Risk Factors for Postpartum Depressive Symptoms Among Oregon women: An Analysis of the Pregnancy Risk Assessment Monitoring System Data 2004

By
Marika Wolfe

A THESIS

Presented to
the Department of Public Health and Preventive Medicine
and the Oregon Health & Science University
School of Medicine
In partial fulfillment of
The requirements for the degree of
Master's of Public Health
March 2008

School of Medicine
Oregon Health & Science University

CERTIFICATE OF APPROVAL

This is to certify that the master's thesis of
Marika Wolfe
has been approved

Kenneth Rosenberg, MD., Committee Chair

Annette Adams, Ph.D.(c), M.P. H

Jennifer P. Wisdom, Ph.D., M.P.H

Jodi Lapidus, Ph.D., M.P.H

Table of Contents

List of Abbreviations

PRAMS	**Pregnancy Risk Assessment Monitoring System**
CME	**Continuing Medical Education**
MMWR	**Morbidity and Mortality Weekly Report**
CDC	**Centers for Disease Control and Prevention**
PPD	**Postpartum Depression**
PDS	**Postpartum Depressive Symptoms**
PPB	**Postpartum Blues**
PPP	**Postpartum Psychosis**
MDD	**Major Depressive Disorder**
ACOG	**American College of Obstetricians and Gynecologists**
AAP	**American Academy of Pediatrics**
AAFP	**American Academy of Family Physicians**
U.S.	**United States**
NH	**Non-Hispanic**
DSM-IV	**Diagnostic and Statistical Manual of Mental Illness (4th Edition)**

List of Tables

Acknowledgements

I would like to thank all of my thesis committee members for their encouragement and support: Dr. Annette Adams for her incredible guidance in my endeavor to learn STATA, run data analysis and for her patience with all of my questions; she was always available and willing to help me. I thank Dr. Jennifer Wisdom, for her insightful ideas and suggestions about the topic, invaluable feedback over several rough drafts, and for her continued commitment to me despite her exciting transition across the country to a new job and state. I thank Dr. Jodi Lapidus, for stepping into this with little introduction to my study and providing her expertise and guidance for data management and analysis. A special thanks to my thesis advisor, Dr. Kenneth D. Rosenberg, for suggesting this topic, providing the expertise using the data, and aiding me in my analysis and final editing of the thesis.

I thank Katie Riley, Director of the MPH Program at OHSU, for all of her advice as I worked through my MPH courses, and for keeping me on track with the thesis paperwork! I also thank Dr. John Stull, for his unending devotion to our MD/MPH group and the program in general. He has been such a wonderful advisor to all of us these past five years and I cannot thank him enough for his commitment, support and pep talks throughout this process! I thank my mom and brother for providing support and unconditional encouragement and my dog Hadley for forcing me to take walks and get some air. Most of all, I would like to thank my husband, Peter, for his unfailing patience and incredible support.

Abstract

Introduction

Postpartum depression is defined as a major depressive episode that is temporally associated with childbirth, having onset generally within four weeks of delivery and lasting up to one year postpartum. Affecting 12-17% of women, it is an important maternal and child health concern and early recognition of symptoms can help prevent adverse health outcomes for mother and child.

Several studies have identified risk factors for postpartum depression but few of these studies have used population-based data. Utilizing population-based data may provide additional information about identified risk factors and increase generalizability to other communities and states. Better data on risk factors can improve early recognition and screening for postpartum depressive symptoms and, ultimately, improve health outcomes for mothers, children and families.

This study had three objectives. The first was to determine the prevalence of postpartum depressive symptoms among Oregon women by risk factors that were selected from prior literature and studies. The second objective was to determine which of the risk factors selected based on prior literature were significant in this sample of Oregon women through multivariate analysis. Finally, the third objective was to evaluate the relationship of individual race and ethnic groups and income on postpartum depressive symptoms.

Methods

This cross-sectional study utilized the Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) 2004 data; the statistical software STATA (version 8.2) was used for data analysis. Data analysis included descriptive statistics, bivariate and multivariate logistic regression. A backward progression model was followed and variables were removed one at a time based on highest insignificant p-values >0.05. For 2004, a total of 2,814 surveys were sent and 1,968 completed surveys were returned, for an unweighted response rate of 69.9% and a weighted response of 74.8%.

Results

The prevalence of postpartum depressive symptoms among Oregon women was 13.2%. In multivariate logistic regression, the following risk factors were statistically significant: Asian/Pacific Islander race/ethnicity (OR_a 1.90; 95% CI 1.16, 3.13), maternal pre-pregnancy body mass index ≥25 m/kg^2 (OR_a 1.70; 95% CI 1.07, 2.70), partner-related stress (OR_a 3.44; 95% CI 2.14, 5.54) income level ≤ 49% FPL (OR_a 3.01; 95% CI 1.53, 5.93) and insufficient dental care (OR_a 1.93; 95% CI 1.08, 3.45).

Conclusion

The results for objective 1 found that the prevalence of postpartum depressive symptoms in Oregon was 13.2% and was similar to other estimates. Objective 2 found that three of the risk factors for postpartum depressive symptoms among Oregon women were similar to what has been found in prior literature: maternal pre-pregnancy BMI ≥ 25 m/kg^2, partner-related stress and low income. Objective 3 found that only the odds ratio for Asian/Pacific Islander

women (compared to Non-Hispanic White women) was significant, after adjusting for income, maternal pre-pregnancy BMI, insufficient dental care and partner-related stress.

There have been few studies evaluating the relationship between Asian/Pacific Islander women and postpartum depression. Qualitative studies of Chinese, Korean and Japanese women and PPD done abroad suggest that there may be cultural factors contributing to postpartum depressive symptoms among Asian women. Further epidemiological research that includes identifying and understanding culturally relevant risk factors for Asian and Pacific Islander women would provide additional information to improve targeted screening and intervention. With a better understanding of risk factors in this population of women, public health recommendations can be made for improved screening, thereby improving the experience for new mothers and preventing adverse outcomes for Oregon women, children and families.

KEY WORDS: Postpartum Depression, Postpartum Depressive Symptoms, Asian/Pacific Islander, Race and Ethnicity, Depression, Asian

Introduction

This study investigates the prevalence and risk factors for postpartum depressive symptoms among Oregon women. The background section provides a review of postpartum depression including how it is defined, the prevalence, potential causes and associated factors, predictors, screening and treatment, as well as a general overview of the database used in this study, the Oregon Pregnancy Risk Assessment Monitoring System (PRAMS).

Postpartum depression is a clinical diagnosis that must be made by a physician. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), postpartum depression is defined as a major depressive disorder episode occurring within 4 weeks of a live childbirth (1). A diagnosis of major depression includes at least five of the following symptoms within a two-week period: depressed mood, decreased interest, weight loss, insomnia or hypersomnia, psychomotor agitation, fatigue or loss of energy, feelings of worthlessness or inappropriate guilt, diminished ability to concentrate, and/or recurrent thoughts of death (1). Three common instruments to screen for postpartum depression that will be discussed in the background and significance section include the Edinburgh Postnatal Depression Scale (EPDS), the Postpartum Depression Screening Scale (PDSS), and the Postpartum Depression Predictors Inventory-Revised (PDPI-R).

Oregon PRAMS includes two questions asking women about postpartum depressive symptoms, which address two of the above criteria: depressed mood and decreased interest. The two questions are: “Since your new baby was born,

how often have you felt down, depressed, or hopeless?" and "Since your new baby was born, how often have you had little interest or little pleasure in doing things?" According to Whooley and colleagues, the following two questions "during the past month, have you often been bothered by feeling down, depressed, or hopeless?" and "during the past month, have you often been bothered by little interest or pleasure in doing things?" had similar sensitivity and specificity to using validated tools for diagnosing major depression (2). This finding suggests that women experiencing postpartum depressive symptoms are likely experiencing postpartum depression. Yet, technically postpartum depression is a diagnosis that must be made by a physician and postpartum depressive symptoms are what women report. Therefore, the outcome for this study will be referred to as postpartum depressive symptoms. Literature that is cited in this study includes either postpartum depression or postpartum depressive symptoms as the outcome. In this study, the two will be referred to distinctly but based on the study by Whooley and colleagues, are likely representing the same women. Furthermore, some studies use the term "self-reported depressive symptoms" rather than postpartum depressive symptoms however the two are synonymous and refer to the same outcome. Mood disorders that will be discussed will be referred to by the following acronyms: postpartum blues (PPB), postpartum depression (PPD), postpartum psychosis (PPP), postpartum depressive symptoms (PDS) and major depressive disorder (MDD).

Background and Significance

Definition

Women can experience three types of postpartum mental illness after childbirth: postpartum blues (PPB), postpartum depression (PPD), and postpartum psychosis (PPP). Experienced by more than 50% of women who have given birth, PPB consists of transient feelings of mild sadness, including tearfulness as well as periods of anxiety, irritability alternating with periods of happiness (3). Feelings associated with PPB may last three to seven days but usually subside by two weeks after delivery (3, 4).

The prevalence of PPD varies in the literature and can be wide, as low as 5% and as high as 25% and likely reflects measurement criteria differences, what type of screening is used (i.e., self-report, clinical interview, physician diagnosis), when screening occurs, and different study designs (5). Prevalence rates also vary depending on the population being studied. For example, the prevalence varies between countries and can be as low as 4.4% and as high as 73.7% (5). Again, this variation may be due to differences in measurement techniques, sampling methodologies, socio-demographic factors and cultural diversity. For example, Segre et al. found, when adjusting for race/ethnicity, education, age and marital status, women living in the lowest income groups (<$10,000) had a prevalence of PPD that was 20% while women in the highest income group (>=$70,000 per year) had a 7.5% prevalence of PPD. Huang et al. found that the prevalence of depressive symptoms varied significantly between different race/ethnic groups and whether a woman was born in the U.S. or abroad (6).

Studies done in the U.S. have found a fairly consistent prevalence of PPD between 12-17% (3, 7-16). For example, a recent secondary analysis of data from a birth cohort found that women had a prevalence of PDS of approximately 16.9% (17). A cross-sectional study using a self-reported screening tool found that out of 4,332 postpartum participants, approximately 12% of women in the sample were clinically depressed (18). Based on the most recent meta-analysis (conducted in 1996 and including 59 studies) evaluating prevalence of PPD, O'Hara and colleagues found an overall prevalence of PPD at 13% (19).

According to the DSM-IV, PPD is a major depressive disorder (MDD) episode associated with childbirth that generally has onset within four weeks of delivery and can last up to 1 year (1). Some studies suggest that PPD can extend beyond this time frame, even into the toddler years (20, 21). For most women, symptoms of PPD include crying, mood swings, anhedonia, and recurring thoughts of death along with changes in appetite, sleep, and body weight beyond what is considered normal after childbirth. Other common symptoms include guilt, anxiety, agitation, and difficulty with concentration (1, 7, 20-22).

Although the DSM-IV has developed a definition for PPD, the reality and clinical application of this definition is less clear. There is considerable discussion in the literature regarding the uniqueness of PPD and whether it warrants study that is different from non-pregnancy related MDD. Hendrick and colleagues state that there is difficulty in determining the etiology of PPD due to the "heterogeneity" of the syndrome; that is whether depression arising postpartum might be etiologically different from depression arising 3 months after or whether

it is a continuation of depression during or before pregnancy (23). Whiffen states that there is little empirical work assessing similarities and differences between PPD and non-pregnancy related MDD. In her opinion, the central difference between PPD and non-pregnancy related MDD seems to be symptom severity but she believes that what might be true for non-pregnancy related MDD might also be true for PPD (24). A recent study by Bernstein and colleagues evaluated the clinical features of PPD and non-pregnancy related MDD by evaluating core depressive symptoms between two groups of females that were matched on the basis of age and all met DSM-IV criteria for non-psychotic MDD (25). Among women with PPD, sad mood was less prominent, while psychomotor symptoms (restlessness and agitation) and impaired concentration and decision-making were most prominent. The authors suggest that the milder symptoms of sad mood may be related to the fact that birth (and having the baby) may reduce suicidal ideation and mute what would have been severe sadness; that perhaps the "symptoms of MDD can shift because of external realities" (25). Another study argued that there is a difference between non-pregnancy related MDD and PPD based on the finding that women with PPD with a history of non-pregnancy related MDD were at increased for further non-pregnancy related MDD, but patients for whom the episode of PPD was the first experience with depression were at increased risk for further episodes of PPD but not for non-pregnancy related MDD (26). The authors conclude that two types of PPD may exist: one that begins in the postpartum and one that is a recurrence or continuation of a previous non-pregnancy related MDD (23, 26). For the purpose of this study, PPD will be

considered a unique entity given that only pregnancy related depression is assessed with PRAMS 2004 data.

