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Factors Associated with Rapid Repeat Pregnancy among Women in a Healthy Start Program in Kent County, Michigan

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Factors Associated with Rapid Repeat Pregnancy among Women
in a Healthy Start Program in Kent County, Michigan

Sarah Jane Schmidt

A Thesis Submitted to the Graduate Faculty of

GRAND VALLEY STATE UNIVERSITY

In

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For the Degree of

Master of Public Health

College of Health Professions

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Dedication

I would like to dedicate this thesis to my mom, Sandy Schmidt, and dad, Jonathan Schmidt, who have always pushed me to be the best version of myself. Their constant support and guidance have led me to where I am today, and they never fail to remind me that I am strong, capable, and intelligent. Thank you, mom and dad, for a lifetime of love and happiness, I love you.

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I would also like to thank Strong Beginnings for allowing me to utilize their program data to explore my research question, and Michigan State University for space and resources for data analysis.

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Abstract

Strong Beginnings (SB) is a federal Healthy Start Program aiming to improve the health and well-being of black and Hispanic families by promoting racial equity and eliminating racial disparities in birth outcomes, including rapid repeat pregnancy (secondary pregnancy within 18 months of index birth). To better prevent the occurrence of rapid repeat pregnancy (RRP), this study explores individual, social, and environmental factors associated with RRP. De-identified data for this study included information from SB, the Maternal Infant Health Program, Medicaid claims, and birth certificates. The sample includes women enrolled in SB with an index birth between 2013 and 2015. Chi-square tests of independence and t-tests were used to assess the relationship between RRP and the predictor variables and logistic regressions were run to obtain adjusted odds ratios for factors associated with RRP, controlling for potential confounders. Results show that women aged 24 years or less are at increased odds of RRP compared to women aged 25 years or greater when individually controlling for individual, social, and environmental factors. Using these results, SB leadership and staff and other health care workers, can design and implement RRP preventions methods in their programs. Future research is needed to further assess the association between RRP and individual, social, and environmental risk factors.

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List of Abbreviations

IPI- Interpregnancy Interval

LARC- Long Acting Reversible Contraceptives

MDHHS- Michigan Department of Health and Human Services

MIHP- Michigan Infant Health Program

PPROM- Preterm Premature Rupture of Membranes

RRP- Rapid Repeat Pregnancy

RLP- Reproductive Life Plan

SB- Strong Beginnings

Chapter I: Introduction

Background

The need to better understand the risk factors of rapid repeat pregnancy RRP is growing, due to the increased risk of adverse birth outcomes associated with RRP. It has been found that women who have a RRP are at a greater risk of preterm birth, having a baby with low or very low birth weight and/or birth defects, and infant mortality (Ekin et al., 2017; Grisaru-Granovsky et al., 2009; Hussaini et al., 2012; Nerlander, Callaghan, Smith & Barfield, 2015; McKinney et al., 2017). These adverse birth outcomes can place a large financial burden on families if their child has to stay in the neonatal intensive care unit, and they can affect the emotional wellbeing of families. Mothers of preterm infants are more likely to be fatigued, experience feelings of anxiety, and have less positive feelings toward her baby (Henderson, Carson, & Redshaw, 2016). In addition to these, parents of children in the neonatal intensive care unit often experience feelings of depression, stress, insecurity, and loss of control (Obeidat, Bond, & Callister, 2009). For these reasons, research to better understand the risk factors for RRP is needed in order to prevent it, thus decreasing the number of adverse birth outcomes and the financial and emotional burden on families.

RRP is defined as a second pregnancy occurring less than 24 months after an index birth (Cha et al., 2016; Crittenden et al., 2009; Hanley et al., 2017; Reese and Halpern, 2017; Rigsby et al., 1998). The term interpregnancy interval (IPI) is used to explain the time between an index pregnancy and a subsequent pregnancy. IPIs are often broken down into three categories: short IPI, pregnancy within zero to 17 months after index birth, intermediate IPI, pregnancy within 18 to 23 months after index birth, and long IPI, pregnancy 24 months or more after index pregnancy (Ekin et al., 2015). The intermediate IPI is considered the ideal IPI in many studies, however,

there is much controversy over this claim, with little research explaining why the 18 to 23 month IPI is considered ideal. (Hogue et al., 2017; Hussaini et al., 2013).

Purpose

This study aims to assess the association between RRP and individual, social, and environmental risk factors among women in a Healthy Start program in Kent County, Michigan. Result of this study may be used to tailor prevention and intervention methods to decrease the rates of RRP among the study population, thus decreasing the risk of adverse birth outcomes. Additionally, this study provides a starting point for future research addressing the association of RRP and individual, social, and environmental risk factors on a larger, broader, scale.

Research Question

What individual, social, or environmental factors are associated with RRP among women in a Healthy Start program in Kent County, Michigan?

Hypothesis

Ho: There are no factors associated with Rapid Repeat Pregnancy among women in a Healthy Start program in Kent County, Michigan.

Ha: There is at least one factor associated with Rapid Repeat Pregnancy among women in a Healthy Start Program in Kent County, Michigan.

Chapter II: Review of Literature

Introduction

A literature review was conducted to assess the effects of RRP, trends over time, and known risk factors. Additionally, newer research on the individual, environmental, and social risk factors for RRP were also included. The information gathered in the literature review provided guidance for the selection of variables and development of the current study.

Articles for this study were found searching the PubMed, ProQuest Medical, and CINAHL Complete databases. These databases were selected because they provided in depth information on the biological, social, behavioral, and environmental aspects of RRP. Primary search terms included: rapid repeat pregnancy and interpregnancy interval, and were paired with secondary search terms such as birth outcomes, short, risk factors, disparities, and effects. The initial search yielded many results, however, articles were excluded if they did not include participants over the age of 18. Articles were also excluded if they addressed the effects of RRP on childhood development rather than birth outcomes and if they were from countries that were not similar to the United States in relation to health care.

Effects of Rapid Repeat Pregnancy

RRP has been shown to affect many birth outcomes. Specifically, researchers have found that RRP can affect gestational age at birth, birth weight, and likelihood of infant mortality. While the majority of birth outcome research focuses on the aforementioned topics, others include birth defects. Additionally, the body of research also includes maternal outcomes prior to and after birth, including preterm premature rupture of membranes (PPROM), gestational diabetes, and preeclampsia. The articles comprising this section were reviewed to provide a basic

understand of the role RRP plays in pregnancy and birth, and to indicate the importance of studying RRP.

Gestational Age. In 2016, approximately one in ten infants was born preterm in the United States (US) (Martin et al., 2018). Preterm birth is defined as birth before 37 weeks gestation. Infants who are born preterm are more likely to experience respiratory distress syndrome, mechanical ventilation, jaundice, apnea, sepsis, temperature instability, hypoglycemia, and feeding problems (Bird et al., 2010). Additionally, mothers of preterm infants are more likely to experience anxiety, fatigue, and flashbacks, as well as have less positive attitudes toward their baby (Henderson et al., 2016). Preterm birth is often caused by spontaneous preterm labor or PPRM, however, the reasons behind these two mechanisms are largely unknown (Goldenberg et al., 2008). Those at highest risk of preterm birth include black women, women with a prior preterm birth, women with a low pregnancy body mass index, and women experiencing a multiple pregnancy.

Multiple studies have shown that an IPI of less than six months also increases the odds of preterm birth (Ekin et al., 2017; Grisaru-Granovsky et al., 2009; Nerlander et al., 2015). Additionally, the study by Nerlander et al. (2015) was the only study to find that an IPI of six to eleven months increases the odds of preterm birth by 11% when compared to those with an IPI of 18 to 23 months. In comparison to Ekin et al. (2017), Grisaru-Granovsky et al. (2009) and Nerlander et al. (2015) stratified their results by preterm and very preterm birth. The preterm birth category included infants born between 32 and 36 weeks gestation, while very preterm birth included those born before 32 weeks gestation. An IPI of less than six months was also found to increase the odds of very preterm birth by a factor of 1.68 when compared to those with an IPI of 18 to 23 months, while the other found that an IPI of less than six months increased the odds of

very preterm birth by a factor of 1.22 when compared to those with an IPI of 12 to 23 months (Grisaru-Granovsky et al., 2009; Nerlander et al., 2015). Additionally, Nerlander et al. (2015), reported that an IPI of less than three months led to 2.52 times greater odds of very preterm birth compared to those with an IPI of 18 to 23 months.

