

Appendix

CEHD Grant Application Form

Submit this application form by one of the following due dates along with your proposal. Applications must be received, at tate-center@wmich.edu, by 5:00 p.m. on August 15, November 15, March 15, and June 15.

Application					
Applicant Name:	Sunmin Lee PhD RD, Arezoo Rojhani PhD RD				
Title:	Assistant Professor (Lee), Associate Professor (Rojhani)				
Department:	Family & Consumer Sciences (Dietetics)				
Title of Proposal:	Assessment of Anemia among Pregnant and Postpartum Women Participating in Women, Infants, and Children Program				
Amount Requested:	\$2000				
Dates of Project:	5.1.2015 - 5.1.2016				
Evaluation Guidelines					
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	
5	4	3	2	1	
The proposed research/creative activity is well conceived and organized.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	4	3	2	1
The proposed work will increase the likelihood that the applicant will secure external funding in the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	4	3	2	1
The methods and/or procedures are clearly stated and appropriate for the proposed activity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	4	3	2	1
The plans for data analysis or evaluation critique are clearly stated and appropriate for the proposed activity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	4	3	2	1
The costs for the proposed budget are clearly itemized and justified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	4	3	2	1
This project has the potential to advance the scholarly/creative reputation of WMU.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5	4	3	2	1

Assessment of Anemia among Pregnant and Postpartum Women Participating in Women, Infants, and Children Program

PURPOSE

This proposed study will focus on assessing anemia in low-income and racially diverse pregnant and postpartum women participating in the Women, Infants, and Children (WIC) program offered through Family Health Center WIC office in Kalamazoo MI.

The three specific aims of this study are:

- 1) To assess longitudinal changes in hemoglobin concentrations and anemia status among low-income pregnant and postpartum women.
- 2) To identify risk factors associated with anemia among low-income pregnant and postpartum women.
- 3) To examine the determinants of recovery from postpartum anemia among low-income postpartum woman.

BACKGROUND, NEEDS & SIGNIFICANCE

Impact of Maternal Anemia and Iron Deficiency on Maternal and Infant Health

Anemia during pregnancy is a global public health problem that affects 56.4 million pregnant women worldwide [1]. Pregnant women are vulnerable to developing anemia and iron deficiency (ID) due to increased demands for iron and poor iron intakes from diet. Iron needs increase by ~1,040 mg over the course of pregnancy to support the physiological changes associated with pregnancy (red cell mass and plasma volume expansion) and fetal needs (fetal and placental growth) [2]. However, the median dietary iron consumption of US pregnant women (15.8 mg) [3] is far less than the recommended dietary allowance (27 mg) [4].

Anemia and ID during pregnancy has been associated with an increased risk of intrauterine growth restriction, premature delivery, low birth weight, postpartum depression and maternal morbidity and mortality [5-7]. Maternal anemia is also a risk factor for suboptimal neonatal iron endowment at birth [8-10], and some studies have shown that the impact of maternal iron status on infant iron stores may persist even later in infancy up to 12 months of age [11]. It is well established that iron plays a critical role in the neurodevelopment for the growing fetus *in utero* and during early infancy (~ 2 y) [11]. Under-nutrition during this period may influence the development of the brain function by interfering with the neurogenesis and differentiation processes [12, 13]. This results in compromised intelligence, behavioral problems, and increased susceptibility to many health problems [12].

During the postpartum period, maternal hematologic status is expected to improve as the red cell mass contracts at delivery, which leads to a large proportion of iron return to body stores. In addition, lactation has a protective effect on iron losses by lengthening postpartum amenorrhea, and only a small amount of iron is lost through breast milk [14]. However, the national data indicates that approximately 1 out of 4 postpartum women are anemic, raising needs for attention as postpartum anemia affects maternal emotion and cognition [6], and is also strongly associated with postpartum depression [15]. Other major

health consequences of postpartum anemia include low milk supply, delayed wound healing, low immunity and increased susceptibility to infection [16, 17].