The last postpartum mental illness is PPP. Often a manifestation of bipolar disorder, PPP occurs in only 0.1% of women but is the most serious psychiatric illness associated with childbirth (22). Onset is usually within the first four weeks of delivery and the symptoms can be very severe including abnormal behavior such as confusion, hallucinations, delusions and suicidal or homicidal ideation (9, 12, 22, 27). PPP is rare, but it is considered a medical emergency. Of women who develop PPP, five percent will commit suicide and four percent will commit infanticide. Fifty percent of women with PPP will have a recurrence in subsequent pregnancies (27).

Biological Causes

Researchers have not clearly established the biological causes of PPD. Some studies posit that the onset of depression may be related to the rapid decline in reproductive hormone levels after delivery (11). Several hormones have been investigated including estrogen, progesterone, thyroid hormones, pituitary hormones and cortisol (28). In one study, women with a history of PPD were more sensitive to the withdrawal of these hormones (29). Two other studies have reported a decrease in postpartum depressive symptoms with estrogen supplementation; unfortunately, these studies had very small sample sizes and had problems with confounding (30, 31). Other studies have demonstrated conflicting information and found no significant difference in the magnitude of change of estrogen from late pregnancy to the immediate postpartum period in depressed

and non-depressed women (32, 33). Furthermore, studies of PPD in women who have not given birth challenge the hormonal theories. For example, there are links between PPD and miscarriage, abortion, and adoption (22, 34). Specifically, depressive symptoms increase in the early weeks following miscarriage; this association was strongly influenced by a women's number of living children, length of gestation at loss, and attitude toward pregnancy (34). Determining the biological cause would be helpful and continues to be researched.

Non-Biologic Risk Factors for PPD

Another area of research has focused on the association between PPD and women's social and environmental factors. In 2001, a meta-analysis including 84 studies found that the following factors were associated with an increased risk of postpartum depression: having a history of depression or depression during pregnancy, lower self-esteem, increased life stress, decreased social support, a difficult marital relationship and an infant considered to have a difficult temperment (14). Other factors found to be associated with an increased risk for PPD included being unmarried, living at lower socioeconomic status and having an unplanned or unwanted pregnancy (14). Similarly, according to several other studies, women with a lower income, less education, Medicaid, and who were overweight or obese were at increased risk for PPD (10-13, 15, 35-37). According to one study, women with annual incomes less than $10,000 had four times higher prevalence of depression when compared to women with annual incomes greater than $70,000 (18). Prenatal stress may be instigated by social factors but may lead to greater prevalence of PPD due to biological factors. There are brain receptors

that operate in balance to coordinate the stress-response and variants in these receptor genes have been characterized and associated with stress-related disorders, including depression (80). Therefore, compounded with social factors, increased stress may have a biologic influence for the development of PPD in certain women. Being a single mother may add to increased prenatal stress because she has fewer resources to draw upon to manage the transition to motherhood (14). A higher education level may be associated with less PPD because a woman may have a greater sense of self-achievement and social networks, which in turn improves her self-esteem (36). Improved self-esteem may counteract the negative effects of other life stressors (14). One study found that adolescent mothers were at higher risk for PPD, and due to the fact that younger women may have less experience with transition, acquiring new roles, appropriate coping skills and finding resources as compared to older women (36). An unwanted or unplanned pregnancy may increase the risk of PPD because women with planned pregnancies are likely to have better social support, feel more prepared for parenthood and more financially stable (36). A recent study using PRAMS data from Utah found that women who were obese or overweight had an increased risk of PDS. These women may have pre-existing negative body image and lower self-esteem, contributing to increased depression (37). Women with a history of depression may be more vulnerable to developing depression and therefore at higher risk for PPD. This risk for depression in general may be biological or genetic (38). Depression during pregnancy has been found to be related to PPD; however, the distinction between depression during pregnancy

and PPD is unclear and the environmental social risk factors are likely very similar for women experiencing depression during pregnancy and PPD (39). Furthermore, depression during pregnancy as a risk factor may not be useful because it is unclear at which point during pregnancy depressive symptoms are the most predictive of PPD (39). Race and ethnicity has been suggested as a risk factor for PPD; however, studies evaluating Blacks and Hispanics have found that when adjusting for socio-economic status, this risk is no longer significant (40). Factors that increase PDS among Blacks and Hispanics include social stress, lack of social support, lower income and not being married. Information about other subgroups is much more limited (41). According to some studies, the most common reasons Asian women report feeling PDS were associated with in-law conflict, marital dissatisfaction, perception of mental disorders as a weakness, expectation that motherhood will increase these symptoms, and difference in expression of symptoms (42-46, 47).

Importance of Early Recognition

PPD has been recognized as an important maternal and child health concern because it can have adverse outcomes for both mother and child (14). Mothers with PPD are not only suffering at the time of their depression but are at greater risk of developing depression later in life or having another episode of PPD (11). A Swedish study found that women with a history of PPD were approximately six times more likely to have recurrent depressive symptoms, compared to those without PPD (48). Moderate to severe PPD in women can impair maternal-infant bonding, and has been associated with attachment

insecurity, social interaction difficulties and general cognitive and emotional development problems (11, 20). For example, PPD has been associated with a mother's decreased initiation of important childcare measures, such as consistent car seat usage and taking children to well-child visits (49). The children of women who had PPD three months after childbirth had more intellectual and cognitive problems compared to other children, including lowered IQ scores, attention problems and difficulties with math reasoning (50, 51). Furthermore, there is an inverse relationship between depressive symptoms and breastfeeding at six weeks postpartum such that more depressive symptoms make it less likely the woman will breastfeed her infant (4). This relationship may be important given that breastfeeding has been shown to have benefits on the overall health of the infant (4).

In order to provide timely and tailored anticipatory guidance about important parenting practices and make appropriate treatment referrals for women, health care providers must identify women experiencing PPD; however, more than fifty percent of women with PPD go undiagnosed by a physician (20). Identifying and diagnosing this mental illness is difficult for several reasons. First, many women experience a difficult period of adjustment after having a baby and may not recognize the severity of depression symptoms (7). Second, during the immediate postpartum period, when a woman is at highest risk for depression, she may have minimal contact with her primary care doctor. For example, a postpartum follow-up with an obstetrician is typically six weeks following birth; the focus of this appointment is on the infant and may not include psychiatric

screening of the woman for PPD. Often, a woman's only physician contact following a birth will be with her infant's pediatrician who may not be trained to inquire or identify symptoms of depression. Third, the social stigma of PPD often prevents women from seeking help. Often, the socio-cultural connotations of motherhood, as well as the social pressure she feels from others and society to be happy make it difficult for the mother to recognize her symptoms as depression: she may interpret her psychological state in moral terms, and feel ashamed or guilty because she is having depressive feelings at a time of life that she feels should be joyful (10).

Screening

Research has shown that PPD symptoms generally occur within two to four weeks after childbirth and are most frequently recognized by a primary care health provider: obstetricians, pediatricians, family practitioners, nurse-midwives, or nurse-practitioners (52-55). Unfortunately, over 50% of women with PPD remain undiagnosed (54). There are approximately twelve instruments for PPD clinical screening. Three popular instruments include the Edinburgh Postnatal Depression Scale (EPDS), the Postpartum Depression Screening Scale (PDSS), and the Postpartum Depression Predictors Inventory-Revised (PDPI-R) (22,56,57). The Edinburgh Postnatal Depression Scale (EPDS) is a self-administered ten-item scale developed in England and is the most commonly used worldwide and in the U.S. to assist primary care health professionals in detecting PPD. It is available in many languages, and has cross-cultural validity (56). The PDSS is a 35-item questionnaire that measures the severity and type of

postpartum depressive symptoms (57). The PDPI-R evaluates risk factors identified in the 2001 meta-analysis described above (14, 22). All three assess the following factors: the ability to laugh; ability to anticipate with pleasure; unnecessary blaming of oneself; worry and anxiety; fear and panic; feeling overwhelmed; difficulty sleeping because of unhappiness; sadness and misery; crying; eating disturbances; insecurity; mental confusion; loss of self; guilt and shame and suicidal/homicidal ideation. Symptom identification using these instruments does not necessarily indicate a woman meets criteria for a diagnosis of PPD but the instruments serve to identify a woman who is at risk and may need more evaluation (22, 57, 58). These tools are extremely useful in identifying women at risk for PPD. As mentioned before, even having two questions addressing mood and interest level can be sufficient in identifying women at risk for PPD and therefore screening can be done very efficiently.

Treatment

Recommended treatment for PPD consists of three main approaches: individual counseling, pharmacotherapy and support groups. Pharmacotherapy for women with PPD typically involves the antidepressants, selective serotonin reuptake inhibitors (SSRI), because of their relatively low side effects and toxicity. According to the American Academy of Pediatrics (AAP), antidepressants are excreted in breast milk and there is a risk of exposure for the infant (59). The long-term effects of these medications on infants is impossible to predict, however no published studies report any adverse effects of breast-fed infants whose mothers were treated with SSRI medications (29, 59). The benefit

of using pharmacotherapy is determined by the severity of the depression and is a discussion between the woman and her physician (29). The long-term consequences of depression may outweigh the undetected long-term consequences of antidepressant use. As a complement to individual treatment, peer-led support group therapy is effective in reducing symptoms of PPD (57). Support groups help women reduce isolation and loneliness, normalize the experience of PPD, develop a support system that understands the unique challenges of new motherhood, and improve symptoms (57).

Role of Primary Care Providers

Although obstetricians are deeply involved in prenatal care and birth of the baby, they may be less likely to detect PPD because they only see women for a single visit, usually four to six weeks postpartum (57). Family physicians and pediatricians may be better situated to detect PPD (55). Well-child visits by these clinicians provide ongoing and consistent contact with women at important time intervals since current recommendations suggest 4-6 visits in the first year (54). The American Academy of Pediatrics recommends the following for first year well-child exams; 2 weeks, 4 weeks, 2 months, 4 months, 6 months, 9 months and 1 year. These visits provide ample opportunity for pediatric physicians to screen women. Pediatric settings actively screening for PPD demonstrate a significant increase in documentation of depressive symptoms during well-child visits in the first year (52).

In pediatric settings, barriers for PPD screening arise because the mother is not an identified patient and/or there are several well-child issues to cover

during the limited time of a visit (53). Pediatrician knowledge of PPD is also a considerable barrier: half of pediatricians reported little or no education about PPD and half underestimated the overall incidence of PPD (53). One study examined self-reported practice in recognizing and treating PPD, and included 98 pediatric health care providers. Greater than 85% of providers felt it was their responsibility to recognize PPD, but only half felt confident in doing so and less than 10% reported asking mothers about depression or using a screening tool (60). Barriers identified by pediatricians for PPD screening include: insufficient time for an adequate history, education and counseling, insufficient training and knowledge to diagnose, counsel or treat a woman with PPD, unsure where to refer women, and insufficient community resources for mental health care (54). Also, healthcare insurance regulations frequently block pediatricians from referring mothers directly to mental health providers (52).

Family physicians may provide more reliable screening, diagnosis and treatment of PPD because they are more trained to consider the family environment of both mother and child than obstetricians and even pediatricians (54, 57). A survey of 362 family physicians in Washington found that seventy-percent “always or often” screened for PPD at postpartum gynecologic exams and forty-six percent “always or often” screened mothers for PPD at well-child visits. Of those who did screen, thirty-six percent reported using a validated tool, with half using a tool specifically designed to detect PPD (55).

PRAMS

PRAMS and PPD

Many states collect PRAMS data, but only some include questions useful for identifying risk factors associated with PDS; therefore, literature using PRAMS data includes three state reports and two studies. The three reports include two individual state reports (Oklahoma and Michigan) and a compiled CDC report from seven states. Different states utilizing PRAMS have asked different questions about PDS (table 1).

