5-9-2024

The Relationship Between Social Risk Factors and Pre-term Births in Hawai'i

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Walden University
2024

Abstract

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MS, Trident University International, 2011

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Dissertation Submitted in Partial Fulfillment

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Public Health

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Abstract

Premature birth remains the leading cause of neonatal death and is associated with birth defects and long-term health morbidities. Hawai'i, with dominant Pacific Islander, Asian, and White populations, ranks 18th amongst the states with the highest rate of preterm birth. Guided by the social ecological model, the purpose of this quantitative, cross-sectional research study was to determine the extent of the association of social risk factors and preterm birth in the state of Hawai'i for the years 2012-2015 using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS). Preterm birth in Hawai'i from 2012- 2015 was found to be 17% of all births. Using logistic regression analysis, results of this study revealed preterm birth was significantly associated with maternal race, maternal age, district of maternal residence, and paternal race ($p < .05$). Black mothers in Hawai'i were twice as likely to experience preterm birth than White mothers. Asian and Filipino mothers followed at 1.8 times greater likelihood of experiencing preterm birth than White mothers. Age was found to have some protective association with preterm birth with mothers in the age group of 20-24 years 48% less likely to experience preterm birth. Urban mothers were 3 times more likely to experience preterm birth. Implications for positive social change include identifying populations vulnerable to preterm birth, facilitating development of programs and projects that target these individuals and groups, alleviating, and eventually eradicating preterm birth.

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Dedication

This dissertation is dedicated to my children: Nicholai Ryann (11), Nathaniel Riley (11), Noah Reinier (5), and Noelle Rose (4). My world revolves around them. They remind me that every waking moment is an opportunity to be grateful and to make a difference even in the smallest way possible.

Acknowledgments

I am ever thankful to my committee: Dr. Diana Naser and Dr. Peter Anderson. They have been the guiding voice in this lengthy process. I am constantly grateful to my husband, Brian, for being my support through my doctoral studies. I am thankful for family and close friends who have been my cheering squad.

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Chapter 1: Introduction to the Study

Introduction

The 10 leading contributors to the infant mortality rate in the United States are congenital malformation, low birth weight, maternal complications, sudden infant death syndrome (SIDS), unintentional injuries, cord and placental complications, bacterial sepsis, diseases of the circulatory system, respiratory distress, and neonatal hemorrhage (Xu et al., 2020). Eli and Driscoll (2019) indicated that 67% of infant deaths are attributed to preterm births (less than 37 weeks of gestation). Preterm birth affects 1 in every 10 births in the United States, about 10.02% (Center for Disease Control and Prevention (CDC), 2017). Infant mortality rates were observed to be at the highest for infants born before 28 weeks of gestation (384.39 infant deaths per 1,000 births) and mortality rates declined as gestation progressed (Eli & Driscoll, 2019). Mortality for infants born before 28 weeks of gestation was 183 times more likely than for full term infants (Eli & Driscoll, 2019). The phenomenon of preterm birth can also be observed worldwide. The incidence of preterm birth ranges from 5% to 13% in Europe, Australia, Northern America, Asia, and Africa (Jing et al., 2018).

Jiang et al. (2018) claimed that the etiology of preterm birth is multifactorial. It is a product of biochemical mechanisms, genetic attributes, and socioeconomic factors. This research will focus on the social factors that affect preterm birth. Braveman and Gottlieb (2014) indicated that a stepwise social gradient is associated with health. Health is impacted by measures of individuals' socioeconomic resources, social position, income, education, and socioeconomic status (Braveman & Gottlieb, 2014). A social gradient persists in the distribution of preterm birth placing women with lower socioeconomic status at higher risk. Ju et al. (2018) implied further investigation is critical to assess interactions between race, maternal health, and neonatal morbidity, and to recognize methods to enhance birth outcomes for minority populations in the state of Hawai'i. The positive social change implication of this research is that the findings may provide a greater knowledge on the of the social factors with preterm birth, as well as maternal and child health on the island of Hawai'i. This chapter includes the background for this study, problem statement, theoretical framework, purpose of study, research questions, and nature of study as well as assumptions and limitations.

Background

Preterm birth is clinically defined by the Institute of Medicine (2007) as birth before 37 weeks of gestation. Previous studies have established the influence of socioeconomic determinants on preterm birth: race, maternal status and paternal involvement, maternal education, and maternal age. Disparities in preterm birth regarding race and ethnicity have persisted through decades (Behrman & Butler, 2007). Previous studies have observed and investigated the association between race and preterm birth (Huynh et al., 2018; Margerison-Ziko et al., 2017). This association is typical observed in non-Hispanic Blacks (Margerison-Ziko et al., 2017; Smid et al., 2017). Lee et al. (2014) indicated significant differences in perinatal outcomes between Pacific Islander and White women and newborns. Previous studies have shown that unmarried or single women have higher risk for preterm birth (Behrman & Butler, 2007). Moreover, paternal involvement has been studied as a protective mechanism for preterm birth (Hibbs et al., 2018). Behrman and Butler (2007) postulated that maternal age is an important risk factor for preterm birth. Mayo et al. (2017) conveyed that teenagers have a higher risk of preterm birth and Kozuki et al. (2013) observed the likelihood of preterm birth in women with advanced age.

Like the association between race and preterm birth, the association between socioeconomic status and preterm birth have also been well studied. Wallaceet al. (2015) postulated that increasing income inequality is associated with increasing rates of preterm birth. Glinianaia et al. (2013) investigated notable associations between socioeconomic status (SES), birth weight, and gestational age in Newcastle, England from 1961 to 2000 but these associations still need to be further explored. There are studies that attribute an association between preterm birth and ethnic disparity because of differential neighborhood opportunities (Pearl et al., 2018) comparing high and low opportunity neighborhoods. Disparities in birth outcomes have also been associated with differential exposures in the built environment (Gray et al., 2014; Padula et al., 2018).