While these results provide evidence of an association between RRP and preterm birth, a study by Hanley, Hutcherson, Kinniburgh, and Lee (2017) found that there was no association between RRP and preterm birth, when matching cases to controls, which in this study was the same women during her previous pregnancy. This mean that when a woman who had a RRP was compared to her previous self, there was no difference in the rates of preterm birth. These finding indicate that there may be other factors that contribute to preterm birth more than RRP. Overall, the majority of research agrees that an IPI of less than six months increases the risk of preterm birth.

Birth Weight. Birth weights are often grouped into two categories: low birth weight, 1,500 grams to 2,499 grams, and normal birth weight, 2,500 grams and greater. The low birth weight category can be further broken into very low birth weight, 1,000 grams to 1,499 grams and extremely low birth weight, 999 grams or less. Birth weight can also be assigned by placing infants in percentile categories based on their gestational age at birth. In this case, a low birth weight infant would weigh less than the tenth percentile weight and a very low birth weight infant would weigh less than the fifth percentile weight (Ekin et al., 2017; Grisaru-Granovsky et al., 2009). While both the grams and percentile methods of birthweight measurement are used in research, there is no research stating what the preferred method or which is better. However, using the percentile based method would allow for gestational age to be taken into consideration, creating a more accurate measure of low or very low birthweight. Infants who have a low birth

weight are more likely to experience neurodevelopmental handicaps, congenital anomalies, and respiratory tract conditions as well as an increased use of neonatal and health care services and disruptions in the bonds between mother and infant (Institute of Medicine, 1985).

The cause of low birth weight is often preterm birth, however, there are many socioeconomic, medical, behavioral, and environmental risk factors that increase the risk of a women having a low birth weight infant. These factors can include low education, childbearing at reproductive age extremes (less than 17 or greater than 34), being black, poor nutritional status, smoking, alcohol consumption, and lack of or inadequate prenatal care (Institute of Medicine, 1985). While there have been numerous studies concerning the effects of low birthweight on infant outcomes, and the risk factors for low birth weight, the rate of low birth weight in the US has remained relatively stable, between 8.07 percent in 2015 and 8.17 percent in 2016 (Martin et al., 2018). The lack of decrease in the rate of low birth weight birth in the United States shows that there may be other factors contributing to the risk of low birth weight that have not been previously mentioned.

Studies show that an IPI of less than six months significantly increases the odds of delivering a low birth weight infant (Ekin et al., 2017; Grisaru-Granovsky et al., 2009). Furthermore, Grisaru-Granovsky et al. (2009) found that an IPI of six to eleven months also increases the odds of delivering a low birth weight infant by 10%. In terms of very low birth weight, an IPI of zero to eleven months was found to similarly increase the odds by a factor of 1.11 (Grisaru-Granovsky et al., 2009). However, the Hanley et al. (2017) study, similar to gestational age, did not find an association between RRP and low birth weight once cases were matched with their controls. This means that there may be other factors contributing to increased

odds of low birth weight rather than RRP. Overall, the associations found in previous studies support that there is an association between RRP and low birth weight.

Infant mortality. Infant mortality is defined as the death of an infant within the first year of life (Hussaini et al., 2012; McKinney et al., 2017). Other categories of infant mortality include early neonatal death, which is defined as death up to six days after delivery and neonatal death, defined as death less than 28 days after delivery (Grisaru-Granovsky et al., 2009 Hussaini et al., 2012). The infant mortality rate in the US is about 5.9 deaths per 1,000 live births, and two-thirds of these deaths were caused by the top ten causes of infant death, some of which include: congenital malformations, low birth weight, sudden infant death syndrome, maternal complications, and respiratory distress (Kochanek et al., 2017). This demonstrates that while RRP may increase the odds of infant mortality, there are many additional factors that can also increase the odds of infant death.

Studies have shown that an IPI of zero to eleven months increases the odds of neonatal and infant death (Hussaini et al., 2012; McKinney et al., 2017). Additionally, Grisaru-Granovsky et al. (2009) found that an IPI of less than six months significantly increases the odds of early neonatal death by a factor of 1.64 and Hussaini et al. (2012) found that an IPI of 12 to 17 months, the first association that has been noted for this IPI range, is associated with a 48% increased odds of infant mortality. These studies show that an IPI of zero to seventeen months has an effect on infant mortality, while IPIs of zero to eleven months are associated with neonatal death. Additionally, the literature has provided evidence that RRP can affect multiple stages of one birth outcome.

Birth defects. Congenital anomalies, are conditions that develop prenatally and present at birth and can affect structural and functional abilities of the skeleton, cardiac, respiratory

systems (DeSilva et al., 2016; Ekin et al., 2017). In 2006, congenital anomalies affected in 1 of every 33 babies, and were responsible for over 20 percent of infant deaths (Parker et al., 2010; Kochanek et al., 2017). While some anomalies may not affect the likelihood of survival, other can lead to infant mortality, stillbirth, or a shorter life expectancy. Other effects of congenital anomalies can include impaired physical and/or social functioning and overall decreased health status (DeSilva et al., 2016). The cause of congenital anomalies overall are errors that occur during fetal development, however there are multiple reasons these errors could occur including medications, toxic environmental exposures, genetic defects, and chromosomal abnormalities and new causes are being identified.

In terms of RRP, the odds of congenital anomalies were found to be 1.14 to 1.38 times higher when a mother had an IPI of less than six months (Ekin et al., 2017; Grisaru-Granovsky et al., 2009). However, when broken down into specific anomalies types, including ventricular septal defect, atrial septal defect, cleft lip with and without cleft palate, pulmonary valve atresia and stenosis, pyloric stenosis, hypospadias, obstructive genitourinary and down syndrome, there was no association found between any of the specific types and RRP (Mburia-Mwalili & Yang, 2015). Currently, there are few studies that break down congenital anomalies into specific types to test their association with RRP, therefore, more research is needed in that area.

Maternal outcomes. The majority of research concerning maternal outcomes focus on preeclampsia, gestational diabetes, and PPRM. Preeclampsia is a high blood pressure disorder defined by a blood pressure of 140/90mm/hg or greater combined with a proteinuria of 300mh/24h or greater and affects an unknown number of women in the US (Ekin et al., 2017). Preeclampsia is often hallmarked by the increase of antiangiogenic factors which are thought to affect vascularization, the process of blood vessel formation (Mendola et al., 2015). Due to the

interference of vascularization, preeclampsia has been shown to increase the risk of adverse neonatal outcomes including perinatal mortality, small for gestational age infants, neonatal intensive care usage, respiratory distress syndrome, anemia, and asphyxia (Mendola et al., 2015).

Gestational diabetes, which affects about two to ten percent of pregnancies every year, and is an insulin resistance that is identified during the second half of a pregnancy. Gestational diabetes has similar risk factors as type 2 diabetes: age, obesity, sedentary lifestyle, and previous gestational diabetes diagnosis (Moncrieff, 2018). Maternal consequences of gestational diabetes include increase risk of hypertensive disorders, caesarean delivery, and type 2 diabetes diagnoses, while infant consequence include birth injury, neonatal hyperglycemia, increased risk of obesity, and increased type 2 diabetes. PPRM occurs in about three percent of all pregnancies (Dars et al., 2014; Ekin et al., 2017). Mothers who experience PPRM are at a higher risk for infant death and preterm delivery, which increases the risk of infants experience the adverse outcomes associated with preterm birth. PPRM is known to have multiple risk factors including: intrauterine infection, inadequate prenatal care, inadequate nutrition, sexually transmitted infections, and trauma (Dars et al., 2014).

Studies have shown that an IPI of less than six months is associated with 1.69 times greater odds of PPRM when comparing cases of RRP to their controls (Ekin et al., 2017). However, preeclampsia was not found to be associated with RRP, and mixed results were observed when analyzing the relationship between gestational diabetes and RRP. In the Ekin et al. (2015) study no association was found between gestational diabetes and RRP, but the Hanley et al. (2017) study found an association between an IPI less than six months and increased odds of gestational diabetes by a factor of 1.35. Overall, the results from these studies suggest that

more research is needed to assess the relationships between RRP and maternal outcomes due to the variations observed in results.

Risk Factors for Rapid Repeat Pregnancy

There is a large body of research focused on identifying the factors associated with RRP. To understand who is at a higher risk for RRP it is important to know these risk factors. While there is still controversy surrounding many of these factors, there are a few factors generally agreed upon by the academic community. These factors are sociodemographic in nature, and include race/ethnicity, marital status, age, and education level.