Table 1: PRAMS Postpartum Depression questions for Oklahoma, Michigan and Oregon

State	Depression Questions
Oklahoma	In the months after your delivery would you say you were 1) not depressed at all, 2) slightly depressed, 3) moderately depressed, 4) very depressed; or 5) very depressed and had to get help
Michigan	In the months after your delivery, would you say that for 2 weeks or more you were a) not depressed at all, b) a little depressed, c) moderately depressed, d) very depressed
Oregon	Since your new baby was born, how often have you felt down, depressed or hopeless: 1) Always, 2) Often, 3) Sometimes, 4) Rarely, 5) Never Since your new baby was born, how often have you had little interest or little pleasure in doing things: 1) always, 2) often, 3) sometimes, 4) rarely, 5) never

In 1995, Oklahoma PRAMS researchers reported the following risk factors for PDS: low socioeconomic status and stressful life events (such as divorce or separation) (12). Women who experienced an unwanted pregnancy were three times as likely to report having severe symptoms after delivery when compared to women with intended pregnancy. Similarly, women experiencing a physical violent event in the twelve months prior to delivery were 3.3 times as

likely to report severe PDS as compared to those who had not (12). In 2001, Michigan PRAMS identified low maternal education, being uninsured and having a pre-term baby, experiencing stressful life events, and physical abuse as risk factors associated with PDS (13). In 2004, the CDC compiled 2000 data from seven states (Washington, Louisiana, New York, Maine, North Carolina, and Utah) on PDS. These seven states included questions that addressed severity of depressive symptoms. Specifically, these questions were "In the months after your delivery, would you say that you were 1) not depressed at all, b) a little depressed, c) moderately depressed, d) very depressed or e) very depressed to get help?" The responses were collapsed into three depression categories: none, low to moderate, and severe (8). Seven percent of women reported having severe depression symptoms and twelve percent reported moderate depression symptoms. Risk factors associated with severe depression included having less than twelve years of education, being a Medicaid recipient, delivery of a low birth weight baby, physical abuse during pregnancy, and emotional, partner-related, financial or traumatic prenatal stress (8).

Two peer-reviewed studies using PRAMS data to determine risk factors associated with PDS have been published. One study used data from Colorado, New York State, and North Carolina and found that women who reported that their pregnancy was "a very hard time" or "one of the worst times of my life" had the highest prevalence of PDS in the months after birth (15). A more recent study found when controlling for marital status and income, normal body mass index was associated with the lowest rate of PDS (37).

PRAMS and Public Health Interventions

PRAMS data not only provides important information on the scope and degree of many maternal and child health issues, but also assists in the implementation of public health programs and policies (62). For example, analysis of Colorado PRAMS data from 1997 and 1998 identified a lack of prenatal care among undocumented immigrant women with increased adverse birth outcomes. Most of these women were not eligible for Medicaid and were not receiving any prenatal care. The state legislature included the results from the PRAMS data in a bill proposal that would allow undocumented immigrant women the right to enroll into a Medicaid HMO and receive prenatal care during pregnancy. As a result, health providers now can provide prenatal care to these women through a pilot project with the Colorado Department of Health Care Policy and Financing. In 1996, using insights from the Alabama PRAMS data, the Alabama Department of Public Health and the University of Alabama-Birmingham obtained a $2.5 million grant (from the National Heart, Lung and Blood Institute) to reduce smoking among pregnant women who receive prenatal care in certain counties. In Maine, PRAMS data on breastfeeding allowed the state Breastfeeding Coalition to establish breastfeeding goals for Maine and was instrumental in the addition of two new health objectives to the "Healthy Maine Year 2000 Objectives" that aimed at increasing breastfeeding rates and support for public health nurses and lactation consultants. Given these examples, using PRAMS to improve public health and clinical efforts for PPD intervention and policy implementations, is not an unrealistic future goal.

Oregon PRAMS

The state of Oregon initiated the PRAMS survey in 1998 and the two questions on PDS were added in 2004. The results of these questions have not been extensively analyzed and these data offer an opportunity to learn more about the prevalence of PDS and risk factors specific to Oregon women. This information could then be used to improve public health and clinical intervention for "at risk" populations.

Study Objective

Many prior studies have revealed important information about prevalence and risk factors for PPD or PDS but given they are based on clinical samples and test discrete risk factors, they are limited in their generalizability to a larger population. The strength of this study is that it is analyzing a population-based sample that is weighted to reflect the population of Oregon births improving the ability to generalize to the broader population of Oregon and other states with similar demographic characteristics. Thus, the objective of this study was three-fold. Objective 1 was to determine the prevalence of PDS among Oregon women. In this study, I expected the prevalence of PDS reported among Oregon women to be consistent with other studies, which is approximately 12-17%. Objective 2 was to determine which of these selected risk factors analyzed were significant in the Oregon sample. This study included risk factors previously evaluated in the literature (10-15, 35,37) and therefore I anticipated that there would be similarity between significant risk factors found in this study with other studies. Objective 3 further explored the relationship of race and ethnic groups and income level with

PDS by looking at subcategories of race and ethnicity and income. Based on prior studies, I expected that race and ethnicity would not be significant when adjusted for income (41, 40). Finally, I hope results of this study will aid in providing useful information to the Office of Family Health at the Oregon Public Health Division and provide recommendations for public health policy and clinical interventions for women at higher risk for PDS.

Methods

PRAMS

Study Design and Data Source

This is a cross-sectional study utilizing a stratified random sample of Oregon women who gave birth in 2004. To determine the a) prevalence of PDS b) the risk factors associated with PDS and c) the relationship of race and ethnicity and federal poverty level to PDS, I used data from the Oregon Pregnancy Risk Assessment and Monitoring System (PRAMS), which is a surveillance project sponsored by the Centers for Disease Control and Prevention (CDC).

PRAMS data uses a standardized data collection methodology which facilitates comparisons among states and optimizes single-state or multi-state analysis. Participating states collect state-specific, population-based data on maternal experiences, attitudes and feelings before, during and shortly after pregnancy through an administered survey, which contains approximately eighty questions. The survey provides unique demographic, behavioral, emotional and environmental information about a woman's experience with pregnancy unattainable from other sources. Approximately thirty-nine states currently

participate in PRAMS and collect data annually on maternal health (table 2). There are two types of questions included in the survey. The “core” questions must be used by every state and address barriers to and content of prenatal care, obstetric history, maternal use of alcohol and cigarettes, physical abuse, contraception, economic status, maternal stress, and early infant development and health status. States can also choose from 185 “standard” CDC questions to supplement the core questions. Standard questions include content of prenatal care, contraception, physical abuse, social support and services, mental health, and injury prevention. The questions addressing postpartum depressive symptoms were standard questions. If there are additional topics of interest not addressed by the core or standard questions, states can create further questions.

In 2004, Oregon PRAMS contained 84 questions and there were two types of questionnaires available: a self-administered questionnaire included for mail administration, and an interviewer-administered questionnaire for phone administration (Appendix). Although the questions are the same in both methods, the format may have differed to accommodate the different type of administration. Also, there were English and Spanish versions of the questionnaire.

The initial mailed item was a pre-letter that introduced the mother to PRAMS and informed her that she would be receiving a questionnaire within a week. The full questionnaire packet was mailed three to seven days later and was followed one week to ten days later with a reminder and thank you note. If a woman had not responded one to two weeks after the reminder note was mailed, a second questionnaire packet was sent. If she had not yet responded one to two

weeks after the second questionnaire was sent, then a third questionnaire was sent. Finally, if there was no response to the third questionnaire, a telephone follow-up was initiated. The entire process from the time the pre-letter was sent to the follow up phone call lasted approximately 60-95 days.

Table 2: Thirty-nine States Participating in PRAMS (includes separate PRAMS for New York City)

Alabama	Michigan	Pennsylvania
Alaska	Minnesota	Rhode Island
Arkansas	Mississippi	South Carolina
Colorado	Missouri	South Dakota
Delaware	Nebraska	Tennessee
Florida	New Jersey	Texas
Georgia	New Mexico	Utah
Hawaii	New York	Vermont
Illinois	New York City	Virginia
Louisiana	North Carolina	Washington
Maine	Ohio	West Virginia
Maryland	Oklahoma	Wisconsin
Massachusetts	Oregon	Wyoming

*From CDC PRAMS website www.cdc.gov/prams/states.htm

PRAMS Sampling Methodology

Oregon PRAMS began in November of 1998 and is administered by the Office of Family Health of the Oregon Public Health Division. The data used in this study was collected from women who delivered a live infant in 2004. Oregon PRAMS, like other states, relies upon a stratified random sample of women selected from birth certificates. To ensure an adequate sample size that is weighted to reflect the entire population of Oregon, 100-250 new mothers are sampled every month from eligible birth certificates with an overall annual sample size between 1,000 to 3,400 women. The goal is to have a sample size that is large enough for estimating statewide risk factor proportions within 3.5% at 95% confidence. To account for the sampling design and to reflect the actual Oregon population of pregnant women, sampled subjects were assigned weights

according to six strata. Five of the six strata (African-Americans, Hispanics, Asians and Pacific Islanders, American Indians and Native Alaskans, and infants with low birth weights (< 2500 grams) were over-sampled and the sixth stratum included Non-Hispanic white women with normal birth-weight-infants (≥ 2500 grams) (table 3). A second weight applied to the data has to do with non-response. Based on extensive CDC analysis, non-response weighting is a complex process that accounts for women who are determined to have less propensity to respond based on certain characteristics decided by the CDC. Essentially, women representing lower response categories are given greater weight than responses of women with higher response rates. The third weight applied to the data was non-coverage, which accounted for the discrepancy associated with collecting data in multiple stages (in this case monthly) and analyzing it per year. Specifically, non-coverage accounted for sampled birth certificates that were found to be duplicate copies and removed in the final tally. The final analysis weight was the product of the sampling strata, non-response and non-coverage. After the surveys were completed, the responses of mothers were linked to birth certificate data from the Oregon Birth Registry to provide more comprehensive demographic and health information. For 2004, a total of 2,814 surveys were sent and 1,968 surveys were completed, for an unweighted response rate of 69.9% and a weighted response of 74. 8%.

Table 3: Frequency and Percent Response Rate per Six Strata: Unweighted and Weighted Response Rates

Characteristic	Number Sampled	Respondents	Percent Responding (unweighted)	Percent Responding (weighted)
Overall	2814	1968	69.9	74.8
Stratum				
Hispanic	543	427	78.6	78.6
White/LBW(a)	440	333	75.7	75.7
White/ NBW(b)	492	370	75.2	75.2
NH Black	442	256	57.9	57.9
NH American Indian	391	252	64.5	64.5
NH Asian/Pacific Islander	506	330	65.2	65.2

Study Data Management

Independent Variables

The independent variables initially selected were risk factors identified in prior literature with some additional variables of interest. Demographic variables included: mother's race and ethnicity, birth-place (U.S. or foreign born), mother's age and education level, income based on federal poverty level (FPL) and marital status. Characteristic and behavioral variables included: pregnancy intention, WIC (Women, Infant and Children nutrition program) enrollment status, physical activity in the past month, Medicaid recipient prior to pregnancy, prenatal dental care, maternal smoking during pregnancy, maternal alcohol use during pregnancy, previous live births, previous terminations, exclusive breastfeeding at 8 weeks postpartum, urban or rural residence, physical abuse by husband or partner during pregnancy, prenatal care initiation and number of visits, mother's body mass index (BMI), and prenatal stress. The independent variables were acquired from PRAMS data and birth variables (table 5).

Dependent Variable

The dependent variable was whether a woman experienced PDS or not. Oregon PRAMS includes two questions asking women about depressive symptoms, which address two symptoms of depression: depressed mood and decreased interest. As mentioned in the introduction, according to Whooley and colleagues, the following two questions, which are essentially identical to the two PRAMS questions: "during the past month, have you often been bothered by feeling down, depressed, or hopeless?" and "during the past month, have you often been bother by little interest or pleasure in doing things?" had similar sensitivity and specificity to using validated tools for diagnosing major depression (2). This finding suggests that women experiencing postpartum depressive symptoms are likely experiencing postpartum depression. Given this, the prevalence of PDS determined in this study can be compared to other estimates of postpartum depression.

The method of outcome variable determination was based on a recent CDC proposal and expected report that will be published in a 2008 Morbidity and Mortality Weekly Report (MMWR), which will use PRAMS data from 19 states (including Oregon) to determine the prevalence of PDS (79). For the dependent variable, answers from two questions were combined from the survey to determine whether a woman did or did not have the outcome. The first question was "Since your new baby was born, how often have you felt down, depressed, or hopeless?" and the second question asked, "Since your new baby was born, how

often have you had little interest or little pleasure in doing things?" For each of these questions, there were initially five possible answers (always, often, sometimes, rarely, never) that were collapsed into a binary outcome such that women who answered "often" or "always" were coded "yes" and women who answered "never", "rarely" and "sometimes" were coded "no." Subsequently, the collapsed answers to the two questions were combined. If a woman answered "yes" to one or both questions, then this was considered a "yes" response to having PDS. Alternatively, if a woman answered no to both questions, this was considered a "no" response (table 4). Women who only answered one question or did not answer either question were excluded from the analysis.