Recent data from the Centers for Disease Control and Prevention (CDC) Pregnancy Nutrition Surveillance System (PNSS) showed that approximately 35.2% of US pregnant women were anemic in the 3rd trimester and 25.5% women were anemic in the postpartum period [18]. The majority of the PNSS data come from the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), a federally funded program that provides supplemental food and nutritional counseling to women and young children. Eligibility to participate and receive services from the WIC program include: 1) “nutritional risk” status determined by a health professional or a State or locally trained health official; 2) pregnant women; 3) women who are breastfeeding during the first year postpartum; 4) non-breastfeeding women in the first 6 months postpartum; 5) infants and children up to 5 years of age [19].

High Risk Populations of Pregnancy and Postpartum Anemia and Iron Deficiency

Women from **low-income households** are at increased risk of anemia and ID. In a recent study in pregnant females (n=1,045) using the National Health and Nutrition Examination Survey 1999-2010, the mean total iron intake from diet and supplement use was significantly lower among low income (Poverty Income Ratio, PIR \leq 130%) pregnant women (26 mg/day) compared to pregnant women living in food-secure (Poverty Income Ratio, PIR >130%) environments (38 mg/day) [20]. In addition, the prevalence of ID was significantly higher among low income pregnant women (31%) than that estimated among food-secure pregnant women (22%), and low income pregnant women had an overall 2.9 times higher risk of being iron deficient compared to those living in food-secure households [20].

The prevalence of ID among postpartum low-income women during 0-6 months postpartum, 7-12 months postpartum, and 13-24 months postpartum were approximately 29.7%, 20.3%, and 15.9%, respectively [21]. These rates were substantially higher than that reported among women with PIR >130% at each time point of estimation (6.9% during 0-6 months postpartum; 8.4% during 7-12 months postpartum; and 3.2% during 13-24 months postpartum) [21].

Substantial **racial disparity** in the prevalence of maternal anemia is also an issue of concern given that anemia is two times higher among non-Hispanic black pregnant women (35.4/1,000) when compared to non-Hispanic white pregnant women (18.0/1,000) [22]. Postpartum anemia also disproportionately affects race / ethnic minority groups in the United States. A national study of 59,428 women participating in WIC programs showed that the prevalence of anemia among non-Hispanic black women (38.3% - 48%) was nearly twice that estimated among non-Hispanic White women [23].

Prevalence of Pregnancy and Postpartum Anemia in Michigan

In Michigan, more than 11,000 clients are served by WIC and 38% of pregnant women enrolled during their 1st trimester [24]. Hemoglobin is routinely measured among WIC participants and utilized as a screening indicator of anemia. The 2013 Michigan PNSS data showed that the prevalence of anemia among the women in their 3rd trimester of pregnancy was 38.9%, an 8% increase when compared to 2003 PNSS data [19]. Postpartum anemia was reported among 28.7% of those surveyed, which was higher than the national rates of 25.5% [19].

Gaps in Knowledge and Rationale of the Study

Although anemia is considered as an important public health problem of women during their reproductive years, few data exist on the *longitudinal changes* of hematological status from early gestation (1st trimester) throughout pregnancy and up to 2 years postpartum. Anemic postpartum women who are likely to become pregnant again may be at greater risk of entering their next pregnancy if one's hematological status is not fully recovered before the next pregnancy. However, little has been reported regarding the determinants of postpartum anemia and the time for recovery, as well as how certain risk factors may modify the time for recovery from postpartum anemia.

The proposed study targets recommendations on future research that were identified by the 2014 National WIC Associations. These recommendations are in line with the agenda in the current research proposal including; "Improve maternal health during periconceptional periods". Results from this study will have relevance to the larger population of pregnant and postpartum women in the United States and will contribute to development of public health nutritional recommendations for low-income pregnant and postpartum women.