Race/ethnicity. One of the most commonly cited factors that contributes to RRP is race/ethnicity. Specifically, it is said that black women are at a higher risk of having a RRP compared to white women. In 1998, this association was shown when Duncan et al. (1998), found that the risk of RRP among black and Hispanic women was 1.4 times higher than that of white women. However, the relationship between race and RRP is one that is not always agreed upon (Rigsby, Macones, & Driscoll, 1998). It was noted that the IPI of black women is shorter than that of white women and black women are twice as likely to have an IPI in the high-risk range of less than six months. This difference in high risk IPI ranges is still present today. In 2016, Thoma, Copen, and Kirmeyer found that 7.1 percent of multiparous births to black women occurred with an IPI of less than six months, while only 4.1 percent of multiparous births to white women occurred with an IPI of less than six months. Overall, the gaps in RRP prevalence between black and white women, and Hispanic and white women are decreasing, however it is important to note that differences still exist, specifically in the high risk IPI ranges.

Marital status. Marital status is often cited as a risk factor for RRP that contributes to increased rates of RRP or decreased IPI. However, the nature of the marital status often varies. In

1998, Duncan et al. found that unmarried women were 1.3 times more likely to have an IPI less than 12 months, compared to married women ($p < 0.05$), while Gemmill and Lindberg (2013) found that married women were more likely to have a short IPI compared to single women. Additionally, a review of the literature by Rigsby, Macones and Driscoll (1998) included results that support Duncan et al. and Gemmill and Lindberg's findings. Overall, there is evidence that marriage is a risk factor for RRP, regardless of if unmarried or married women have higher odd of having a RRP. Further investigation of the association between marital status and RRP is needed to better understand the true direction of this association, and/or identify differences among various populations or time periods.

Age. Younger age, specifically under 20 years, is often cited as a risk factor for RRP. A 1998 report found that women aged 15 to 17 years were 7.8 times more likely to have an IPI less than 12 months, while those aged 18 to 19 years were 6.0 times more likely to have IPI of less than 12 months compared to women aged 40 to 47 years (Duncan, 1998). Furthermore, it was found that two thirds of women aged 15 to 19 years, with at least two births, had a short IPI (Copen, Thoma & Kirmeyer, 2015; Gemmill & Lindberg, 2013). In addition to young age, there are also increased rates of RRP among those of older age, specifically those 30 years and over (Thoma et al., 2016). However, it was found that 70% of women over 30 years of age intended to have a RRP, while only 30% of women aged 15 to 19 years intended to have a RRP (Gemmill & Lindberg, 2013). From this, it can be concluded that RRP among older women may be a choice, not an unintended outcome due to other factors. Overall, the association between younger age and increased likelihood of RRP has been shown in the literature and is a widely accepted risk factor for RRP.

Education. Many researchers have found that lower educational achievement is associated with increased rates of RRP. Duncan et al. (1998) found that those with less than age-appropriate education are 1.5 times more likely to have an IPI of less than 12 months, compared to those with age appropriate education. These results are further supported by Thoma et al. (2015), who found that each increasing level of education, up to a master's degree, was significantly associated with decreased rates of RRP with an IPI of less than six months. Specifically, women aged 25 and over with only a high school diploma were 1.82 times more likely to have an IPI of less than six months compared to someone with a bachelor's degree, and 2.21 times more likely than someone with a master's degree or higher. However, the effect education has on likelihood of RRP is the opposite when examining IPIs of six months or more.

When broken down by IPI category, women aged 25 and over with a bachelor's degree or higher are 1.2 times more likely to have an IPI of six to 11 months compared to those with only a high school diploma (Thoma et al., 2015). Finally, women aged 25 and over with a bachelor's degree were 1.96 times more likely to have an IPI of 12 to 17 months compared to those with only a high school diploma, while those with a master's degree were 2.11 times more likely, and those with a doctorate/professional degree were 2.37 times more likely. These results suggest that those with a high school diploma or less are more likely to have IPIs less than six months, while those with a bachelor's degree or higher are more likely to have IPIs of 12 to 17 months.

Current Research on Rapid Repeat Pregnancy

Currently, there are only a few risk factors for RRP that are commonly known. However, the list of factors is growing, and there is ongoing research to address other individual, social, or environmental factors that may be associated with RRP.

Individual factors. While there are many individual risk factors for RRP, much of the current research focuses on family planning, specifically contraception use and pregnancy intentions, and mental health. The World Health Organization views family planning as the ability of a women/family to choose if and when to become pregnant and their desired number of children (Family Planning/contraception, n.d). Effective family planning is accomplished by assuring access to preferred contraceptives, and often prevents unintended pregnancies, poor health outcomes, and unsafe abortions while maintaining a women's autonomy. The use of family planning may decrease the likelihood of RRP, however, women have identified barriers to family planning including: no feeling of reproductive control, lack of knowledge about contraception and how to use it, beliefs of inability to become pregnant, and reproductive coercion or male discordance on pregnancy intentions (Borrero et al., 2015; Hodgson et al., 2013). These barrier to family planning can often lead to unintended rapid repeat pregnancy.

Unintended pregnancy has been defined as a pregnancy that is mistimed or unwanted (Kendall et al., 2005). In a study by White et al. (2015), it was found that women who had pregnancies conceived within 11 months of a previous pregnancy, after contraception initiation at birth, were significantly more likely to identify it as an unintended pregnancy than an intended pregnancy. These results are further supported by Huber et al. (2018), who found that 76 percent of women in their study reported their RRP as unintended. Furthermore, black women had four times higher odds of reporting their RRP as unintended compared to white women, women who were not married had over twice the odds compared to married women, and women without health insurance had twice the odds compared to women with health insurance (Huber et al., 2018). In addition, a study by Cha et al. (2016) examined the effects of discordant pregnancy intentions among couples and found that when males intended another pregnancy, but the female

did not, the odds of RRP increased more than two-fold. Furthermore, when the male did not intend pregnancy, but the female did, the odds of RRP decreased by a factor of 1.33. These results suggest that even when women attempt family planning, RRP still occurs.

When studying mental health as an individual risk factor for RRP, many researchers focus on depression. The National Institute of Mental Health describes depression as a common, but serious, mood disorder that can affect how a person handles daily activities and how they think, feel, and act (Depression, 2018). A few symptoms of depression include persistent sadness or anxiety, irritability, difficulty concentrating or remembering, lack of interest, decreased energy or fatigue and physical pain, cramps, or digestive problems. Symptoms often have to be present for two weeks or more for a clinical diagnosis. In a study conducted by Patchen and Lanzi (2013), it was found that first time mothers with moderate to severe depression had 7.24 times the odds of becoming pregnant with a second child within six months compared to first time mothers with minimal to moderate depression. However, multiple studies have found that when controlling for things such as education level, contraception use, and measures of aggression, there is no association between RRP and depression (Bennett et al., 2006; Crittenden et al., 2009). This difference in results indicates that more research is needed to address the relationship between RRP and mental health.

Social factors. Social risk factors often include socioeconomic status, social capital, social support and networks, religious beliefs, and social relations (Brandt et al., 2005). The research on the relationships between social risk factors and RRP recently has been focusing on social attachments, specifically among adolescents. Social attachments include those to school, family, friends, and church. In a study conducted by Reese and Halpern (2016), it was found that those who did not have social attachments to church had 1.04 to 1.47 times greater odds of RRP

compared to those who did have social attachments to church. Furthermore, those with a stronger parental-adolescent relationship had a 20% decrease in the odds of RRP. However, there was no relationships between RRP and school attachments. While more research needs to be conducted, these results suggest that there may be a relationship between RRP and social attachments among adolescents.

Environmental factors. The research on environmental factors mainly focuses on the barriers to access to care, however, not specifically access to care for RRP prevention. Healthy People 2020 defines access to care as access to comprehensive, quality, and timely health care services in order to achieve the best personal health outcomes (Access to Care, n.d). Delays in health care due to many barriers can lead to chronic disease exacerbations, worse health outcomes, and lack of appropriate medical treatments or unmet needs (Syed, Gerber, & Sharp, 2013). Transportation is often cited as a major barrier to health care, with 10 to 50 percent of patients reporting that transportation was the cause of missed, delayed, or rescheduled medical appointment or medication use (Syed, Gerber, & Sharp, 2013). Furthermore, in terms of women needing prenatal care, 53 percent indicated that transportation was a significant barrier to care (Aved, Irwin, & Cummings, 1993). Additionally, during interviews Roman et al. (2017) found that transportation was the most common and stressful barrier to prenatal care specifically. While transportation has not specifically been studied in terms of access to care for RRP prevention, it is important to understand the role it plays in overall access to care and how that can relate to decreases in prenatal and postnatal access to care.

Another notable barrier to prenatal and postnatal care seeking is education and understanding the benefits of care. Approximately 40 percent of women who felt fine believed they did not need to seek care (Aved, Irwin, & Cummings, 1993; DiBari, Yu, Chao & Lu, 2014).