Table 4: Questions and Collapsed Answers for the Outcome Variable: Postpartum Depressive Symptoms

Outcome variable	Two original questions	Collapsed answers	Combined answer
Postpartum Depressive Symptoms	Since your new baby was born, how often did you feel down, depressed, or hopeless? Since your new baby was born, how often have you had little interest or little pleasure in doing things?	Yes=Always, often, No=Sometimes, rarely, never Yes=Always, often, No=Sometimes, rarely, never	Yes=yes to both or either question No=No to both

Variable Recoding

Many of the independent variables were recoded for the purpose of this analysis (table 5). Continuous variables such as age and education of mother were categorized into two categories based on prior PRAMS reports and studies (8-10).

Race and ethnicity for the women was combined into one variable with five categories: Non-Hispanic White, Hispanic, Non-Hispanic Black, Non-Hispanic American Indian and Non-Hispanic Asian/Pacific Islander. Income levels (based on 2004 household FPL guidelines as per table 6) were combined into one variable with five different categories: ≤49% FPL, 50-99% FPL, 100-199% FPL, 200-299% FPL, and >=300%.

There were thirteen questions addressing prenatal stress, which were ultimately categorized into four categories of prenatal stress: emotional, financial, traumatic and partner-related stress (table 5). Gross and colleagues discuss the categorization of these 13 items based on the work of Ahluwalia and colleagues, who tested the association of individual items using the concept of principal component work; that is the correlation of individual similar items into a whole in order to create a construct that the individual items might not appropriately capture (15, 63). Several other PRAMS reports as well as a recent study using PRAMS utilized this method of categorization for prenatal stress (8, 12, 13, 15, 37, 62, 63). The prenatal stress question was “Did any of these things happen during the 12 months before your new baby was born?” If a woman answered “yes” to any of the included questions, it was a “yes” answer. If she answered “no” to all of the questions within the category, this counted as a “no” answer. If a woman did not answer any of the questions in the category, she was excluded from the analysis. If one or more questions were answered, she was included in the analysis.

Dental care was included in this analysis because of recent work

conducted about oral health and pregnancy and an association found between oral health and depression in general (64, 65). Better understanding dental care during pregnancy, including dental care as a potential risk factor for PPD was of interest by the Office of Family Health. To evaluate whether a woman had received insufficient dental care during her pregnancy, two questions were combined. The first question asked whether the woman needed to see a dentist for a problem during pregnancy and the second question asked whether she had seen a dentist. If a woman answered "yes" to the first question and "no" to the second question, her answer was considered "yes" to not having received sufficient dental care. If she answered "no" to the first and second question or "no" to the first question and "yes" to the second question, her answer was considered "no" to having received sufficient dental care. Women who did not answer these questions or only answered one question were excluded from the analysis. Pregnancy intention was recoded into three categories: intended (wanted a baby then), mistimed (wanted a baby later) and unwanted (did not want a baby then or later). This categorization was based on prior PRAMS analysis, and allowed for a distinction between women who had mistimed pregnancies versus unwanted. The birthplace of women was coded into two categories: U.S. and all other countries abroad. Oregon PRAMS asks two questions about depression during pregnancy. Although antenatal depression could be considered a potential risk factor for postpartum depression, it was not included in this analysis because the overlap with PPD is large and the distinction between and the other is impossible.

Table 5: Independent and Dependent Variable Coding: Variables from PRAMS and Oregon

birth certificate for 2004		
Independent Variables	**Coding**	**Data Source (Question #)**
Pregnancy intention	0=intended 1=unintended 2=unwanted	PRAMS (Q10)
On WIC during pregnancy	0=no 1-yes	PRAMS (Q26)
Smoking during pregnancy	0=no 1=yes	PRAMS (Q31)
Alcohol during pregnancy	0=none 1= >1	PRAMS (Q35a)
Marital Status	0=yes 1=no	Birth Certificate
Mother Race/ethnicity	0=Non-Hispanic White 1=Hispanic 2=Non-Hispanic Black 3=Non-Hispanic American Indian 4=Non=Hispanic Asian Pacific Islander	Birth Certificate
Mother's Birth Place	0=U.S. or Canadian born 1=Born abroad	Birth Certificate
Mother Education	0= ≥12 years 1= <12 years	Birth Certificate
Mother age	0 = >24 1 = ≤24	Birth Certificate
Termination of pregnancy	0=none 1=one or more	Birth Certificate
Previous live births	0=no 1=yes	Birth Certificate
Previous Pregnancy losses	0=no 1=yes	Birth Certificate
Any physical abuse by husband or partner during pregnancy	0=no 1=yes	PRAMS (Q 39b)
Income level (Federal Poverty Level)	0=300%+ 1=200-299% 2=100-199% 3=50-99% 4=0-49%	Birth Certificate
Insufficient Prenatal Dental Care	0=no 1=yes	PRAMS (Q76 a & b)
Physical activity in last month	0=yes (1 or more days a week) 1=no (less than 1 day per week)	PRAMS (Q74)
Mother Body Mass Index	0= <25 m/kg^2 (normal and underweight) 1= ≥25 m/kg^2 (overweight and obese)	Birth Certificate

Prenatal care start	0=1st or 2nd trimester 1=3rd or never	Birth Certificate
Number of Prenatal Visits	0=>10 1=≤10	Birth Certificate
Exclusive breastfeeding at 8 weeks	0=no 1=yes	Birth Certificate
Urban/Rural	0=rural 1=urban	Birth Certificate
Emotional Prenatal Stress Close family member was very sick and had to go to the hospital. Someone very close to me died.	0=no to both 1=yes to at least one	PRAMS (Q36 a, m)
Financial Prenatal Stress I moved to a new address My husband or partner lost his job. I lost my job even though I wanted to go on working I had a lot of bills I couldn't	0=no to all four 1=yes to at least one	PRAMS (Q36 c, e, f, i)
Traumatic Prenatal Stress I was homeless I was in a physical fight My husband or partner or I went to jail. Someone very close to me had a bad problem with drinking or drugs	0=no to all four 1=yes to at least one	PRAMS (Q36 d, j, k, l)
Partner-related Stress I got separated or divorced from my husband or partner I argued with my husband or partner more than usual. My husband or partner said he didn't want me to be pregnant.	0=no to all three 1=yes to at least one	PRAMS (Q36 b, g, h)
Dependent Variable		
Postpartum depressive symptoms	0=no 1=yes	PRAMS (Q 75 a, b)

Table 6: Federal Poverty Level Guidelines 2004

Size of Family Unit	48 States and D.C. ($)
1	9,310

2	12,490
3	15,670
4	18,850
5	22.030
6	25,210
7	28,390
8	31,570
Each additional person, add	3,180

*Adapted from Federal Register, Vol 69, No. 30, February 13, 2004, pp.7336-7338
*PRAMS family income does not include infant

Statistical Analysis

The statistical software STATA version 8.2 was used for data analysis. Data analysis included descriptive statistics, bivariate and multivariate logistic regression. Descriptive statistics were used to describe the population of women included in the study based on investigated risk factors and included the number of observations, frequency and weighted percent of women who experienced PDS within each category. Bivariate logistic regression was done on all the independent variables selected. Those that were significant (based on confidence intervals that did not include 1.00 and p-value <0.05) were included in the full multivariate logistic model.

A backward progression approach was used for multivariate regression analysis. Insignificant variables were sequentially removed from the model based on the highest p-value above 0.05. If the odds ratio estimate changed by more than 10% when a variable was removed, the variable remained in the model to assess for confounding. Subsequently, subcategories of race and ethnicity as well as income levels were assessed in the final model.

Results

Descriptive Statistics

All results are weighted unless otherwise specified. Objective 1 was to determine the prevalence of PDS. The overall prevalence of PDS in this study was 13.2%. Specifically, the prevalence of PDS among subcategories of race and ethnicity was as follows: NH White (11.5%), Hispanic (17.4%), NH Black (21.6%), NH American Indian (20.9%) and NH Asian/Pacific Islander (15.8%). The prevalence of PDS among subcategories of income was as follows: ≤49% FPL (23.8%), 50-99%FPL (14.3%), 100-199% FPL (14.0%), 200-299% FPL (13.5%) and ≥300%FPL (5.2%). As income decreased, the prevalence of PDS increased (table 7).

The mean age of women responders was 27.2 years (95% CI: 26.7, 27.7). Of women, 33.5% were unmarried and the mean education level was 13.9 years (95% CI: 13.2, 14.6). In the total sample, 70.1% of women were non-Hispanic White, 19.1% were Hispanic, 2.2% were Non-Hispanic Black, 1.6% non-Hispanic American Indian, and 5.6% were non-Hispanic Asian/Pacific Islander. On average, women lived at 218% FPL (95% CI: 206.6, 230.1) with a distribution as follows: ≤49% FPL (17.6%), 50-99% FPL (11.1%), 100-199% FPL (20.8%), 200-299% FPL (13.6%) and ≥300 FPL (36.9%). Approximately 75.1% of women lived in an urban area (table 7).

Twelve percent of women were receiving Medicaid and 42% of women were enrolled in WIC. For pregnancy intention, 45.6% of women identified their pregnancy as intended, 46.9% as mistimed and 7.5% as unwanted. Approximately 1.4% reported physical abuse during pregnancy. The mean BMI was 25.6 m/kg2 (95% CI: 25.1, 26.1). Approximately 54.6% of women reported exclusive

breastfeeding at 8 weeks. Several women reported some form of prenatal stress during their pregnancy. Specifically, 27% of women reported having emotional stress, 56% reported having financial related stress, 21% reported having some traumatic related stress and 7.6% reported having partner-related stress (table 7).

Of the variables examined, the following characteristics demonstrated a higher prevalence of PDS: unmarried, Non-White race and ethnicity, younger age, less education, WIC enrolled, lower income, on Medicaid, unintended pregnancy, maternal smoking during pregnancy, maternal alcohol use during pregnancy, previous births, previous losses or terminations, physical abuse before or during pregnancy, late prenatal care, and prenatal stress (table 7).

Table 7. Frequency (weighted and unweighted) and Prevalance of PDS among participants based on independent variables (N=1968)

Characteristics	n(a)	Percentage (weighted)	PDS symptoms present(b) (95% CI) (weighted)	
Postnatal depression				
No	1579	86.8		
Yes	323	13.2	13.2	(10.9, 15.6)
Missing	66 (3.4%)			
Marital Status				
Unmarried	715	33.5	18.9	(14.2, 23.6)
Married	1253	66.5	10.4	(7.8, 13.0)
Missing	0			
Mother Race/ethnicity				
Non-Hispanic White	700	70.1	11.5	(8.3, 14.6)
Hispanic	420	19.1	17.4	(13.7, 21.2)
NH Black	256	2.2	21.6	(16.3, 26.9)
NH American Indian	251	1.6	20.9	(15.6, 26.2)
NH Asian/Pacific Islander	332	5.6	15.8	(11.5, 20.0)
Missing	9 (0.5%)			
Birth Place				
U.S. or Canadian born	1294	76.7	12.4	(9.6, 15.4)
Foreign born	674	23.3	15.7	(12.6, 18.9)
Missing	0			
Mother age				
≤24	737	37.5	17.2	(12.8, 21.5)
>24	1231	62.5	10.8	(8.1, 13.5)

Missing	0			
Mother education				
<12 years	452	19.8	19.6	(14.0, 25.1)
≥12 years	1496	80.2	11.6	(9.0, 14.3)
Missing	20 (1.0%)			
WIC (c)				
No	1083	58.2	9.8	(7.2, 12.6)
Yes	885	42.0	17.9	(13.8, 22.1)
Missing	0			
Medicaid Recipient				
No	1625	87.8	11.5	(9,2, 13.9)
Yes	332	12.2	26.1	(16.7, 35.2)
Missing	11 (0.6%)			
Income				
0-49%	410	18.9	23.8	(17.2, 30.3)
50-99%	251	12.0	14.3	(7.0, 21.4)
100-199%	422	22.4	14.0	(8.3, 19.6)
200-299%	191	14.6	13.5	(6.4, 20.5)
300+	512	31.2	5.2	(2.5, 8.0)
Missing	182 (9.2%)			
Pregnancy intention (d)				
Intended	808	45.6	10.7	(7.4, 13.9)
Mistimed	968	46.9	13.6	(10.2, 16.9)
Unwanted	159	7.5	25.6	(13.6, 37.7)
Missing	33 (1.7%)			
Maternal Smoking(e)				
No	1705	87.3	12.0	(9.7, 14,4)
Yes	204	12.7	17.6	(9.1, 26.0)
Missing	59 (3.0%)			
Maternal Alcohol Use(f)				
None	1881	98.7	12.5	(10.2, 14,9)
>= 1 per week	25	1.3	23.9	(-2.2, 50.0)
Missing	62 (3.2%)			
Previous live births				
No	859	44.2	11.6	(8.3, 14.9)
Yes	1109	55.8	14.5	(11.2, 17.8)
Missing	0			
Previous terminations				
None	1461	74.0	12.5	(9.9, 15.1)
>=1	506	26.0	15.4	(10.1, 20.6)
Missing	1(0.05%)			
Previous pregnancy losses				
No	1443	73.2	12.2	(9.6, 14.8)
Yes	525	26.8	16.0	(10.7, 21.2)
Missing	0			

