Kaleidoscope

Volume 10 Article 39

August 2012

An Examination of Maternal Stress, Inflammatory Markers, and Preterm Labor in Pregnant Women

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I am a native of Ghana, located in West Africa. It lies north of the Equator. It is a beautiful, tropical country with very rich culture. I have been a student at the University of Kentucky, College of Nursing since 2009 and will be graduating in May 2011. I began as a second-degree student; my first degree was in Educational Psychology (B.eD) at the University of Cape Coast, 2002 (in Ghana). I also graduated from the Bluegrass College in December, 2008 (in Lexington Kentucky) with a degree in Practical Nursing.

I have been working with Dr. Kristin Ashford as a research intern since spring 2009. The research project is centered on examining the risks and health disparities of preterm birth. The project has been presented as a poster at the Southern Regional Nursing conference (SRNS) in February 2011 in Jacksonville, Florida and as an oral presentation at the Nursing School's Scholarship Showcase in March 2011. It will also be presented at the Showcase of Undergraduate Scholars in April 2011.

I am a very dedicated student and highly diligent in my studies. I have had consistent appointments to the University of Kentucky Dean's List and have been an active member of Phi Kappa Alpha Honor Society since 2007. I was also the winner of the yearly Faculty Award for my graduating class (Class of May, 2011).

I have a great passion for improving global health of women and children, which has motivated me to enroll in nursing. I am an aspiring Nurse Midwife and am preparing to pursue a Doctorate of Nursing Practice (DNP) degree. After graduation, I will be working as a bedside nurse to gain more experience prior to embarking on further educational goals.

Faculty Mentor: Dr. Kristin Ashford

I have had the privilege of mentoring Cecilia as an undergraduate research intern and advisor at the University of Kentucky College of Nursing for the past three years. Cecilia is clearly a very intelligent and motivated student with a true enthusiasm for improving the health of women and children through her research. Cecelia's academic accomplishments are impressive. She continually exceeds the rigorous academic and clinical standards of the college while working as an undergraduate nursing research intern.

Cecilia is a self-directed, hard-working student, who is not afraid to take on new scholarly activities, including statistical analysis and hands-on clinical research. Her proactive work ethic and generous spirit coupled with her motivation to achieve her career goals undoubtedly makes her and exceptional student. I have no doubt Cecilia will excel and become a leader in the nursing profession. I feel very fortunate to have been able to work with her and look forward to future research collaborations.

Introduction and Background

The purpose of this study was to examine the relationship between inflammatory biomarkers and reported maternal stress in a multiethnic sample of pregnant women. The specific aims were to: 1) compare levels of reported prenatal stress among African American (AA) and Caucasian (CC) women across all trimesters and; 2) examine the differences in levels of C-reactive protein (CRP) in three mediums (serum, saliva, and cervical vaginal fluid (CVF)) in AA women and CC women.

Preterm birth (PTB) is defined as the percentage of infants delivered at less than 37 completed weeks of gestation and it can result in substantial economic and societal costs (CDC, 2009). Over nearly the past decade, that rate in the U.S. has steadily increased. In 2005, the PTB rate was 12.7% among all ethnic groups (CDC, 2005). Racial and ethnic disparities related to PTB continue to exist. African American women are disproportionately affected by PTB compared to Caucasian and Mexican-American women (CDC, 2006). In 2003, "…17.8% of U.S.- born African American women delivered preterm compared to 11.5 % of non-Hispanic white women" (CDC, 2005). Adverse pregnancy outcomes are disproportionately expressed in ethnic and racial minority populations and historically underserved populations, particularly from rural regions of the nation. However, a substantial proportion of the general overall increase in incidence of PTB cannot be explained by classical risk factors; thus, a broader view of the potential interrelationships leading to adverse pregnancy outcomes, including biologic and ethnic markers is needed

Preterm delivery is attributed to both psychological and physiological stress. Racial and ethnic disparities influence the perception of various stressful events and ultimately influence pregnancy outcomes such as preterm birth. These observations are deemed important because stress experienced during pregnancy increases the risk of childhood illnesses, which may extend far beyond infancy through adulthood (Coussons-Read et al., 2005). According to Christian et al. (2010), psychosocial stress and depressive symptoms are associated with poor birth outcomes such as premature delivery and gestational hypertension. African American women are more likely to experience preterm birth and low birth weight infants as compared to other races (Gennaro et al., 2008). It is suggested that high stress, anxiety, and depression contribute to this phenomenon.