These results show that some women need more education about the importance of prenatal and postnatal care. This apparent lack of education is often shown when women are asked about the use of contraception as a way to prevent index pregnancies and RRP. During focus groups aimed at gaining information about women's knowledge about contraception and their decision-making process, Hodgson et al. (2012), found that many women did not know about contraception, did not know how to get it, and/or did not know the breadth of options that they could choose from. Furthermore, Kendall et al. (2005), found that many women struggled with the side effects of contraception, and often had misperceptions and misinformation about how to effectively use their chosen form of contraception.

In many studies, women often attribute their lack of knowledge to the lack of communication between them and their care provider. It has been found that women who were attending an appointment specifically for contraception counseling with parents who had less than a college degree were less than half as likely to have long acting reversible contraception mentioned to them during an appointment, but were more 2.1 times more likely to be given the opportunity to ask questions, compared to women with parents who had a college degree or higher (Dehlendorf et al., 2017). Additionally, providers were twice as likely to elicit black and Hispanic women's contraception preferences compared to white women. These results show that providers offer different information to each patient, which can lead to some patients having less knowledge about contraception than others. While these findings are useful, women often state that their care providers are not in the room long enough for them to ask questions, that they often left with the feeling that they gained nothing, and they wanted their provider to engage them in their care and make them feel as if they were getting cared for, not just checked (Roman et al., 2017). Overall, these results show that women are not getting all of the information they

need concerning prenatal, postnatal, or contraception care, even women who have an appointment specifically for contraception counseling. In order to prevent RRP, patient and provider communication needs to be enhanced to increase women's overall knowledge about reproductive health.

Trends of Rapid Repeat Pregnancy in Kent County

The current study takes place in Kent County, Michigan, and to better understand RRP, it is important to assess the trends over time, and the factors that may be influencing the trend. Figure 1 in Appendix A shows the percent of multiparous live births with an IPI of 18 months or less from 2006 to 2017 in Kent County by race/ethnicity (Geocoded Michigan Birth Certificate Registry, 2016). In 2006, among all women, 33.6% of all multiparous live births had an IPI of less than 18 months, and the percent of RRP increased through 2008 until there was a 0.4% decrease in 2009. The decrease continued through 2011, when an increase in the percent of RRP occurred between 2011 (32.2%) and 2012 (33.3). Since 2012, the percent of RRP has remained relatively stable, never increasing past the percent in 2012. The increase in RRP between 2011 and 2012 is surprising as the prevention of RRP is a public health priority in the US. In 2010 the Healthy People 2020 goals were released, and included a goal of decreasing RRP by 10 percent (Family Planning, n.d). The inclusion of this goal would lead to the belief that efforts to decrease RRP would be made, however, an increase in rates was still seen one year later.

Another interesting thing to note about the trends in Kent County are the differences that are present between the racial and ethnic groups. With the exception of 2010, multiparous white women have higher rates of RRP than multiparous black women, and all races combined. This trend contradicts the body of research that has shown that multiparous black and women are at a greater risk of RRP than multiparous white women (Gemmill & Lindberg, 2013; Hogue et al.,

2011). However, this discrepancy in research and the trends in Kent County may be explained by the composition of multiparous women within the categories of IPI less than 18 months. In 2016, Thoma et al., found that the multiparous black women rates of IPIs of less than six months and six to eleven months was 1.73 times greater than the rates for white women, while multiparous white women had rates of 12 to 17 months IPIs that were about 1.42 times greater than that of black women. This could explain why the overall rates of multiparous white women with an IPI of less than 18 months is higher than that of multiparous black women.

In Kent County, Hispanic women had the lowest rates of all race and ethnic groups across all years. One study has shown that Hispanic women have 1.22 times greater odds of an IPI of less than six months, when compared to non-Hispanic white women (Thoma et al., 2016). However, majority of previous literature has shown that Hispanic women have lower rates of RRP compared to non-Hispanic white and non-Hispanic black women (Copen et al., 2015; Gemmill & Lindberg, 2013). Another thing to note is that the pattern of RRP rates among Hispanic women closely followed that of black women, with the exception of 2010. This suggests that there may be a factor for RRP that affects the Hispanic and black populations similarly.

Conclusion

There is a plethora of research surrounding the associations between RRP and adverse outcomes for the infant and the mother. These adverse outcomes include preterm birth, low birth weight, infant death, PPRM, gestational diabetes, and birth defects. In order to decrease the prevalence of the adverse outcomes related to RRP, the occurrence of RRP must be decreased. However, there was relatively no change in the percent of multiparous women who have had a RRP from 2006 to 2016 in Kent County, Michigan. Additionally, there is little research

addressing the factors that may increase the odds of RRP, and the research that has been done is new and needs further exploration. More research is needed to identify the individual, social, and environmental risk factors that may increase the odds of RRP.

Chapter III: Methodology

Data Source

This study aims to identify individual, social, or environmental factors that are associated with RRP among women in a Healthy Start Program in Kent County, Michigan. A prospective cohort study design was used to address this question utilizing secondary data analysis with data provided by the Michigan Department of Health and Human Services (MDHHS) and the Strong Beginnings program. This study was deemed non-human subjects research by the institutional review boards at Michigan State University, Spectrum Health, and Grand Valley State University.

Michigan Infant Health Program (MIHP). MIHP is Michigan's largest evidence-based program for Medicaid eligible pregnant women and infants (Michigan Infant Health Program, n.d). MIHP strives to increase positive birth outcomes while reducing infant and maternal morbidity and mortality. The program is a supplement to prenatal and postnatal care, and offers in home visits by registered nurse or social workers while helps provide families with support, resources, and education (Michigan Infant Health Program, n.d). To further strengthen the MIHP program, the Strong Beginnings program was created in Kent County, Michigan.

Strong Beginnings. Strong Beginnings is a federal Healthy Start Program that aims to improve the health and well-being of black and Hispanic women, men, and children (Strong Beginnings, n.d). The goals of Strong Beginnings are addressed by promoting racial equity and eliminating disparities in birth outcomes between whites and people of color including preterm birth, low birth weight, and rapid repeat pregnancy (Strong Beginnings, n.d). While Strong Beginnings focuses on black and Hispanic women, they offer services to all pregnant women living in Kent County, their partners, and to parents of young children. Women enrolled in

Strong Beginnings receive home visits from MIHP care coordinators along with community health workers to offer additional education, social support, mental health services, fatherhood programs, and connections to resources in the community (Strong Beginnings, n.d).

There are two service periods of Strong Beginnings for women, prenatal stage and interconception. The prenatal period takes place prior to the birth of a child, and the interconception period continues after a prenatal participant's child is born, or when a parent enrolls after a birth (Strong Beginnings, n.d). Participants have been able to be enrolled in the program for up to two years postpartum, and are able to be re-enrolled if they become pregnant again. The Strong Beginnings program partners with many agencies to meet their goals including: Arbor Circle, Cherry Health, Grand Rapids African American Health Institute, Healthy Kent Infant Health Action Team, Kent County Health Department, Mercy Health-Saint Mary's, Metro Health Community Clinic, Michigan State University, and multiple sections of Spectrum Health. Cherry Health, Mercy Health, Metro Health, Spectrum Health, and Kent County Health Department are all medical groups or health organizations that employ community health workers and refer women to Strong Beginnings. Arbor Circle provides Strong Beginnings with mental health resources and offers counseling services for their participants. Michigan State University is one of the independent program evaluators for Strong Beginnings, while Grand Rapids African American Health Institute leads the fatherhood program attached to Strong Beginnings.

Throughout the program, Strong Beginning participants complete paper based screening questionnaires during enrollment and at subsequent home visits to assess their needs, goals, accomplishments, overall health status, parental roles and family planning. Additionally, MIHP has their own set of screening questionnaires at prenatal and postpartum enrollment. The

responses from these questionnaires are entered into a database by the Strong Beginnings and MIHP home visitors. Strong Beginnings data for this study was provided by the administrative offices of the Strong Beginnings Program, housed in Spectrum Health Healthier Communities. It was de-identified by a Strong Beginnings subcontractor for linkage to an existing de-identified and linked database with the Maternal Infant Health Program, Medicaid claims, and birth certificate data that has been cleaned by Michigan State University researchers. The researchers only had access to de-identified data delivered by the Strong Beginnings sub-contractor. Data are owned by Michigan State University under agreements with Spectrum Health and the Michigan Department of Health and Human Services, and remained on a secured Michigan State University server to which the researcher had access during the study period only.

Sample

For this study, the sample included women enrolled in interconception services period in the Strong Beginnings program who had an index birth between January 1st, 2013 and December 31st, 2015, with the follow-up period lasting until June 30th, 2017. An initial sample of 556 participants was identified from the Strong Beginnings database. Participants were excluded from the study if they were missing responses to any of the variables of interest. After accounting for missing data, a total of 455 participants were included in the statistical analysis of this study.