Physical abuse by husband/partner during pregnancy				
No	1691	98.6	12.6	(10.1, 15.0)
Yes	49	1.4	40.8	(10.2, 71.5)
Missing	228 (11.6%)			
Maternal Body Mass Index (g)				
<25 m/kg^2	1027	58.9	9.9	(7.3, 12.7)
≥25 m/kg^2	766	41.9	16.9	(12.1, 21.0)
Missing	175 (8.9%)			
Prenatal Start				
1st /2nd trimester	1891	96.0	12.5	(10.2, 14
3rd trimester/never	75	4.0	30.5	(12.9, 48. 1)
Missing	2 (0.1%)			
Number Prenatal Visits				
None	25	1.2	1.4	(-0.08, 3.5)
>=1	1939	98.8	13.4	(10.9. 15.8)
Missing	4 (0.2%)			
Exclusive Breastfeeding At 8 weeks				
No	842	45.3	15.2	(11.0, 19.4)
Yes	754	54.7	10.7	(7.6, 13.8)
Missing	372 (18.9%)			
County of Residence				
Urban	1570	75.1	13.4	(10.8, 16.1)
Rural	398	24.9	12.6	(7.5, 17.7)
Missing	0			
Insufficient Dental Care(h)				
No	1630	87.6	11.1	(8.8. 13.5)
Yes	244	12.4	26.6	(17.2, 35.9)
Missing	94 (4.8%)			
Physical Activity After Pregnancy (i)				
No	531	24.2	15.7	(10.7, 20.7)
Yes	1370	75.8	12.4	(9.7, 15.1)
Missing	67 (3.4%)			
Emotional Stress				
No	1381	73.4	11.6	(9.0, 14.1)
Yes	520	26.6	16.1	(10.8, 21.2)
Missing	67 (3.4%)			
Financial Stress				
No	798	43.6	7.6	(4.9, 10.4)
Yes	1113	56.4	16.5	(12.9, 19.8)
Missing	57 (2.9%)			
Traumatic Stress				
No	1468	78.8	9.3	(7.2, 11.4)
Yes	436	21.2	25.7	(18.6, 32.8)

Missing	64 (3.3%)			
Partner-related Stress				
No	1285	71.3	7.6	(5.5, 9.7)
Yes	613	28.7	25.2	(19.3, 31.1)
Missing	70 (3.6%)			

(a) Unweighted number of respondents (including those who did not know or did not respond)
(b) Percentage of women who reported PDS
(c) Enrollment in the Women, Infants, and Children program during pregnancy
(d) Intended includes women who wanted to be pregnant sooner or women who wanted to be pregnant then, mistimed includes women who wanted to be pregnant later, unwanted includes women who did not want to be pregnant then or any time in the future
(e) Maternal smoking in the last three months of pregnancy
(f) Maternal alcohol use in the last three months of pregnancy
(g) $<25 m/kg^2$ refers to normal and underweight women and ≥ 25 m/kg^2 refers to overweight and obese women.
(h) Insufficient dental care refers to women who needed dental care but did not seek it.
(i) Any physical activity within the past month

Logistic Regression

Objective 2 was to explore which risk factors were significantly associated with PDS (table 7). In multivariate logistic regression, the following risk factors remained statistically significant: Non-White race and ethnicity (OR 1.17: 95% CI 1.03, 1.33), mother's BMI>=25 m/kg2 (OR 1.70: 95% CI 1.07, 2.70); partner-related stress (OR 3.44: 95% CI 2.14, 5.54); income ≤300% FPL (OR 1.28: 95% CI 1.10, 1.48); and insufficient dental care (OR 1.93: 95% CI 1.08, 3.45) (table 8).

Objective 3 included subcategories of race and ethnicity and income in the final model. The following subcategories remained statistically significant: Asian/Pacific Islander race/ethnicity (OR 1.90: 95% CI 1.16, 3.13) and income ≤49% FPL (OR 3.01: 95% CI 1.53, 5.93) (table 8).

Table 8. Risk Factors for PDS: Bivariate and Multivariate Analysis (N=1799)		
Risk Factors for PDS	**Bivariate OR(a) (95% CI)**	**Multivariate OR (b) (95%CI)**
Race/ethnicity mother		

Non-Hispanic White	Referent	Referent
Non-White(c)	**1.16 (1.04, 1.30)**	**1.17 (1.03, 1.33)**
Hispanic	**1.51 (1.05, 2.18)**	1.34 (0.81, 2.23)
NH Black	**1.85 (1.26, 2.69)**	1.54 (0.91, 2.60)
NH American Indian	**1.75 (1.20, 2.57)**	1.45 (0.87, 2.43)
NH Asian/Pacific Islander	1.25 (0.85, 1.83)	**1.90 (1.16, 3.13)**
Mother BMI		
<25 m/kg^2	Referent	Referent
≥25 m/kg^2	**1.84 (1.22, 2.78)**	**1.70 (1.07, 2.70)**
Partner-related prenatal stress		
No	Referent	Referent
Yes	**4.07 (2.64, 6.27)**	**3.44 (2.14 5.54)**
Federal Poverty Level		
>=300%	Referent	Referent
<300%(d)	**1.37(1.20, 1.56)**	**1.28 (1.10, 1.48)**
200-299%	1.03 (0.54, 1.95)	2.03 (0.91, 4.57)
100-199%	1.09 (0.64, 1.83)	1.83 (0.89, 3.79)
50-99%	1.10 (0.59, 2.07)	2.15 (0.98, 4.69)
0-49%	**2.54 (1.63, 3.96)**	**3.01 (1.53, 5.93)**
Insufficient Dental Care(e)		
No	Referent	Referent
Yes	**2.89 (1.69, 4.95)**	**1.93 (1.08, 3.45)**
Mother's age		
<=24	**1.71 (1.13, 2.60)**	
>24	Referent	
Medicaid Recipient		
No	Referent	
Yes	**2.71 (1.60, 4.59)**	
Financial prenatal stress		
No	Referent	
Yes	**2.33 (1.49, 3.66)**	
Traumatic prenatal stress		
No	Referent	
Yes	**3.38 (2.16, 5.29)**	
Physical abuse by husband/partner during pregnancy		
No	Referent	
Yes	**4.79 (1.32, 17.4)**	
Marital Status		
Unmarried	**2.01 (1.32, 3.05)**	
Married	Referent	
Mother's education		
<12 years	**1.84 (1.19, 2.84)**	
>=12 years	Referent	
WIC(f)		

No	Referent
Yes	**2.01 (1.33, 3.05)**
Pregnancy intention(g)	
Intended	Referent
Mistimed	1.31 (0.84, 2.06)
Unwanted	**1.70 (1.19, 2.44)**
Prenatal Start	
1st/2nd Trimester	Referent
3rd Trimester/never	3.06, 1.3 (7.24)
Number Prenatal Visits	
None	11.2 (2.2, 56.2)
≥1	Referent
Birth Place	
U.S. or Canadian born	Referent
Foreign born	1.31 (0.91, 1.87)
Maternal Smoking	
No	Referent
Yes	1.55 (0.83, 2.90)
Maternal Alcohol Use	
None	Referent
≥1 drink per week	2.18 (0.51, 9.32)
Exclusive Breastfeeding at 8 weeks	
No	Referent
Yes	0.66 (0.42, 1.05)
Activity after pregnancy	
No	1.32 (0.84, 2.07)
Yes	Referent
Previous Live Births	
No	Referent
Yes	1.29 (0.85, 1.95)
Previous Terminations	
None	Referent
≥1	1.02 (0.97, 1.08)
Previous Pregnancy Losses	
No	Referent
Yes	1.36 (0.86, 2.16)
County of Residency	
Rural	Referent
Urban	1.07 (0.42, 1.05)

(a) Statistically significant values in bivariate analysis. All of these variables were included in the full multivariate model.

(b) Results of the final multivariate model. Those variables that do not have values listed were removed from the model during analysis.
(c) Includes Hispanic, Non-Hispanic Black, Non-Hispanic American Indian, Non-Hispanic Asian/Pacific Islander
(d) Includes 0-49% FPL, 50-99% FPL, 100-199% FPL and 200-299% FPL
(e) Insufficient dental care refers to women who reported that they needed dental care during pregnancy but did not seek it.
(f)Enrollment in the Women ,Infants, and Children program during pregnancy
(g) Intended includes women who wanted to be pregnant sooner or women who wanted to be pregnant then, mistimed includes women who wanted to be pregnant later, unwanted includes women who did not want to be pregnant then or any time in the future

Discussion

Objective 1: Prevalence of PDS

The reported prevalence of PPD in prior studies has been 12-17% (3, 7-15), with the most current meta-analysis estimate at 13% (17). The overall prevalence in my study (as determined by PDS) was 13.2%. Specifically, the prevalence of PDS for subcategories of race and ethnicity groups was as follows: Non-Hispanic Whites (11.5%), Hispanics (17.4%), Non-Hispanic Blacks (21.6%), Non-Hispanic American Indian (20.%) and Non-Hispanic Asian/Pacific Islander (15.8%). Huang and colleagues, using information derived from a longitudinal birth cohort study, have the first (and only) study to present national estimations of the burden of PPD by multiple race and ethnic groups (6). The study evaluated three severities of depression: mild, moderate and severe. Women reporting severe symptoms were as follows: Non-Hispanic White (14.6%), Hispanics (14.8%), Non-Hispanic Black (25.5%), Non-Hispanic Asian (15.7%), Pacific Islander (11.4%) (6). Two differences make direct comparison between this study and Huang and colleagues' challenging. First, Huang and colleagues evaluated depressive symptoms by severity while our study categorized depressive symptoms into a binary outcome. The second challenge that makes comparison

somewhat difficult is that Huang and colleagues evaluated Asian and Pacific Islander women as separate categories. In our study, the percentage represented by Asian women is not distinct from Pacific Islander women. However, given Oregon demographics, the population of Asian women is considerably higher than Pacific Islander women, therefore, the very similar estimates among the Huang study and our study becomes relevant. Regarding outcome, it is reasonable to assume that women who responded always or frequently were likely having more severe depressive symptoms than women who responded sometimes, rarely or never. Given this, the prevalence of PDS by race and ethnicity was comparable to what Huang and colleagues report for severe depressive symptoms among subgroups, particularly among Asian women. The difference between Hispanics and NH White women was considerably less. The trends for racial and ethnic subgroups was similar with the highest percentage of PDS among NH Blacks, followed by Hispanics, then Asian women, Pacific Islander and finally NH Whites.

Objective 2: Risk factors for PDS

BMI, Partner-related Stress and Insufficient Dental Care

In multivariate analysis, this study found five significant risk factors for PDS. Three of these results have been found elsewhere: pre-pregnancy maternal BMI$\geq$ 25 m/kg^2, lower income, and partner-related stress. In my study, women who were either obese or overweight had a significantly higher risk for PDS (OR 1.70; 95 % CI 1.07, 2.70) as compared to women who were normal weight or underweight. LaCoursiere and colleagues, in a recent study using PRAMS in

Utah, found a two-fold increase in “self-reported depressive symptoms” among overweight and obese women (37). In their study, “self-reported depressive symptoms” referred to whether a woman reported she had postpartum feelings of depression or not. LaCoursiere and colleagues discuss factors such as pre-existing negative body image and/or lower self-esteem as contributing factors to overweight and obese women having a higher risk for PDS. Future research on overweight and obese women and PDS would be important.

My study found that partner-related prenatal stress (see table 4 for definition) was significantly associated with PDS (OR 3.44; 95% CI 2.14, 5.54). Partner-related stress as an independent variable has not been extensively analyzed. Rather, it is often intertwined with a broader context of social support and physical abuse and may be actually be a proxy for these factors, which have been associated in prior studies with increasing the risk for PDS (10-15, 35-37). Further exploration of a partner’s role in PDS, as well as a more concrete definition of this variable is important and should be included in future analysis.

