H. (2006). Course of functional status and pain in osteoarthritis of the hip or knee: A systematic review of the literature. *Arthritis and Rheumatism, 55*(5), 779-785.

Vleeming, A., Albert, H. B., Östgaard, H. C., Sturesson, B., & Stuge, B. (2008). European guidelines for the diagnosis and treatment of pelvic girdle pain. *European Spine Journal, 17*(6), 794-819.

Vleeming, A., Volders, A. C. W., Snijders, C. J., & Stoeckart, R. (1990a). Relation between form and function in the sacroiliac joint: Part I: Clinical anatomical aspects. *Spine, 15*(2), 130-132.

Vleeming, A., Volders, A. C. W., Snijders, C. J., & Stoeckart, R. (1990b). Relation between form and function in the sacroiliac joint: Part II: Biomechanical aspects. *Spine, 15*(2), 133-136.

Walsh, T. M., LeBlanc, L., & McGrath, P. J. (2003). Menstrual pain intensity, coping, and disability: The role of pain catastrophizing. *Pain Medicine, 4*(4), 352-361.

Wang, S.-M., Dezinno, P., Maranets, I., Berman, M. R., Caldwell-Andrews, A. A., & Kain, Z. N. (2004). Low back pain during pregnancy: Prevalence, risk factors, and outcomes. *Obstetrics and Gynecology, 104*(1), 65-70.

Watnick, S., Wang, P. L., Demadura, T., & Ganzini, L. (2005). Validation of 2 depression screening tools in dialysis patients. *American Journal of Kidney Diseases, 46*(5), 919-924.

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review, 96*(2), 234-254.

Waxman, S. E., Tripp, D. A., & Flamenbaum, R. (2008). The mediating role of depression and negative partner responses in chronic low back pain and relationship satisfaction. *The Journal of Pain, 9*(5), 434-442.

Webb, D. A., Bloch, J. R., Coyne, J. C., Chung, E. K., Bennett, I. M., & Culhane, J. F. (2008). Postpartum physical symptoms in new mothers: Their relationship to functional limitations and emotional wellbeing. *Birth, 35*(3), 179-187.

Wijnhoven, H. A., de Vet, H. C., & Picavet, H. S. (2007). Sex differences in consequences of musculoskeletal pain. *Spine, 32*(12), 1360-1367.

World Health Organization (2009). Depression. Retrieved May 24, 2009, from http://www.who.int/mental_health/management/depression/definition/en/

Wu, W., Meijer, O. G., Jutte, P. C., Uegaki, K., Lamoth, C. J., Sander de Wolf, G., et al. (2002). Gait in patients with pregnancy-related pain in the pelvis: An emphasis on the coordination of transverse pelvic and thoracic rotations. *Clinical Biochemistry, 17*(9-10), 678-686.

Wu, W. H., Meijer, O. G., Uegaki, K., Mens, J. M., van Dieen, J. H., Wuisman, P. I., et al. (2004). Pregnancy-related pelvic girdle pain (PPP), I: Terminology, clinical presentation, and prevalence. *European Spine Journal, 13*(7), 575-589.

Yap, J. C., Lau, J., Chen, P. P., Gin, T., Wong, T., Chan, I., et al. (2008). Validation of the Chinese Pain Catastrophizing Scale (HK-PCS) in patients with chronic pain. *Pain Medicine, 9*(2), 186-195.

Yeung, A., Fung, F., Yu, S. C., Vorono, S., Ly, M., Wu, S., et al. (2008). Validation of the Patient Health Questionnaire-9 for depression screening among Chinese Americans. *Comprehensive Psychiatry, 49*(2), 211-217.

Young, J. (1940). Relaxation of the pelvic joints in pregnancy: Pelvic arthropathy of pregnancy. *The Journal of Obstetrics & Gynaecology of the British Empire, 47*(5), 493-524.

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The Multidimensional Scale of Perceived Social Support. *Journal of Personality Assessment, 52*, 30-41.

Zimet, G. D., Powell, S. S., Farley, G. K., Werkman, S., & Berkoff, K. A. (1990). Psychometric properties of the Multidimensional Scale of Perceived Social Support. *Journal of Personality Assessment, 55*, 610-617.