Measures

RRP. For this study, RRP was defined as a second pregnancy within 18 months of a previous birth. This definition was chosen because it is being used by the state of Michigan governor's office to examine the trends in RRP, in which they are invested. RRP was calculated using IPI length calculated from birth certificates of participants' children. First, the birthdate of

the first child was subtracted from the birth date of the second child, giving the time from the end of the first pregnancy to the end of the second pregnancy. Then the gestational age of child two at birth was subtracted from the first calculation to provide the IPI. The calculation completed was as follows: $IPI = (\text{Birth date of 2nd child} - \text{Birth date of 1st child}) - \text{gestational age of 2nd child}$.

Independent variables. In order to address individual, social, and environmental risk factors for RRP, many independent variables were used for this study that were assessed during enrollment into interconception services.

Individual Factors. Reproductive Life Plan. A reproductive life plan is an element of preconception care that women utilize to identify their plans for childbearing before they become pregnant (Files et al., 2011). A reproductive life plan often includes information about the women's desire for and ideal number of children, spacing of children maternal and paternal age, and maternal health, but can include an abundance of other information. This factor was assessed using a reproductive life plan variable that stated whether a reproductive life plan was developed, reviewed and not changed, or updated during enrollment. If any of these occurred the participant was identified as having a reproductive life plan. If participant did not have a reproductive life plan or if the reproductive life plan variable was missing a response the participant was identified as not having a reproductive life plan.

Pregnancy intendedness. Pregnancy intendedness was assessed using the question "Are you doing anything to prevent pregnancy?" Those who indicated yes were identified as not intending to become pregnant, while those who said no were identified as intending to become pregnant.

Contraception use. A combination of 17 variables were used to determine if a woman is using contraception. Each of the variables asked if the woman is using that specific type of birth control, true or false. The 17 types of birth control included abstinence, cervical cap, cervical ring, condoms, the patch, the diaphragm, female sterilization, male sterilization, implant, IUD, the pill, rhythm method, shot once a month, shot every three months, sponge, withdrawal, or other. These 17 specific types were broken down into six individual variables that included abstinence, barrier methods, sterilization, LARC methods, other modern methods, and none. A woman was identified as not using contraception if none of the variables was true, or if all of the variables were left blank.

Postpartum care. Postpartum care was assessed using the statement “Mother completed preventative health visit: 6-8 weeks postpartum”. If the participants had completed the six to eight-week preventative visit, she was identified as having completed postpartum care. Those who did not complete the visit were identified as not having completed postpartum care.

Mental health status. Mental health status was assessed using the Edinburgh Perinatal Depression Scale Score (EPDS) (Cox, Holden, & Sagovsky, 1987). The EPDS is a validated and frequently used self-report measure designed to screen women for depression and emotional distress during pregnancy and after birth. A score of 13 or higher was used to indicate that a woman was experiencing high depressive symptoms. Additionally, the Perceived Stress Scale (PSS) was used to assess whether a woman was experiencing high stress. The PSS is a frequently used, validated, self-report measure that considers a score of 27 or greater as high perceived stress (Cohen, Kamarck, & Mermelstein, 1983). Strong Beginnings utilizes a shortened version of the PSS scale with a score of seven or greater indicating high stress. Therefore, women with a score of 7 or greater were identified as having high stress.

Social Factors. Social support. Social support was determined using the question “Is there someone in your life who you can count on to help you with your baby?”, with yes or no response options.

History of abuse. History of abuse was recorded with the question “Have you ever been emotionally, physical, or sexually abused by your partner or someone important to you?”, with yes, no and refused response options.

Environmental Factors. Transportation. To assess the role of transportation in RRP, the question “Do you have access to routine transportation?” was used with yes and no response options. Participants who indicated yes were identified as having transportation issues, while those who indicated no or did not answer the question were identified as not having transportation issues.

Housing. Concerns about housing were assessed using the question, “Do you currently have concerns or worries about your housing situation?” If participants indicated yes, they were identified as having housing concerns, and those who indicated no were identified as not having housing concerns. Additionally, if a participant indicated that they were homeless, they were also identified as having housing concerns.

Variables Excluded from Analysis. There were a number of variables that were initially included in the data set, that were ultimately excluded during data cleaning due to a large number (20% or greater) of missing responses. These variables included information about a participant’s health understanding and confidence with their health literacy, Bridge card status, if they had trouble paying bills, and if they ever cut meals because they did not have enough money for food.

Sociodemographic factors. Using previous literature, sociodemographic factors for this study were identified and included: age, race/ethnicity, education level, and relationship status. Due to the low number of participants aged 18 years or less and 30 years or greater, age was evaluated using two categories, those aged 24 years and younger and those 25 years and older. Race/ethnicity was provided to the researchers broken down into Black, Hispanic, or other categories, with the other category including all other races that a participant could have identified as. Education was categorized as less than a high school diploma, high school diploma, and some college or more, and relationship status was either married, not married but paternity established, or not married and paternity not established. All sociodemographic variables were established using birth certificate data.

Data Analysis

Descriptive statistics were conducted for all variables in the sample and Chi-square tests of independence were utilized to assess differences between RRP and the potential predictor variables. Next, multivariable logistic regression models were fit to explore the effects of each predictor variable on the likelihood of RRP. All preliminary models built off of a base model which predicts the log odds of RRP using the sociodemographic factors. Then, the individual factors were added to the base model one at a time to identify those that may be suggestive of an association with RRP while controlling for the sociodemographic factors. Next, the individual factors that were found to be suggestive of an association with RRP ($p < 0.10$) were added to the model. However, there were no individual factors, outside of sterilization, found to be suggestive of RRP during this step, therefore this process was repeated for each of the social factors, while controlling for only the socio-demographic factors. Again, none of the social factors were found to be associated with RRP, therefore, each environmental factor was then explored in a similar

manner, while controlling for the socio-demographic factors to identify environmental factors suggestive of an association with RRP. Finally, the full model for this study was found to be the base model as none of the individual, social, or environmental factors were found to be associated with RRP, with the exception of sterilization, when controlling for the sociodemographic factors. Results of these analyses are reported in the form of odds ratios, 95 percent confidence intervals, and p-values. All statistical analysis was conducted using SAS version 9.4 (Cary, NC).

Chapter IV: Results

Demographics

Demographic characteristics of the study population are included in Table 1 in Appendix A. The cohort was equally distributed between the two age groups, over half identified as Black, 26% identified as Hispanic, and the remaining participants identified as another race/ethnicity; 36% had obtained a high school diploma while 27% had some college experience or more. The majority of the participants were unmarried, with 41% unmarried with established paternity and 42% unmarried without established paternity. Approximately one third of participants reported housing concerns or transportation issues (36% and 26%, respectively), while 94% of participants indicated that they had social support. Ten percent of participants had a high depression score, while 60% had a high stress score. Seventy-eight percent of the women in the cohort indicated that they were doing something to prevent pregnancy, with 79% of women using some form of contraception. Forty-four percent of participants had a reproductive life plan, and 40% had attended a six to eight-week postpartum visit after the index birth.

Seventy-nine women had a RRP (17%) during the study period. Twenty-five percent of women aged 24 years or younger had a RRP, and among those who identified as black 17% had a RRP while 21% of those who identified as Hispanic had a RRP. Twenty percent of those with less than a high school diploma had a RRP, while 17% those who were married, trying to prevent pregnancy, had a reproductive life plan, or had a high stress score had a RRP. Among women experiencing transportation issues or housing concerns, 16% had a RRP, and 15% of those with a history of abuse had a RRP. Eighteen percent of those with social support had a RRP and 11% of those with high depression scores had a RRP.

Chi-Square Tests of Independence

Compared to those who did not have a RRP, younger women were more likely to have a RRP, and women who indicate sterilization as their contraception method were less likely to have a RRP ($\chi^2(1, N=455) = 17.1, p<0.001$; $\chi^2(1, N=455) = 9.50, p=0.002$; respectively). While not statistically significant, women who completed the six to eight-week postpartum visit had a lower proportion of RRP occur compared to women who did not complete the six to eight-week postpartum visit (32% compared to 41%; $\chi^2(1, N=455) = 1.88, p<0.170$).