Insufficient dental care as a potential risk factor has not been previously evaluated in the literature. In this study, women who had insufficient prenatal dental care had almost a two-fold risk (OR 1.93; 95% CI 1.08, 3.45) of developing PDS as compared to women who did. The clinical relationship of dental care and PDS is difficult to elucidate for a few reasons. The perception of dental needs is very subjective and will vary considerably between women. Perhaps dental care can be considered a proxy for more subjective characteristics of a woman, such as low self-esteem. A woman with less self-esteem may be less

likely to seek needed dental care if it does not pose an immediate discomfort for her (64). There are limited studies on the relationship between dental care and pregnancy and virtually none on the postpartum period. Lydon-Rochelle and colleagues state that 21% of women reported that they had dental problems during pregnancy but did not receive dental care (65). Another study found that young women, women in poverty, and women with Medicaid coverage were at increased risk of not having a dentist visit during pregnancy (66). Gaffield and colleagues, using PRAMS from four states, found similar results: that among women who reported having a dental problem during pregnancy, there was a modest increase in risk of dental care under-use associated with women who lived in poverty, had Medicaid coverage, and had late-onset prenatal care (67). Clearly, insufficient dental care occurs during pregnancy and according to this study, may indicate an increased risk for PDS. A better understanding of this relationship is warranted through future research.

Income Level

This study found that women living at the lowest income level (≤49% FPL) were at the highest risk for PDS and that the prevalence of PDS decreased as FPL increased. This finding was not surprising as low income status has been a well-documented risk factor for PPD and PDS (14, 68). Low income is thought to be a risk factor for several reasons. According to Segre and colleagues, low-income women face challenges such as substandard housing, limited or no health care access, inadequate schools for their children, exposure to increased crime and other life stresses associated with financial limitations (68). An additional infant

increases the burden on women with already limited finances and resources (68). Yet, not all women in the lowest income groups were depressed; nearly 60% of women living below $10,000 per year were not depressed. In this study, approximately 75% of women living at the lowest income level were not experiencing PDS. The fact that not all women in these lower income levels experience depression or symptoms suggest that low-income status may not be sufficient to explain the development of depressive symptoms (68). Despite this, it is important to recognize the impact of poverty on PDS, since women who are poor face a negative feedback dynamic; depression can make it more difficult to be motivated to work to improve their financial situation (68).

Non-White Race and Ethnicity

This study found that non-White women had a 17% increased risk for PDS as compared to NH White women. The proportion of non-White women in Oregon is considerably less than the U.S. population (table 9). An increased risk for non-White women may be due to differences in income level, cultural factors, and perceptions of PDS or health care in general (42, 46, 49, 69-71). For example, studies have found that, regarding health care in general, non-White women are more likely to perceive bias and lack of cultural competence when seeking treatment in the health care as compared to non-Hispanic Whites (69). Specifically, dissatisfaction regarding the quality of interrelationship and interpersonal care by physicians and the health care system in general has been reported for non-White race and ethnic groups (49). As a result, mental health service utilization among minorities who have mental health needs is lower than

non-minorities (49, 69). One study found that Blacks and Hispanics may have more negative perceptions about antidepressant medication compared to Whites (72). Similarly, Blacks were less likely to feel counseling was beneficial for depression while Hispanics were more likely than Whites to feel this was the case. Blacks were more likely than Whites or Hispanics to believe that prayer was more healing and to seek a health care professional of the same race and ethnicity (72). Regarding PDS, Chaudron and colleagues found that the recognition of PDS was different between Hispanic mothers and health professionals. Specifically, they found that different cues to describe PDS were used contributing to miscommunication (49). Johnson and colleagues found that Asian respondents felt that physicians look down on them and the way they live their lives, inhibiting women from discussing sensitive issues (69). Halbreich and colleagues state that socio-economic environmental factors subject to culture-specific standards that may influence reporting styles across ethnic groups include pre and postnatal access to healthcare; quality of care available; religious customs; nutrition; actual or perceived levels of social support; poverty or its perception; stress; attitudes regarding pregnancy and motherhood; gender roles; attitudes regarding mental disease and biological vulnerability and factors (42). Clearly, these cultural, environmental and perception differences may explain some of the variance in PDS prevalence rates reported in previous literature and my study.

Table 9: Demographic Characteristics: Oregon vs. United States

Characteristics	Oregon	U.S.
Population estimate	3,700,758	299,398,484

Female Persons (%)	50.3	50.7
White persons (%)	90.5	80.1
Black (%)	1.9	12.8
American Indian and Alaska Natives (%)	1.4	1.0
Asian (%)	3.6	4.4
Native Hawaiian and Other Pacific Islander (%)	0.3	0.2
Hispanic (%)	10.2	14.8
Non-Hispanic White (%)	81.0	66.4
Foreign born (%)	8.5	11.1

*From U.S. Census Bureau

Objective 3: Race and Ethnicity

Black, Hispanic and American Indian

This study found that, when adjusting for other risk factors, including income, women of non-Hispanic Black and Hispanic race/ethnicity did not demonstrate a significantly increased risk for PDS. Most prior studies report only the prevalence of PPD or PDS comparing Black, Hispanic and White women, and do not report risk ratios. Studies have found that among Black and Hispanic women, the higher prevalence of PDS (as compared to White women) becomes less significant when adjusting for socio-demographic factors (41, 73). Beeghly and colleagues found that, after adjusting for single marital status and low-income status, the prevalence was not higher among Black women as compared to White women (40). Determining the actual relationship between race/ethnicity and PDS or PPD is difficult since there is often overlap between women who are lower income and Black or Hispanic women (42). Other confounders reported in the association between Black and Hispanic women and PPD include higher levels of stress, lower levels of self-esteem and social support and higher religiosity (41).

Surkan and colleagues found an inverse relationship between greater social networks and social support and having PDS among Black women (74). This study was able to adjust for income and prenatal stress, but not for self-esteem, social support and higher religiosity.

Similarly, this study did not find a significant association between non-Hispanic American Indian women and PDS. I found no other studies evaluating this group of women and therefore could not make any comparisons.

Asian/Pacific Islander Women

This study found that when adjusting for other risk factors, Asian/Pacific Islander women were the only subcategory of race/ethnicity to demonstrate a significantly increased odds ratio for PDS. Specifically, Asian/Pacific Islander women had almost twice the odds of developing PDS as compared to Non-Hispanic White women. Unfortunately, comparing this data to other studies is difficult because there are very few studies evaluating the prevalence or risk of PPD or PDS for Asian/Pacific Islander women. An exception is the study by Huang and colleagues that reported that (in the U.S.) for severe depressive symptoms, there was a prevalence of 15.7% in Asian women and 11.4% in Pacific-Islander women. Among Asians, Chinese, Filipino, Japanese and Korean immigrants had a higher prevalence of PDS as compared to Whites (6). Huang and colleagues included analysis of U.S.-born and foreign-born women and found that there was a higher prevalence of PDS reported among foreign-born women (6). Women born abroad, and faced with a new environment, possible social isolation as well as a new baby may have a different perspective and therefore

report differently than a woman born in the U.S. who does not face these additional challenges (6,74). The birth-place of a woman was not a significant risk factor in this study, yet there might be interaction between race/ethnicity and birth place that needs further investigation.

My study, similar to the study by Huang and colleagues, found that the prevalence of PDS was lower among NH Asian/Pacific Islander women as compared to NH Black and Hispanic women. The reason for this difference between race/ethnicity may be attributable to cultural factors. Asian women may express emotional complaints by describing more somatic symptoms while other women may describe more affective symptoms, therefore prevalence may be under-reported in Asian/Pacific Islander women as compared to other race and ethnic subgroups (46, 70). Also, psychological meaning may be different for Asian/Pacific Islander women and simply translating language does not take into account how questions and answers may be understood, leading to under-represented reporting (42, 71). This may be especially true in self-reporting surveys, such as PRAMS. However, when evaluating subcategories in multivariate analysis, the risk was higher for Asian/Pacific Islander women than for other race and ethnic groups. The reason for this is unclear. Perhaps there are more profound cultural factors, which inadvertently create added stress during postnatal transition, contributing to increased risk for depressive symptoms. Clearly, understanding cultural perceptions of motherhood and PDS among Asian/Pacific Islander women may be useful to better elucidate this relationship.

Why are Asian/Pacific Islander Women at higher risk for PDS?

Asian/Pacific Islander women had a risk of PDS 90% higher than Non-Hispanic White women. There are several possible reasons why this might be the case. According to my study, approximately 77.8% of Asian/Pacific Islander women were not born in the U.S. Huang and colleagues found that among Asian/Pacific Islander women, those who had immigrated to the U.S. reported more PDS than those who were born in the U.S. There are likely cultural factors that contribute to this higher risk. Examples of cultural factors include differences in the perception of mental health, interpretation of symptoms, expectations of motherhood, relationship with extended family, and unique traditions and rituals associated with the postpartum period.

For example, Hau and colleagues found that Chinese women in Hong Kong reported similar symptoms of PPD with the exception of "phantom crying"—hearing the baby cry when the baby was sound asleep (45). Often, "unhappy" feelings were attributed to a non-caring husband as well as controlling and powerful in-laws (45). Lee et al. found that commonly identified risk factors for PPD among Chinese women were conflict with a mother-in-law, marital dissatisfaction; past depression and antenatal depression independently predicted the occurrence of postnatal depression (75). In a study done by Chan et al., Chinese women diagnosed with PDS were reluctant to obtain treatment possibly due to a Chinese belief that mental disorders may confer an inability to solve problems or represent behavior that is out of control and ultimately can bring shame to the family (43). For 93% of women, PPD was the first encounter with mental illness (46). Holroyd and colleagues describe the traditional expectation of

following a prescribed set of rules in the month following childbirth referred to as "doing the month" (76). Women following this tradition are restricted to the home (often with the mother-in-law) and are expected to eat only certain foods and avoid wind, exercise and washing their hair (44,76). Although this ritual and others may include receiving support from family members and relatives, women sometimes felt that these rituals actually increased PDS, especially for non-traditional women who were not working at home. The expectation to fall into a certain role as mother (to rear the children and take care of the home) also increased PDS (44).

Kim et al. states that Korean mothers scored high on the EPDS or BDI and were less likely to seek help for PPD because depression was considered a normal part of mothering—that is to feel sadness, frustration, anger and anxiety was not considered unusual. Furthermore, it is an expectation that to be a mother also means the end of "easy free days" and the beginning of responsibility and hard work (77). Similarly, Korean women may be less likely to present with PPD to a physician because there is strong family support. Large families provide support and often work together in times of crisis. In some cases, the extended family may step in to take a more active role in the baby's care if it appears necessary, thereby decreasing the apparent need to seek professional help. If women did seek help, often they preferred traditional oriental medicine treatment or help from an obstetrician to relieve symptoms (77). Kim and colleagues state that Korean mothers were found to report depressive symptoms as somatic symptoms rather than affective symptoms, as would more be more commonly seen in Western

cultures. Furthermore, a postpartum mood disorder is referred to by a name, “sanhupung”, and considered a pain syndrome thought to be caused by inadequate post-partum care. Described pain symptoms include joint pain and stiffness, chills, chest tightness, headache, numbness, sleep disturbance, tiredness, dizziness and anxiety. According to this belief, if “sanhupung” develops, it indicates that a mother needs more nutrition and that she needs to receive more family support and help. Although there have been changes in traditional roles and women have increased direct expression of feelings, the profound traditional customs and beliefs concerning childbirth and postpartum care are still very present among Korean mothers (77).

Yoshida et al. discuss PPD among Japanese women. Perceptions of marriage, childbearing and social support are different than in Western cultures and that it is common for women to stop working when they get married. Often a woman’s family is more likely to provide the majority of social support after childbirth (70). Halbreich et al. state that Japanese women may be more likely to accept physical and psychological discomfort for the infant’s well being because of high importance placed on the future of the family generations and increased status associated with a healthy baby (42). Demonstrating emotion is associated with weakness of the mind and often people are encouraged to suppress personal difficulties (42).

These examples regarding perceptions of motherhood, PPD and postpartum care provide important insight into cultural influences, which is important for physicians to be aware of. Moreover, there are 5.6 million Asian

and Pacific Islander women who reside in the U.S. who represent nearly 50 countries or ethnic groups and speak over 100 different languages and dialects (47). This large subgroup is diverse in many ways, including income, culture, and history and yet the literature on this broad categorization of women remains incomplete (47).

Limitations

There were several limitations to this study. In order to complete the written survey, women must be literate, have sufficient time and be physically able or have help (e.g., from a family member). This may have led to a bias since the survey was sent to women's homes and required all of these factors to be in place for completion. The sample may have been overly represented by women who were more educated and had higher income or more fluent English. Women with risk factors such as lower income may have been less likely to complete the survey due to insufficient time or other responsibilities. Given that lower income was found as a risk factor for PDS, this under-representation may under-estimate the odds ratio. However, PRAMS includes non-response in the weighting process, which accounts for women who may be less likely to respond and may help counteract this potential bias. For those women who cannot read, administering the survey by telephone is an alternative method to obtain the information. Yet, there may be discrepancy between women who answer directly and women who self-report. Since most surveys were returned by women by mail, this likely did not have a significant effect. Similarly, women who are depressed may have been

less likely to respond to the survey and this also could have led to an under-estimation of PDS.