Inflammatory mechanisms associated with distress may also predispose a person to poor pregnancy outcomes. Pregnant women who have increased amounts of pro-inflammatory cytokines and decreased levels of anti-inflammatory cytokines are at high risk for preterm labor and preeclampsia. Moreover, increased levels of CRP can also lead to preterm labor and preeclampsia (Piccinni et al., 2000; as cited in Coussons-Read et al., 2006). In an *in vitro* and *in vivo* study, findings suggest that inflammatory responses mediated by cytokines and chemokines are different in each geographic population and thus, contribute to the differences in the PTB rates found in African-Americans and Caucasians in the United States. (Velez et al., 2008).

Methods

A secondary analysis was conducted using data from a larger prospective cohort study of pregnant women. The primary study was an IRB- approved prospective cohort study of a multi-ethnic sample of pregnant women recruited from the University of Kentucky Chandler Hospital (n=82). Twenty-one African-American women and sixty-one Caucasian women ranging in age from 18-40 years old participated. Participants had to be over 16 years of age and with singleton gestation. Subjects gave consent and were recruited upon admission to the hospital. The women were enrolled in the first trimester of pregnancy—from 6 and12 weeks pregnant. At each visit, participants were compensated $25 for their time. Women who had the following conditions were not eligible to participate: beyond their 1st trimester upon enrollment, having a history of diabetes and/or heart disease, current history of illegal or prescription drug abuse, second trimester diagnosis of bacterial vaginosis (BV) or sexually transmitted disease, and/or a multifetal pregnancy.

The two key stress measures described in the secondary analysis include self-reported maternal stress and CRP levels during pregnancy. Maternal stress was measured using the *Everyday Stressors Evaluator* (ESS) tool. The ESS is a 20-item questionnaire used to measure chronic stress **(**psychosocial and social support**)** in women of childbearing age (Cronbach's–α ranged from .80-.85). Items were rated on a 5-point Likert scale ranging from "not at all" to "very much." Possible scores ranged from 0-60. A higher composite score on the ESS generally indicate a higher level of daily stress (Hall et al., 1985). Biological stress was measured via CRP levels obtained in three mediums—serum, saliva and cervical vaginal fluid (CVF). CRP is a protein found in serum. An increased amount of CRP in blood indicates that there is an infection or acute inflammatory process occurring in the body. Pregnancy is a state in which there is generally an increase in oxidative stress; whereas higher levels have been associated with to adverse pregnancy outcomes. Both self-reported maternal stress and CRP levels were measured and compared at each trimester. Other data obtained included demographic information. Statistical data analysis included descriptive measures, T-tests, and Pearson Correlation Co-efficient.

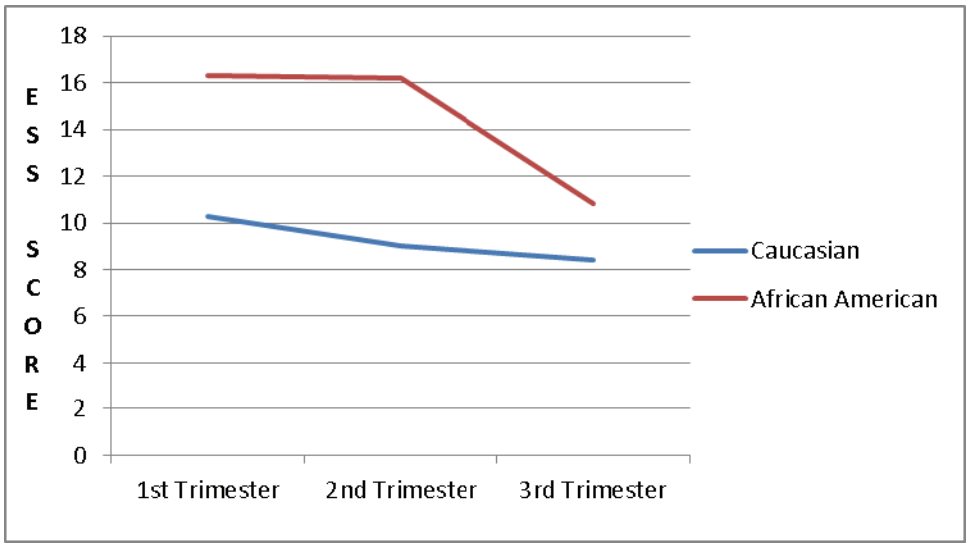
Table I. Demographics

Variables	Caucasian	African American
Sample	n= 61	n= 21
Married	47.7%	5.3%
Average age	25.7	24.2
Education: completed high school, GED, or beyond	77.1%	66.6%
Annual household income: <$30,000	52.5%	94.7%