Logistic Regression

Results of the logistic regression models are reported in Table 2 in Appendix A. The base model suggests that age, race/ethnicity, education level, and relationship status are collectively associated with RRP ($\chi^2(4, N=455) = 23.0, p=0.002$). However, age was the only significant variable in the model, such that when controlling for other variables in the model, women aged 24 years or younger had 3.36 times greater odds of RRP compared to women aged 25 or greater (95% CI: 1.89-5.97; $p<0.001$). During further modeling, the association between age and RRP remained approximately the same, regardless of additional adjustment for the individual, environmental, and social factors. Sterilization as a contraception method was found to decrease the odds of RRP when controlling for all factors in the base model, however it was not included in further modeling (OR: 0.118, 95% CI: 0.016-0.884; $p=0.04$). All other factors investigated were not significantly associated with RRP, therefore, the base model was the final model for this study.

Chapter V: Discussion

Women in a predominantly minority Medicaid eligible population, aged 24 years or less were at three times greater odds of having a RRP compared to women aged 25 years and greater, when controlling for individual, social, and environmental risk factors. However, no other individual, social, or environmental risk factors were significantly associated with RRP. However, many of the individual, social, and environmental risk factors identified in this study have not been studied in previous literature to assess their association with RRP, specifically among a population similar to this study population. While no new risk factors for RRP were identified in this study and not all previously identified risk factors were confirmed, these findings provide useful information for Strong Beginnings, as well as future research exploring the association between individual, social, and environmental risk factors and RRP.

Primary Findings

The majority of studies that have examined the association between RRP and maternal age found that women under 20 and over 30 years of age are at the highest odds of RRP (Copen et al., 2015; Duncan, 1998; Thoma et al., 2016). However, this study has shown that among a Medicaid insured, predominantly minority population, women aged 24 years or less are at increased odds of RRP. This is important because, previous studies have examined the association between RRP and maternal age using samples that are demographically similar to the United States, where 14% of the population is black and 17% is Hispanic. These samples are not representative of the large minority participant population in Strong Beginnings, therefore the results of previous studies are not necessarily generalizable to the Strong Beginnings participant population. The current study has a predominant minority population (89%); therefore, the results are more generalizable to minority women, specifically women in Strong

Beginnings or programs with similar participant populations. This provides Strong Beginnings with statistics that are more applicable to their program participants, which can be useful when developing programming and prevention methods that could decrease RRP rates. This decrease in RRP rates would also aid Strong Beginnings in meeting some of their other goals, because a decrease in RRP rates may lead to a decrease in low and very low birth weight and preterm birth.

While this study did provide the Strong Beginnings population with an age group at increased odds of RRP specific to their program, the researchers were only able to break age down into two groups. Age data were provided to the researchers in categorical form. When filtering these categories down into four groups, it was found that there was a small number of participants in the lowest (19 years of age or less) and the oldest age group (30 years of age or greater). Therefore, these age groups were further combined into the two age groups that were included in the data analysis. This led to the inability of the study to compare multiple age groups to one another and it created a relatively large spanning age group to which the results were applied. Additionally, this limits the comparison that one can draw between studies, as previous research has utilized a larger and more diverse range of age groups in their analysis.

In addition to age, sterilization was found to decrease the odds of RRP when controlling for sociodemographic factors. However, the variable was not kept in the model for a few reasons. First, sterilization mostly has an irreversible effect on someone's ability to reproduce, and is sometimes done for the health of an individual, rather than because they wanted it performed. Additionally, sterilization could have been identified as a contraception method whether the women or her partner was sterile. This means that those who were utilizing sterilization were not necessarily the participants themselves. Finally, sterilization may not be desired among many

women, as they may weigh the option to continue to grow their family in the future, therefore, it is not necessarily useful on a programmatic level.

The Weathering Hypothesis

The findings from this study regarding age are contrary to previous literature, however, there may be a reason for these findings among this study population. In 1992, Geronimus (p. 207) hypothesized that “the health of African-American women may begin to deteriorate in early adulthood as a physical consequence of cumulative socioeconomic disadvantage”. This went on to be referred to as the weathering hypothesis, with the early deterioration of health referred to as weathering.

The proposal of the weathering hypothesis challenged the idea that risk factors affect each population the same way. One such factor that warranted reconsideration was maternal age. One reason for reconsideration laid within the black/white disparity in neonatal mortality, and how this disparity widens as maternal age increases (Geronimus, 1996). This widening occurs because the risk of neonatal mortality increases for black women during the late teens to early 20s, however, at the same age, white risk of neonatal mortality decreases. Geronimus (1996) suggested that maternal age be reexamined as an indicator of how social inequalities, racial bias or discrimination during exposures to psychosocial or environmental hazards may, on a population level, differently affect the health of black women compared to white women who will become mothers.

When exploring this reconsideration of maternal age, it was found that among black women, but not white women, increasing maternal age was associated with increased odds of low birth weight and very low birth weight (Geronimus, 1996). Specifically, 25-year-old black mothers see a 28% increase in the odds of low birth weight and 70% increase in the odds of very

low birth weight when compared to 15-year-old black mothers. When controlling for prenatal care, smoking, high blood pressure, and high-risk pregnancy, there is no association between maternal age and low birth weight, however, 25-year-old black mothers still experience 55% greater odds of very low birth weight compared to 15-year-old black mothers. Additionally, the relationship between maternal age and adverse birth outcomes was found to be stronger among black moms in low socioeconomic groups (Geronimus, 1996). For example, when controlling for maternal health characteristic, 25-year-old mothers at low socioeconomic status had 52% greater odds of low birth weight and 72% greater odds of very low birth weight compared to 15-year-old black mothers, while 25-year-old black mothers at high socioeconomic status had lower odds of low birth weight and 42% greater odds of very low birth weight compared to 15-year-old women. When focusing on Hispanic women, it was found that US born Hispanic women aged 17 to 19 years had lower rates of neonatal mortality than US born Hispanic women aged 20 to 23 and 30 to 34 years (Wildsmith, 2002). Furthermore, Hispanic women aged 15 to 19 years were found to have the greatest probability of a normal birth weight baby among all age groups, and after age 19, the probability of a normal birth weight decreased as age increased (Dennis, 2019). However, when comparing US born Hispanic women to white women, patterns of low birth weight by maternal age are largely similar (Dennis, 2013). Overall, previous literature has shown that socioeconomically disadvantaged black women experience health deterioration and risk of low and very low birth weight infants at an earlier age and more frequently than advantaged black women. Among Hispanic women, however, more research is needed to address the role that weathering may play in their reproductive health and risk of adverse birth outcomes.

The population in the current study is Medicaid eligible women in a Healthy Start program, therefore they are likely at a lower socioeconomic status than other women in the

community. Additionally, majority of the women in this study are Black or Hispanic. While the effects of weathering on Hispanic women is not as strong as for black women, it is possible that the women in the current study are choosing to start having children, and are having multiple children, at a younger age in order to decrease their risk of adverse birth outcomes such as low birth weight. This push to have multiple children younger may be why increased odds of RRP are seen among the women aged 24 years or less when compared to women aged 25 years or greater in the current study population.

Other Variables

Race/Ethnicity. This study was not able to identify difference between race and ethnicity in regard to the odds of RRP, while previous studies have shown that black women are at increased odds of RRP when compared to white women, especially among the shortest IPI ranges, and Hispanic women usually have the lowest rates of RRP (Copen et al., 2015; Duncan et al., 1998; Gemmill & Lindberg, 2013; Thoma et al., 2016). The main reason for this was the racial/ethnic breakdown of the study population. In this study population majority of participants identified as black (63%) or Hispanic (26%), therefore the comparison group typically used in previous literature, white women, was not available. However, due to this high minority population, researchers were able to focus on how individual, social, and environmental factors that may be affecting minority populations specifically, whereas previous studies were not able to do this. While looking at this large minority population, there were no difference in odds of RRP between the racial/ethnic groups, and this could be due to the way RRP was categorized in this study. RRP for this study was defined as a second pregnancy within 18 months of an index birth, without further breakdown of other IPI categories. Previous research has shown that black women have the greatest increase in odds of RRP during the zero to five month IPI ranges, while

white women see an increase in odds of RRP during the 12 to 17 month IPI range, however, these findings were not adjusted for age or education as in the current study (Thoma et al., 2016). Furthermore, Hispanic rates of RRP are typically lower than black rates among the six to eleven, and 12 to 17 month IPI ranges. Therefore, if this study was able to break down the RRP variable into IPI categories, difference between race/ethnic groups may have been identified. The identification of racial/ethnic difference in odds of RR during different IPI ranges would allow for Strong Beginnings to know when a woman of a specific race or ethnicity is most in need of RRP prevention methods.