Information bias may have occurred, particularly given that the survey is only provided in two languages. Women are not fluent in English may misunderstand questions regarding risk factors and outcome. Similarly, interpretation of risk factors and the outcome may vary depending on culture and health perspective. This may have led to misclassification, which would have likely been non-differential. Women who have more English will be more likely to answer the survey, and therefore those responding may not be immigrant women. Given that Huang and colleagues found that women who were born abroad were more likely to have PDS (6), this suggests that there may be an under-estimation of risk among Oregon Asian/Pacific Islander women given the large population of immigrant women. It is possible that foreign-born Asian/Pacific Islander women were not as likely to answer the survey. Similarly, if there is a discrepancy between the Asian/Pacific Islander women represented by PRAMS and the overall Oregon population of women of Asian/Pacific Islander immigrant women, then the odds ratio may again under-estimate the risk for this population of women in Oregon.

Another limitation is that the survey is sent 2-4 months after birth. According to the DSM-IV, postpartum depressive symptoms can develop at any time, including one month after childbirth or later than 4 months postpartum. Therefore, there may have been women who responded to the survey prior to

developing symptoms and this would under-estimate the prevalence and effect risk measurements.

Recall bias is a concern given questions about prenatal information after giving birth and perceptions may have changed. For example, a woman who may not have wanted a baby prior to being pregnant may answer differently now that she has chosen to have and keep her baby. PRAMS was not able to account for women with a history of depression that was unrelated to pregnancy. A history of non-pregnancy related depression has been found to be significantly associated with PPD, and would be important to include in future analysis (38). Like any cross-sectional study, determining a clear causal relationship between risk factors and the outcome is not possible. For most factors, the questions clearly indicated the timing of feelings or factors. However, for some of the predictors, this may be more difficult. For example, antenatal depressive symptoms and PDS are so co-linear that determining a temporal relationship may not be valid.

As mentioned above, the Asian and Pacific Islander subgroup of women is comprised of many diverse cultures and having one broad category does not provide sufficient information to develop in depth understanding of risks for subgroups of women. Most data aggregate measures should be considered carefully given the wide diversity among this group of women (47). Knowing that there is an increased risk among this subgroup is important in guiding more specific research for this group in the future. Future studies, including with PRAMS, should consider further subdividing this broad category of women.

Finally, given the variable PDS was a proxy variable for PPD, I can only determine the risk factors for women who report PDS and cannot presume that they are experiencing PPD. However, as mentioned in the introduction section, Whooley and colleagues found that two questions (similar to the two used in PRAMS) had similar sensitivity and specificity to a screening tool for PPD, indicating that women reporting PDS are likely experiencing PPD (2).

Public Health Implications

PPD is an important maternal and child health concern as it can have adverse consequences for mother, child and family. Although there has been a wealth of literature and information about women and PPD, there is still deficiency in screening. This is in large part due to physicians not feeling properly trained and that there are no universal recommendations for who should screen. Improving screening training and implementing universal recommendations, perhaps through the U. S. Task Force, as is done for other diseases would be beneficial. Similarly, increased public health campaigns to decrease the social stigma associated with PPD would be important. Currently, much is being done, both at the Oregon Department of Public Health and through organizations such as Postpartum Support International to address this issue, and continued work on this is essential. Given that Asian/Pacific Islander women are at higher risk for PDS, informing organizations that work closely with immigrant women, particularly during pregnancy may be important.

One challenge to improving recognition is to remove barriers primary care providers face in PPD screening. Several suggestions have been proposed to

combat these challenges. For example, education could be improved by providing credible, focused, and convenient mechanisms such as web-based courses or links to established websites like Postpartum Support International, simultaneously providing continuing medical education (CME) credit (61). Another approach is for professional organizations to advocate and take more responsibility for improving clinical practice of its members in the problem of PPD. Currently, there are no mandates for continuing education of PPD by the Academy of Obstetricians and Gynecologists (ACOG) or the American Academy of Pediatrics (AAP). Government organizations should also be involved in raising awareness among primary care providers about PPD. For example, the National Institute of Mental Health and the Department of Health and Human Services have taken a leadership role in increasing funding for research on PPD through senate bills as well as calling for proposals from small businesses to develop educational programs for primary care providers about PPD. Lastly, the Joint Commission of Accreditation of Hospitals should require certification of competence in the care of patients with PPD by providers of inpatient maternity care. As studies have shown, these interventions promise to increase the screening and treatment of women with PPD in clinical settings (61).

Future Research

There are many questions that have been generated by this study which could be translated into future endeavors. First, it would be important to validate the 2004 findings with another year of PRAMS. This can be done easily and would strengthen the results of this study. Secondly, it would be important to see

if the association is consistent with other datasets, particularly those using different methodologies. Thirdly, it would be interesting to further evaluate the relationship between nativity and PPD among Asian/Pacific Islander women and to stratify by subgroup and birthplace. A study done in 2001, evaluating nativity and health status by national origin, found the health of certain Asian and Pacific Islander groups (women and men), notably Pacific Islanders and Vietnamese, to be less favorable than average, and that this health status declined with duration of residence in the U.S. (78). Engaging in qualitative studies evaluating specific cultural risk factors associated with Asian/Pacific Islander subgroups for PPD would be beneficial.

Another interesting question would be to explore the relationship between weather, precipitation and PPD in Oregon. Oregon is known for many rainy and short winter days. Finally, determining the risk for PDS among subgroups of Asian/Pacific Islander women is crucial given the extreme diversity among this group.

Conclusions

This study analyzed the prevalence and predictor variables for PDS in a sample of Oregon women. Based on the results, the prevalence of PDS in Oregon reflects prior research. Three risk factors found to be significant were similar to what has been found in prior literature. The new risk groups found were insufficient dental care and Asian/Pacific Islander women. All other race and ethnic groups (White, Black, Hispanic and American Indian) did not have statistically significantly increased odds ratio for PDS after adjusting for income,

maternal BMI, insufficient dental care and partner-related stress. These results suggest that other factors increase the risk for PDS among Asian/Pacific Islander women. These factors may likely be cultural, but need to be further elucidated.

The U.S. population is extremely diverse and representative of many international ethnicities and cultures. It is important to understand the prevalence and risk of general and mental health disorders of all race and ethnic groups represented in the U.S. in order to ensure every woman is carefully screened and treated for in a culturally competent and consistent manner. According to the Office of Minority Health, cultural competence is "the ability of health care providers and health care organizations to understand and respond effectively to the cultural and linguistic needs brought by patients to the health care encounter" (69). According to the U.S. Census Bureau, there is a steady increase diverse population of women in the U.S. and this translates to a need for health care providers to evaluate, treat and work with patients of ethnically diverse populations. Understanding the socio-cultural factors influencing diverse groups of women is important for ensuring adequate identification, diagnosis and treatment of PPD in all women.

I have found limited research on risk ratios for PPD among various race and ethnic groups, particularly Asian/Pacific Islander women. As a result of limited epidemiological research, the status of PPD Asian and Pacific Islander women is largely unknown. This study is important because it has expanded upon limited data available regarding the health of Asian and Pacific Islander women. Although many prior studies have revealed important information about

prevalence and risk factors for PPD or PDS, they are based on clinical samples and test discrete risk factors and are therefore limited in their generalizability. The strength of this study is that it analyzes a population-based sample that is weighted to reflect the Oregon population of pregnant women improving the ability to generalize to broader populations with similar demographics. Additional insight into targeted screening and intervention for PDS is a very important public health issue because it means better health for women, children and families in Oregon.

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, D.C.: American Psychiatric Association, 1994.

2. Whooley MA, Avins AL, Miranda J, Browner WS. Case-Finding Instruments for Depression: Two Questions Are as Good as Many. J Gen Intern Med 1997; 12: 439-445.

3. Beck, CT. The Lived Experience of Postpartum Depression: A Phenomenological Study. Nurs Res 1995; 41:166-170

4. Hatton, DC, Harrison-Hohner J, Coste S, Korato V, Curet L, McCarron. Symptoms of Postpartum Depression and Breastfeeding. J Hum Lact 2005; 21: 444-449.

5. Leahy-Warren, P, McCarthy G. Postnatal Depression: Prevalence, Mothers' Perspectives, and Treatments. Arch Psychiatr Nurs 2007; 21: 91-100

6. Huang ZJ, Wong FY, Ronzio, CR, Yu, SM. Depressive Symptomology and Mental Health Help-Seeking Patterns of U.S.-and Foreign-Born Mothers. Maternal Child Health Journal 2007; 11: 257-267.

7. Epperson, C. Post-partum Major Depression: Detection and Treatment. Am Fam Physician 1999; 59: 2247-2262.

8. Center for Disease Control and Prevention. PRAMS and Postpartum Depression. 2000.

9. Wisner, K. other authors. Postpartum Depression, Clinical Practice. N Engl J Med 2002; 347: 194-199

10. Righetti-Veltema M, Conne-Perreard E, Bousquet A, Manzano J.Risk Factors and Predictive Signs of Postpartum Depression. J Affect Disord 1998; 49: 167-180.

11. Dennis C, Janssen P, Singer, J. Identifying Women At-risk for Postpartum Depression in the Immediate Postpartum Period. Acta Psychiatr Scand 2004; 110: 338-346.

12. Nida JR, DePersio SR, Lorenz RR, DeCoster E, Thomas W, Rhoades E, Ronck S. Depression After Delivery Among Oklahoma Mothers. PRAMSGRAM prepared by Maternal & Child Health Service, Oklahoma State Department of Health 1995; 5: 1-4.

13. Patel RV, Larrieux C, Grigorescu V, Bouraoui Y, Paterson D. Postpartum Depression Among Michigan Women. MI PRAMS Delivery prepared by Family and Community Health, Michigan Department of Community Health 2004; 3: 1-4.

14. Beck CT. Predictors of Postpartum Depression: An Update. Nurs Res 2001; 50: 275-285.

15. Gross KH, Wells CS, Radigan-Garcia A, Dietz PM. Correlates of Self-Reports of Being Very Depressed in the Months After Delivery: Results From the Pregnancy Risk Assessment Monitoring System. Maternal and Child Health Journal 2002; 6: 247-253

16. Wood, AF, Thomas SP, Droppleman PG, Meighan,M. The Downward Spiral of Postpartum Depression. Maternal Child Nursing 1997; 22: 308-316.

17. Horwitz SM, Briggs-Gowan MJ, Storfer-Isser A, Carter AS. Prevalence, Correlates, and Persistence of Maternal Depression. Journal of Women's Health 2007; 16: 678-691

18. O'Hara MW, Swain AM. Rates and Risk of Postpartum Depression: A meta-analysis. International Review of Psychiatry 1996; 8: 37-54.19.

19. O'Hara MW, Swain AM. Rates and Risk of Postpartum Depression-A Meta-analysis. Int Rev Psychiatr 1996; 8: 37-54.

20. McLearn KT, Minkovitz CS, Strobino DM, Marks E, Hou W. The Timing of Maternal Depressive Symptoms and Mothers' Parenting Practices with Young children: Implications for Pediatric Practice. Pediatrics 2006; 118: 174-182.

21. Minkovitz CS, Strobino D, Scharfstein D. Maternal Depressive Symptoms and Children's Receipt of Health Care in the First Three Years of Life. Pediatrics 2005; 15: 306-314.

22. Beck CT, Records K, Rice M. Further Development of the Postpartum Depression Predictors Inventory-Revised. JOGNN 2006; 35: 735-745.

23. Gregoir AJ, Kumar R. Everitt B, Henderson AF, Stuff JW. Transdermal Estrogen for Treatrment of Severe Postnatal Depression. Lancet 1996; 347: 930-933.

24. Whiffen VE. The Comparison of Postpartum with Non-postpartum Depression: A Rose by Any Other Name. J Psychiatr Neurosci 1991; 16: 160-165.

25. Bernstein IH, Rush AJ, Yonkers K, Carmody, T, Woo A, McConnell K, Trivedi, MH. Symptom Features of Postpartum Depression: Are They Distinct?

Depress Anxiety 2008; 25: 20-26

26. Cooper PJ, Murray L. Course and Recurrence of Postnatal Depression. Evidence for the specificity of the diagnostic concept. Br J Psychiatry 1995; 166: 191-195.

27. Engqvist I, Nilsson A, Nilsson K, Sjöström B. Strategies in Caring for Women with Postpartum Psychosis: An Interview Study with Psychiatric Nurses. J Clin Nurs 2007; 16 :1333–1342.