Results

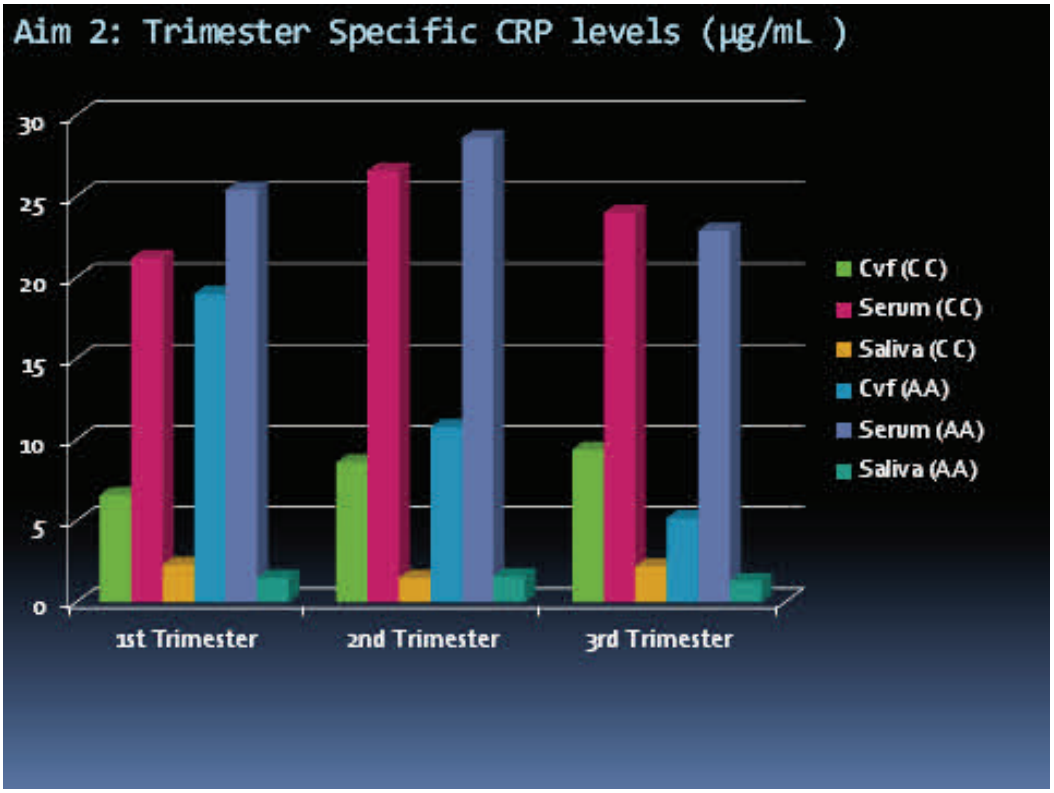
When comparing levels of reported prenatal stress among African American and Caucasian women, African American womens' self-reported stress levels were significantly higher compared to Caucasian women in both the 1st and 2nd trimesters ($p = 0.005$: See *Figure 1 below*). Mean scores for African American were highest in the first trimester at 16.3 compared to Caucasian women whose mean score was 10.2. In the third trimester, there was no significant difference in reported stress among all participants.

Figure 1. **Self-reported Stress Scores**



When examining the difference in levels of CRP in the three mediums (serum, saliva, and CVF) in African American women and Caucasian women, they did not significantly correlate to reported prenatal stress in any of the mediums (See *Figure* 2 below). However, in the first trimester only, levels of CRP in CVF amongst African American approached significant levels (p=0.1). Moreover, in all trimesters for both groups of women, serum (red-CC and purple-AA; See *Figure* 2) contained the highest levels of CRP. At the other end, whole saliva (orange-CC and aqua-AA; see *Figure* 2) contained the least CRP in all trimesters. Also, CRP levels in CVF (green-CC and blue-AA; See *Figure* 2) were higher among African American women as compared to Caucasian women with levels approaching significance in the first trimester only (p =0 .09). In short, serum was the most sensitive measurement of CRP levels and saliva was the least sensitive measure.

Figure 2. **C - reactive protein Levels.**



Clinical implications

African American women reported higher prenatal stress level scores than Caucasian women throughout pregnancy. Higher stress levels during pregnancy are a contributory factor to poor pregnancy outcome. Therefore, it is necessary for healthcare professionals to screen for stress and offer stress reduction interventions earlier in pregnancy. Furthermore, prenatal CRP levels have not been shown to reflect reported prenatal stress in African American women. For this reason, further research should be conducted to identify more reliable prenatal stress biomarkers including *serum cortisol* and *tumor necrosis factor alpha* (TNFα). Future research should recruit a larger sample of African American women to develop significant conclusions.

Acknowledgements

Funding for this initial project was from NIH BIRCWH fellowship through Dr. Kristin Ashford: Grant # K12DA14040. I would also like to thank Andrea McCubbin and Susan Westneat for assisting with the content and data analysis sections.

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