Directionality. During analysis, a suggestive association was found between RRP and postpartum care. When controlling for the variables in the base model, women who did complete the six to eight-week postpartum care visit had 38% decrease in the odds of RRP compared to women who did not complete the six to eight-week postpartum care visit. While these were the only suggestive findings from the logistic regression models, it is important to note that the directionality of the results for some of variables analyzed was what would have been expected, based on the literature. For example, directionality shows that, if the results were significant, women with less than a high school diploma would have increased odds of RRP compared to women with a high school diploma and women with some college education or more, while women doing something to prevent pregnancy would have decreased odd of RRP compared to women not trying to prevent pregnancy.

However, other variables analyzed in this study did not have enough literature to support an expected outcome, including transportation issues, housing concerns, and history of abuse. All of these variables had a directionality that suggested having any of these factors would decrease your odds of RRP. This is opposite of what researchers hypothesized, however, some changes in

perspective explain why this directionality may be occurring in these variables. For example, researchers believed that women without access to transportation, or access to reliable transportation, would not be able to attend the six to eight-week postpartum care visit, therefore increasing their odds of RRP. However, majority of our participants were unmarried, and potentially not living with their partner if they had one, therefore, a lack of transportation could decrease the amount of time that a woman could be with her partner, and therefore decrease their odds of RRP. Similarly, if a woman had housing concerns she may not have time or a place for sexual activity to occur. Many of these changes in perspective are supported by literature that has found that women experiencing homelessness are more likely to isolate themselves, are focused on other priorities, such as finding a house, and often lack a safe or private place to have sex (Ecker, Cherner, Rae, & Czechowski, 2017). Additionally, transportation constraints were identified as a barrier to sexual relationships among those experiencing mental illness, however more research would be needed to see how it related to sexual relationships among a larger population. Furthermore, if a woman had experienced previous abuse, specifically by her partner or another man, she may not be engaging in physical or sexual activities, thus decreasing her odds of RRP. However, studies have found that majority of people say their history of physical or sexual abuse has influenced their current sexuality, but the way it affects each person is different (Roller, Martsofl, Draucker, & Ross, 2009). While some people engage in riskier sex behaviors, other are more likely to become non-sexual. Therefore, hypothesizing how history of abuse affects a participant's sexuality in this study population is not necessarily possible.

Another variable with interesting directionality was high depression score, where women having a high depression score would have had decreased odds of RRP. This directionally could be, in part, due to the proportion of the sample population (10%) that had a high depression

score. Further analysis including milder depression scores may increase the proportion of the study population who could be affected by depression symptoms, thus being able to complete another level of analysis. An explanation for this directionality could lie within the symptoms of depression itself. Women diagnosed with depression may experience excessive sadness, loss of interest, social isolation, and many other factors, that may deter them from partaking in physical or sexual activities, thus decreasing their odds of RRP. This is supported by Ostman (2008) who found that people experiencing depression can lose sexual drive, especially when using certain medications, and sometimes don't want to engage in sexual activity. However, it is important to note is that many participants indicated a loss of sexual capacity not a loss of sexual desire. One last thing to note concerning the non-significance of the high depression variable in this study, is that it is consistent with studies by Bennett et al., (2006) and Crittenden et al. (2009) that found when controlling for things such as education level, contraception use, and measures of aggression, there is no association between RRP and depression.

Social Support among this study population was high (94%), however, this factor was not associated with RRP and did not have a directionality to it, with the odds ratio being exactly one. These results, however, are some-what consistent with previous literature which indicates that among adolescents, attachments to church groups and parents, but no other forms of social support or social attachments, were associated with decreased odds of RRP (Reese and Halpern, 2016). This study only utilized one mode of social support, if a woman had someone to help her with the baby, including variables with more detail on the forms of social support, would have allowed for more comparisons to be made.

Finally, the reproductive life plan variable was consistent with previous findings. Literature has shown that when a woman participates in family planning, RRP still occurs. This

is driven by disconcerting pregnancy intentions among couples. For example, when a woman intends a pregnancy, but her partner does not, the odds of RRP decrease (Cha et al. 2016). However, when a woman does not intend pregnancy, but her partner does, the odds of RRP increase. This information suggests that the lack of significance surrounding the family planning variable in this study may be, in part, due to the lack of detail surrounding family planning. Specifically, information on who took part in family planning, as well as what the plan may have impacted the results of this study.

Public Health Implications

Prevention is the main reason for identifying risk factors for any outcome in public health. This is the case when studying risk factors for RRP. However, the prevention of RRP would also lead to a decrease in a number of adverse birth outcomes including low and very low birth weight, preterm birth, birth defects, and infant mortality. These birth outcomes place a large financial burden on families in Kent County, Michigan, and nationwide, when the cost of a one day neonatal intensive care unit can exceed \$3,500 (Muraskas & Parsi, 2008). In addition to the financial burden, families with children in the neonatal intensive care unit experience depression, anxiety, stress, insecurity, senses of alienation, and feelings of control loss (Obeidat et al., 2009). This is why a study of this nature is pivotal in the field of public health. While this study did not identify modifiable risk factors associated with RRP, it did identify an age group, among a specific population in Kent County, Michigan, with increased odds of RRP that has not previously been identified, which creates a few key areas for public health intervention.

First, replication of these results with additional years of data, would be beneficial, in order to increase and strengthen the evidence of the association among the Strong Beginnings population. Additionally, research on the association between individual, social, and

environmental factors and RRP using a more diverse, state or nationwide, sample may identify other risk factors that this study was not able to. Results from a study this nature would provide public health professionals with information on modifiable risk factors for RRP that are applicable to the general population, which could be used to develop more effective prevention methods. Furthermore, assessing the association between RRP and age on a continuous scale, versus a categorical scale, during future studies may provide more insight on which specific age or ages are at increased odds of RRP. While more research is being conducted, changing the focus of RRP prevention may be beneficial. Not only targeting prevention methods to the women in the 24 years of age or less age group, but making an effort to understand why these women are having a second pregnancy so quickly. Identifying whether the second pregnancy was intentional or unintentional would be a great start. Once this is established, exploring the reasons behind an intentional RRP may provide insight for the Strong Beginnings team as to what areas need more focus, updating, and refinement in terms of education, prevention, and resources.

When drawing in the weathering hypothesis, it would be beneficial for more research to be done surrounding the association between RRP and weathering. This could be done by including variables that measure socioeconomic status such as income, geographic location, home ownership, employment, occupation, and many others and assessing their association with RRP when adjusting for age and race/ethnicity. Additionally, a composite score could be created using multiple variables. There is no gold standard way to measure socioeconomic status, so research would be needed to identify the best measures for the Strong Beginnings, or other, populations. Results from a study of this nature could allow for public health professionals to implement programs to decrease the gap in socioeconomic disadvantage seen between black and whites in Kent County. Intervention methods of this magnitude would be a lot for any one

person, group, or organization to take on, but the ground work that has been laid by Strong Beginnings and other organization in Kent County provides a great place to start. Additionally, intervention methods addressing these issues would not only decrease rates of RRP, they would also have other positive effects on the mental and physical health of black and Hispanic persons in Kent County.

Finally, increase in education surrounding RRP on a countywide scale would be beneficial. Strong Beginnings currently educates program participants on RRP and the benefits of waiting to have another child. Implementation of similar education practices during postpartum care and/or primary care visits would increase the knowledge of RRP among the general population. Additionally, revamping or introducing reproductive health classes on a community level would allow for greater knowledge of RRP, maternal risk factors for adverse birth outcomes, the most dangerous periods of fetal development, overall reproductive health, and other pregnancy related topics would be beneficial. Programs like this could provide resources and social support for women, and men, in the community who are pregnant, have a pregnant partner, are planning to become pregnant, or want to know more about their reproductive health. The basic understanding of what can affect maternal, child, and life-long health would allow any person to make more informed, potentially better, decisions during their lifetime.

Strengths

This study has many strengths, with it being one of the first studies to look at the association between RRP and many individual, social, and environmental risk factors overall, and specifically among this type of population. The high proportion of black and Hispanic women in this population allowed researchers to gain a better understanding of RRP among these

racial and ethnic minority groups. The results provide a great stepping stone for further research of association with RRP. Next, the results of this study are of interest to Strong Beginnings, the provider of the data. This means that the results of this study will be used by an organization to analyze and improve programming, education, and intervention efforts. Finally, the results of this study are generalizable to many of the 100 Healthy Start Programs and other home visiting programs in the United States that serve similar populations. This mean that the improvements or changes made in the programming, education and intervention efforts made at Strong Beginnings could be implemented and adapted in other Healthy Start Locations, potentially decreasing rates of RRP in more than one location.