METHODS & PLAN OF WORK

Data Source & Collection

The proposed project will use extant and current data from the Kalamazoo Family Health Center WIC, provided by the Michigan Department of Public Health. **Table 1** summarizes the type of variables that will be analyzed in this longitudinal study.

Table 1. Information collected in the WIC participants' baseline certification records & health records

Maternal sociodemographic variables (Source: Baseline Certification Record)	<ul style="list-style-type: none"> • Household size • Annual income • % of poverty level • Public assistance status • Insurance type • Migrant status • Maternal education • Timing of WIC enrollment • Race / ethnicity • Age • Smoking • Supplement use and dietary behaviors
Anthropometry (Source: Health Records)	<ul style="list-style-type: none"> • Maternal pre-pregnancy weight and BMI • Maternal height, weight at each visit
Anemia (Source: Health Records)	<ul style="list-style-type: none"> • Hemoglobin, all measures taken from WIC enrollment to up to 2 years postpartum
Breastfeeding (Source: Health Records)	<ul style="list-style-type: none"> • Initiation and duration • Exclusive Breastfeeding

Data Analysis

Data analysis will begin immediately, as we will utilize an extant data that has already been collected through the WIC program and the Family Health Center Obstetrics Practices but not yet analyzed. In this study, hemoglobin concentrations repeatedly measured over time within the same individual are more likely to be correlated. In addition, this longitudinal data are not balanced, because participants may have had hemoglobin measurements at different time gestational weeks, or may have missed their follow up hemoglobin measurements. Therefore, incorporating information of with-in subject correlations and missing mechanisms plays an important role in longitudinal data analysis. To address this point, study of missing mechanism of data and correlations between primary dependent and independent variables will be examined for each study aim. After the initial investigation of the data, we will undertake the descriptive statistics and longitudinal data analysis such as the generalized estimation equation and the quadratic inference function methods to identify the significant relevant factors that influence maternal hemoglobin concentrations and anemia. These exploratory approaches take into account the informative correlations and therefore, provide more effective prediction model. Data analysis will be conducted with the collaboration of the Department of Statistics at Western Michigan University and the study statistician (Dr. Hyunkeun Ryan Cho) will aid in interpreting the analyzed data and identifying proper implications and significance of each specific aim. All data transformations and analyses will be performed and managed using R and JMP (SAS Institute Inc, Cary, NC).

BUDGET

(omitted)

TIMELINE OF STUDY

May 2015 - July 2015	<ul style="list-style-type: none"> • Meet key personnel at WIC agency & Michigan Dept. of Community Health • Firm up commitment by local WIC agencies to share access to data • Complete Human Subjects Institutional Review Board training and applications
July 2015 - Dec 2015	<ul style="list-style-type: none"> • Data cleaning & statistical analysis
Jan 2016 – May 2016	<ul style="list-style-type: none"> • Write reports and manuscripts

ANTICIPATED OUTCOMES & PLANS FOR CONTINUING RESEARCH

Findings from this study will identify the subgroups with one or more identified risk factors for pregnant and postpartum anemia. While this study will be examining maternal hemoglobin concentrations and anemia as primary outcomes as a proxy of iron status, assessment of iron status based on iron-specific biochemical indicators will not be undertaken as such data are not collected at WIC programs. Iron homeostasis entails three compartments (storage iron, functional iron, and transport iron) and a number of biochemical indicators are needed to be assessed to fully capture the severity of iron deficiency. In addition, anemia can also be caused by other micronutrient deficiencies such as folate and vitamin B₁₂ deficiencies. Given these aspects of iron homeostasis and anemia, we anticipate to conduct a prospective, longitudinal study assessing multiple iron status indicators (ferritin, soluble transferrin receptor, total body iron) targeted to women who are at highest risk of anemia based on the findings from this study. These data will also be used for designing community-based nutrition education interventions to reduce the risk of anemia in pregnant and lactating women. We anticipate 2-3 publications to be generated from the analysis of the data. Findings will be shared with the Kalamazoo Family Health Center WIC program and will be presented at field related professional conferences.

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