28. Dennis CE. Preventing Postpartum Depression: A Review of Biological Interventions. Can J Psychiatry 2004; 49: 467-475.

29. Wisner KL, Parry BL, Piontec CM. Postpartum Depression. N Engl J Med 2002; 347: 194-199.

30. Sichel DA, Cohen LS, Robertson LM, Ruttenberg A, Rosenbaum JF. Prophylactic Estrogen in Recurrent Postpartum Affective Disorder. Biol Psychiatry; 38: 814-818.

31. Hendrick V, Altshuler L. Suri R. Hormonal Changes In The Postpartum And Implications For Postpartum Depression. Psychosomatics 1998; 39: 93-101

32. O'Hara MW, Schlechte JA, Lewis DA, Varner MW. Controlled Prospective Study of Postpartum Mood Disorders: Psychological, Environmental and Hormonal Variables. J Abnorm Psychol 1991; 100: 63-73

33. Harris B, Johns S, Fung H, Thomas R, Walker R, Read G, Riad-Fahmy D. The Hormonal Environment of Post-natal Depression. Br J Psychiatry 1989:154: 660-667

34. Neugebauer R, Kline J, O-Connor P, Shrout P, Johnson J, Skodol A, Wicks J, Susser, M. Determinants of Depressive Symptoms in the Early Weeks after Miscarriage. Am J Public Health 1992; 82: 1332-1339

35. Howell EA, Mora P, Leventhal, H. Correlates of Early Postpartum Depressive Symptoms. Maternal and Child Health Journal 2006; 10: 149-157.

36. Hung C. Predictors of Postpartum Women's Health Status. Journal of Nursing Scholarship 2004; 36: 345-351.

37. LaCoursiere DY, Baksh L, Bloebaum L, Varner MW. Maternal Body Mass Index and Self-Reported Postpartum Depressive Symptoms. Maternal and Child Health Journal 2006; 10: 385-390.

38. Mancini F, Carlson C, Albers, L. Use of the Postpartum Depression Screening Scale in a Collaborative Obstetric Practice. J Midwifery Women's Health 2007;52:429-434.

39. Lee AM, Lam SK, Lau SM, Chong CS, Chui HW, Fong DY. Prevalence, Course, Risk Factors for Antenatal Anxiety and Depression. Obstet Gynecol 2007;110:1102-1112.

40. Beeghly M, Olson KL, Weinberg, MK, Pierre SC, Downey N, Tronick EZ. Prevalence, Stability, and Socio-Demographic Correlates of Depressive Symptoms in Black Mothers During the First 18 Months Postpartum. Maternal Child Health Journal 2003; 7: 157-168.

41. Jesse DE, Walcott-McQuigg J, Mariella A, Swanson MS. Risks and Protective Factors Associated With Symptoms of Depression in Low-Income African American and Caucasian Women During Pregnancy. J Midwifery Women's Health 2005; 50: 405-410.

42. Halbreich U, Karkun S. Cross-cultural and Social Diversity of Prevalence of Postpartum Depression and Depressive Symptoms. J Affect Disord 2006; 91:97-111.

43. Chan S. Postnatal Depression: A Qualitative Study of the Experiences of a Group of Hong Kong Chinese Women. Journal of Clinical Nursing 2004; 13: 120-123.

44. Leung S, Martinson IM, Arthur D. Postpartum Depression and Related Psychosocial Variables in Hong Kong Chinese Women: Findings from a Prospective Study. Res Nurs Health 2005; 28: 27-38.

45. Hau FWL, Levy VA. The Maternity Blues and Hong Kong Chinese Women: an Exploratory Study. J Affect Disord 2003; 75: 197-203.

46. Lee D, Yip A, Chiu H, Leung T, Chung T. A Psychiatric Epidemiological Study of Postpartum Chinese Women. Am J Psychiatry 2001; 158: 220-226.

47. Ro M. Moving Forward: Addressing the Health of Asian American and Pacific Islander Women. Am J Public Health 2002:92:516-519.

48. Josefsson A, Sydsjo G. A Follow-up Study of Postpartum Depressed Women: Recurrent Maternal Depressive Symptoms and Child Behavior After Four Years. Arch of Womens Ment Health 2007; 10: 141-145.

49. Chaudron LH, Kitzman HJ, Peifer KL, Morrow S, Perez LM, Newman MC. Self-Recognition of and Provider Response to Maternal Depressive Symptoms in Low-Income Hispanic Women. Journal of Women's Health 2005; 14: 331-338.

50. Hay DF, Pawlby S, Angold A, Harold GT, Sharp D. Pathways to Violence in the Children of Mothers who were Depressed Postpartum. Dev Psychol 2003; 39: 1083-1094.

51. Hay DF, Pawlby S, Sharp D, Asten P, Mills A, Kumar R.. Intellectual Problems Shown by 11–year old Children Whose Mothers had Postnatal Depression. J Child Psychol Psychiatry 2001; 42: 871-889.

52. Chaudron LH, Szilagyi PG, Kitzman HJ, Wadkins HI, Conwell Y. Detection of Postpartum Depressive Symptoms by Screening at Well-Child Visits. Pediatrics 2004; 113: 551-558.

53. Wiley CC, Burke GS, Gill PA Law NE. Pediatricians' Views of Postpartum Depression: A Self-administered Survey. Arch Womens Ment Health 2004; 7: 231-236.

54. Olson AL, Kemper KJ, Kelleher KJ, Hammond CS, Zuckerman BS, Dietrich AJ. Primary Care Pediatricians' Roles and Perceived Responsibilities in the Identification and Management of Maternal Depression. Pediatrics 2002; 110: 1169-1176.

55. Seehusen DA, Baldwin LM, Runkle GP, Clark G. Are Family Physicians Appropriately Screening for Postpartum Depression?. JABFP 2005; 18: 104-112.

56. Cox JL, Holden JM,, Sagovsky R. Detection of Postnatal Depression: Development of the 10-item Edinburgh Postnatal Depression Scale. Br J of Psych 1987; 150: 782-786.

57. Beck CT. Postpartum Depression: It Isn't Just the Blues. American Journal of Nursing 2006; 106: 40-50.

58. Santos S, Matijasevich A, Tavares BF, da Cruz Lima AC, Riegel RE, Lopes BC. Comparing Validity of Edinburgh Scale and SRQ20 in Screening for Post-partum Depression. Clin Pract Epidemol Ment Health 2007; 3: 18

59. American Academy of Pediatrics Committee on Drugs. Transfer of Drugs and Other Chemicals into Human Milk. Pediatrics 2001: 108: 776-89.

60. Connelly CD, Baker MJ, Hazen AL, Mueggenborg MG. Pediatric Health Care Providers' Self-Reported Practices in Recognizing and Treating Maternal Depression. Pediatr Nurs 2007; 33: 165-172.

61. Logsdon MC, Wisner K, Billings DM, Shanahan B. Raising Awareness of Primary Care Providers About Postpartum Depression. Issues in Mental Health Nursing 2006; 27: 59-73.

62. Center for Disease and Prevention. http://www.cdc.gov/prams/Examples.htm. Washington, DC. CDC year

63. Ahluwalia IB, Merritt R, Beck LF, Rogers M. Multiple Lifestyle and Psychosocial Risks and Delivery of Small for Gestational Age Infants. Obstet Gynecol 2001; 97: 649-56.

64. Anttila S, Knuuttila M, ylostalo P, Joukamaa M. Symptoms of Depression and Anxiety in Relation to Dental Health Behavior and Self-perceived Dental Treatment Need. Euro J Oral Sci 2006;114:109-114.

65. Lydon-Rochelle MT, Krakowiak MS, Hujoel PP, Peter RM. Dental Care Use and Self-Reported Dental Problems in Relation to Pregnancy. Am J Public Health 2004; 94: 765-771

66. Mangskau KA, Arrindell B. Pregnancy and Oral Health: Utilization of the Oral Health Care System by Pregnant Women in North Dakota. Northwest Dent 1996; 75: 23-28.

67. Gaffield ML, Gilbert BJC, Malvitz DM, Romaguera R. Oral Health During Pregnancy: An Analysis of Information Collected by the Pregnancy Risk Assessment Monitoring System. JADA 2001; 132: 1009-1016.

68. Segre LS, O'Hara MW, Arndt S, Stuart S. The Prevalence of Postpartum Depression: The Relative Significance of Three Social Status Indices. Soc Psychiatry Psychiatr Epidemiol 2007; 42: 316-321.

69. Johnson RL, Saha S, Arbelaez JJ, Beach MC, Cooper LA. Racial and Ethnic Differences in Patient Perception of Bias and Cultural Competence in Health Care. J Gen Intern Med 2004; 19: 101-110.

70. Yoshida K, Marks MN, Kibe N, Kumar R, Nakano H, Tashiro N. Postnatal Depression in Japanese Women Who Have Given Birth in England. J Affect Disord 1997; 43: 69-77.

71. Huang YC, Mathers N. Postnatal Depression-Biological or Cultural? A Comparative Study of Postnatal Women in the UK and Taiwan. J Adv Nurs 2001; 33: 279-287.

72. Cooper LA, Gonzales JJ, Gallo JJ, Rost KM, Meredith LS, Rubenstein LV, Wang N, Ford DE.. The Acceptability of Treatment for Depression Among African-American, Hispanic, and White Primary Care Patients. Med Care 2003; 41: 479-489.

73. Howell EA, Mora PA, Horowitz CR, Leventhal, H. Racial and Ethnic Differences in Factors Associated With Early Postpartum Depressive Symptoms. Obstet and Gynecol 2005; 105: 1442-1450.

74. Surkan PJ, Peterson KE, Hughes MD, Gottlieb BR. The Role of Social Networks and Support in Postpartum Women's Depression: A Multiethnic Urban Sample. Maternal and Child Health Journal 2006; 10: 375-383.

75. Lee D Yip A, Leung T, Chung T., Ethnoepidemiology of Postnatal Depression: Prospective Multivariate Study of Sociocultural Risk Factors in a Chinese Population in Hong Kong. Br J Psychiatry 2004; 184: 34-40.

76. Holroyd E, Katie FK, Chun LS, Ha SW. "Doing the month": An exploration of postpartum practices in Chinese women. Health Care Women Int 1997;18:301-313.

77. Kim J, Buist A. Postnatal Depression: a Korean perspective. Australian Psychiatry 2005; 13: 68-71.

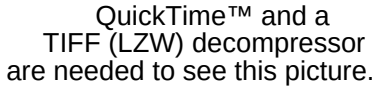
78. Frisbie WP, Cho Y, Hummer R. Immigration and the Health of Asian and Pacific Islander Adulst in the United States. Am J Epidemiol 2001; 153: 372-380.

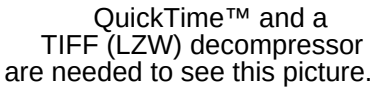
79. Williams C, Brett K, Barfield W. CDC Research proposal: Prevalence of Self-Reported Postpartum Depression, 19 States-Pregnancy Risk Assessment Monitoring System 2004. Journal of Morbidity and Mortality Weekly Report. Expected 2008.

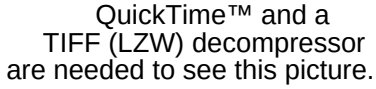
80. Derijk R, van Leeuwen N, Kiok M, Zutman F. Corticosteroid Receptor-Gene Variants: Modulators of the Stress-response and Implications for Mental Health. Eur J Pharmacol 2008; 585: 492-501

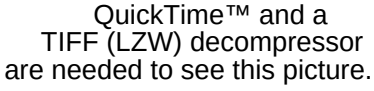
Appendix

Oregon Prams Survey 2004

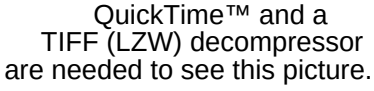


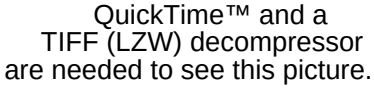

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

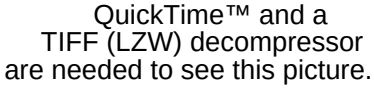

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

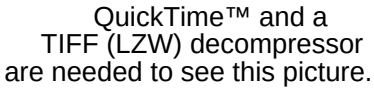

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

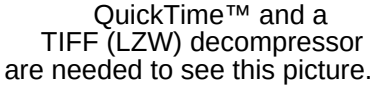

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

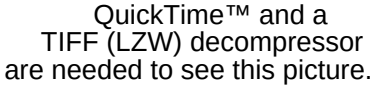

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

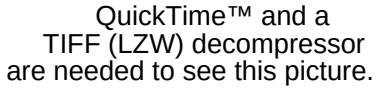

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.