Limitations

In addition to the strengths to this study, there are a few limitations as well. The first being that sample population used for this study was limited to women in a Healthy Start program, meaning the results of this study are not generalizable to the general United States population. Additionally, there was misclassification when identifying women who have a RRP. This issue stemmed from women changing insurances between their index and secondary pregnancy and women who do not have a live birth for the secondary pregnancy. Women who were enrolled in Medicaid during the index pregnancy who went on to have private insurance during the second pregnancy were misclassified as not having a second pregnancy, as the birth certificate was not available to Strong Beginnings. Additionally, if a woman did not have a live birth at the end of the second pregnancy, there was no birth certificate for the child, therefore she will be misclassified as not having a second pregnancy.

Another limitation lies within the assumptions the researchers worked throughout data cleaning and analysis. First, any participant that did not indicate that they had transportation

issues were categorized as not having transportation issues. This may have led to an underestimation of women experiencing transportation issues, thus influencing the potential association, and/or directionality of the association, between RRP and transportation, which in this study showed that those with transportation issues would have lower odds of RRP. In addition to transportation, researchers were working under the assumption that pregnancy prevention utilization could be used as a proxy for pregnancy intendedness. However, researchers only had baseline data about whether women were doing anything to prevent pregnancy, therefore were unable to identify changes in pregnancy prevention, thus pregnancy intendedness, throughout the study. This means that women may have been identified as having an unintended RRP, when in reality they were intending the pregnancy, and therefore, the association between RRP and pregnancy intendedness may have been skewed in this analysis. Overall, these assumptions may have skewed the results of these variables, therefore hindering the identification of true associations.

The two-level grouping of age in this study also proved to be a limitation of this study. The inability to create smaller spanning age groups limits the comparability of this study to previous literature and limited the analysis that compared age groups to one another. One last limitation is that this is a secondary data analysis. This cause there to be a lack of data available for some factors that were of interest in the study, and some factors were not included in this data set, therefore their relationship with RRP was not able to be explored during the analysis.

Main Conclusions

RRP had been shown to increase the risk of adverse birth outcomes such as preterm birth, low birth weight, birth defects, and infant mortality. However, limited research had been conducted with adult populations to identify individual, social, or environmental risk factors for

RRP. This study identified that in a predominantly minority Medicaid eligible population, women aged 24 years or less are at increased odds of experiencing a RRP compared to women aged 25 years and greater, when individually controlling for many individual, social, and environmental risk factors. This may be in part due to the effects of socioeconomic disadvantage that black and Hispanic women experience throughout their lives, and how that impacts their overall and reproductive health. However, more studies are needed to identify the association between weathering and RRP. Additionally, larger, state or nationwide studies are needed to assess the association between RRP and individual, social, and environmental factors in a more diverse and representative sample.

Appendix A

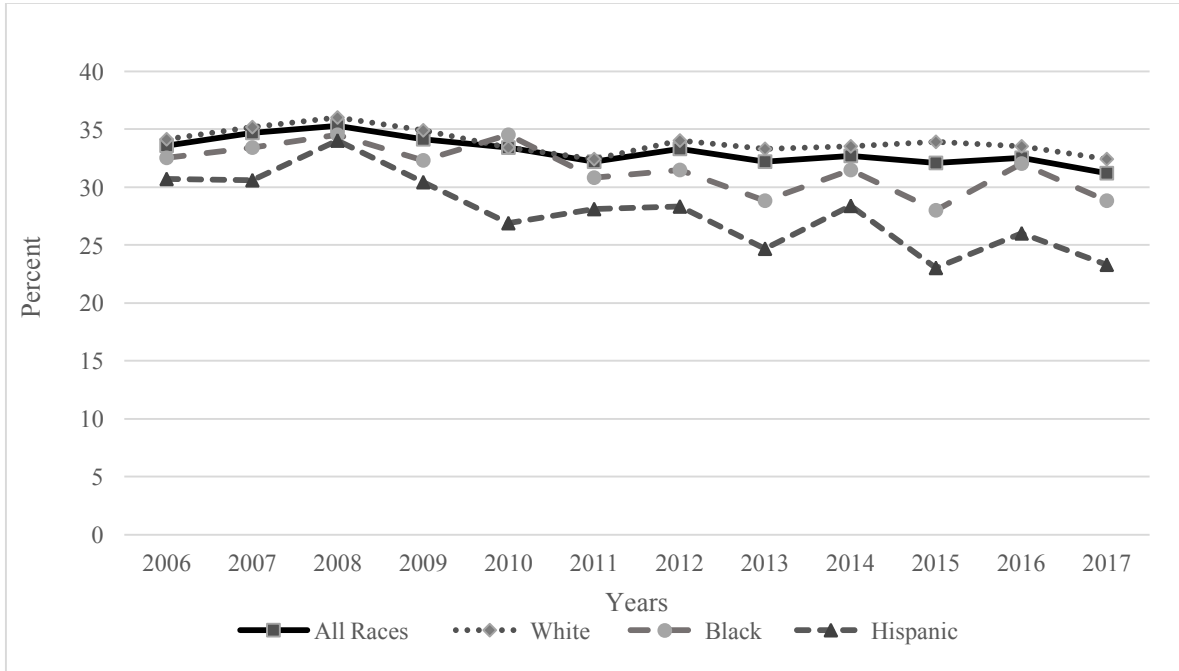


Figure 1. Percent of multiparous live births with an IPI of 18 months from 2006 to 2016 in Kent County.

Geocoded Michigan Birth Certificate Registry. (2016). Division for Vital Records & Health Statistics, Michigan Department of Health & Human Services.

Table 1*Demographic characteristic of the study population broken down by rapid repeat pregnancy status*

Variable	Total	Rapid Repeat Pregnancy		No Rapid Repeat Pregnancy		<i>P</i>
	<u>N</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
Total	455	79	17	376	83	
Age						
≤ 24	232	57	25	175	75	<0.001
25+	223	22	10	203	90	
Race						
Black	287	48	17	239	83	0.466
Hispanic	116	24	21	92	79	
Other	52	7	13	45	87	
Education Level						
Less than High School Diploma	164	33	20	131	80	0.411
High School Diploma	164	28	17	136	83	
Some College or More	127	18	14	109	86	
Partner Status						
Married	78	13	17	65	83	0.531
Not Married & Paternity Established	188	37	20	151	80	
Not Married & Paternity Not Established	189	29	15	160	86	
Reproductive Life Plan	201	35	17	166	83	0.979
Intending to Prevent Pregnancy	353	60	17	293	83	0.702
Contraception						
None	121	21	17	100	83	0.998
Abstinence	97	21	22	76	78	0.209
Barrier Methods	20	5	25	15	75	0.356
Sterilization	51	1	2	50	98	0.002
LARC Method	12	0	0	12	100	0.108
Ring/Patch/Shot/Pill	154	31	20	123	80	0.265
Postpartum Care	181	26	14	155	86	0.170
High Depression Score	44	5	11	39	89	0.269
High Stress Score	272	47	17	225	83	0.954
Social Support	427	77	18	350	82	0.141
History of Abuse	151	23	15	128	85	0.398
Housing Concerns	163	26	16	137	84	0.553
Transportation Issues	119	19	16	100	84	0.563

Intending to Prevent Pregnancy	0.851 (0.473 , 1.53)						
Contraception							
None	1.04 (0.593 , 1.84)						
Abstinence		1.44 (0.806 , 2.58)					
Barrier Methods			1.55 (0.521 , 4.61)				
Sterilization				0.118 (0.016 , 0.884) *			
LARC				---			
Ring/Patch/Shot/Pill					1.17 (0.689 , 1.97)		
Postpartum Care						0.626 (0.356 , 1.10)	
High Depression Score							0.663 (0.247 , 1.78)
High Stress Score							1.00 (0.599 , 1.67)
Social Support							2.39 (0.534 , 10.7)
History of Abuse							0.924 (0.534 , 1.60)

Housing Concerns

0.927
(0.543
, 1.58)

Transportation
Issues

0.897
(0.496
, 1.62)

Notes. *significant at the 0.05 level; **significant at the <0.001 level

Abbreviations: HSD, High School Diploma; RLP, Reproductive Life Plan

Models: Base Model: Age, Race, Education Level, and Partner Status; Model 1: Base + RLP; Model 2: Base + Intending to Prevent

Pregnancy; Model 3: Base + Contraception- None; Model 4: Base + Contraception- Abstinence; Model 5: Base + Contraception- Barrier

Methods; Model 6: Base + Contraception- Sterilization; Model 7: Base + Contraception- LARC; Model 8: Base + Contraception-

Ring/Pill/Patch/Shot; Model 9: Base + Postpartum Care; Model 10: Base + High Depression Score; Model 11: Base + High Stress Score;

Model 12: Base + Social Support; Model 13: Base + History of Abuse; Model 14: Base + Housing Concerns; Model 15: Base +

Transportation Issues

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