Problem Statement

Hawai'i has a unique population demographic from the rest of the United States, with 37.6 % Asians, 10.1% Pacific Islander, and 24% mixed race (Census.gov, 2019). Despite advancement in technology the prevalence of preterm births in Hawai'i has remained constantly high. According to the March of Dimes 2020 Report Card for Hawai'i (2021), preterm births in Hawai'i have remained at 10% (or 1 in 10 births) since 2010. Researchers have depicted the associations between preterm birth with social determinants, such as maternal and social characteristics, household income, and social support. Premature birth remains the leading cause of neonatal deaths and is associated with birth defects and long-term health morbidities and consequences, with an annual national price tag of 26.2 billion dollars (March of Dimes, 2015). In comparison with their full-term counterparts, preterm infants are at increased risk for neonatal and infant mortality, as well as respiratory, intestinal, immune, neurological, cardiovascular, hearing, and vision problems that can manifest in childhood and adulthood (Margerison-Zilko et al., 2015). Ju et al. (2018) also expressed the need for further research investigating the interactions of social factors and birth outcomes. Though data and reports exist depicting the rates and prevalence of preterm birth in Hawai'i, there are no primary publications evaluating the risk factors of maternal and social characteristics, household income, and social support associated with preterm birth in Hawai'i.

Purpose of the Study

The purpose of this cross-sectional quantitative research study was to test the association of social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal race, paternal education, annual income, and county and district of residence) and preterm birth in the state of Hawai'i for the years 2012 to 2015 using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS). The dependent variable in this study was preterm birth and the independent variable was social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal race, paternal education, annual income, and county and district of residence).

Research Question and Hypotheses

RQ1: Using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS), is there an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015?

$H_0$1 There is no association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a1 There is an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

RQ2: Using the Hawaii Pregnancy Risk Assessment and Monitoring Systems (PRAMS), is there an association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015?

$H_0$2 There is no association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015.

H_a2 There is an association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015.

RQ3: Using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS), is there an association between paternal age, race, and education in Hawai'i for the years 2012-2015?

$H_0$3 There is no association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a3 There is an association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

Theoretical Framework

With the idea of the social etiology of disease, I chose to use the social ecological model (SEM) as the guiding framework for my research. SEM posits how the difference in exposure in risk factors ensues from intricate interactions at the individual, community, organizational, and policy levels (McLeroy et al., 1988). SEM provides a framework for identifying and understanding how different social variables influence the adverse outcome of preterm birth. The individual level of SEM identifies personal factors that increases the likelihood of preterm birth like age, education, and race. Relationship level of SEM depicts close relationships and influences that can increase the risk for preterm birth like maternal status or paternal involvement. The community level of the SEM recognizes the importance geographical and environmental settings in the prevalence of preterm birth. SEM will also help me identify possible recommendations for interventions that are directed towards changes at the intrapersonal, interpersonal, organizational, community, and public policy levels. The theoretical framework is discussed in more detail in Chapter 2.

Nature of Study

For this cross-sectional quantitative research study, I will use the Hawai'i Pregnancy Risk Assessment and Monitoring System (PRAMS). PRAMS is a collaborative surveillance project of the Centers for Disease Control and Prevention (CDC, 2019) and state health departments (Hawai'i Department of Health (HDH) 2017). The CDC (2019) asserted that the vigor of the PRAMS surveillance system lies within standardized data collection methodology which allows for comparisons among states and for optimal use of the data for single-state or multistate analysis. This methodology is prescribed by the CDC and followed by each state, but each state also could modify some portions of the questionnaire to adapt to the needs of the state (CDC, 2019). PRAMS combines two modes of data collection; a survey conducted by mailed questionnaire with multiple follow-up attempts, and a survey by telephone (CDC, 2019). In Hawai'i, the PRAMS questionnaire is mailed to approximately 200 new mothers per month that are randomly selected from birth records (State of Hawai'i DOH, 2020). The questionnaire includes the core questions that are asked by PRAMS programs in all PRAMS states as well as Hawai'i-specific questions. I analyzed PRAMS data for the years 2012 to 2015. The PRAMS data is a fusion of birth data and survey question data. I used logistic regression to enumerate the association of social risk factors and preterm birth with a dependent variable of preterm birth and independent variables of social risk factors (age, race, education, household annual income, marital status, and county and district of residence).

Definition of Terms

Preterm birth: (also termed *prmature birth*) is an adverse outcome of pregnancy in which delivery of a live-born infant occurs before the completion of 37 gestational weeks (Boslaugh, 2008).

Gestational age: is the period in which the fetus grows inside the uterus. which is taken from the beginning of the woman's last menstrual period (Boslaugh, 2008).

Term birth: is a birth that occurred between 37 and 41 completed weeks of gestation (Spong, 2013).

Socioeconomic status: is a measure of an individual's or family's relative economic and social standing as determined by a composite of factors such as income, educational attainment, occupation, residential location, and social status in the community (O'Leary, 2007).

Maternal/Paternal race (birth data variable): is the indication of a mother's/ father's ethnic background (Shyang-Yun et al., 2005).

Maternal / Paternal education (birth data variable): is a measure of socioeconomic status, indicating the highest level of education a mother/ father has attained (Harding et al., 2015).

Maternal / Paternal age (birth data variable): *is the measure of age in years at the time of pregnancy (Cavazos, et al., 2015).*

Household income (PRAMS question # 75): is a measure of socioeconomic status, indicating an individual or groups annual earnings (Whitehead, 2012).

Assumptions

Research studies are conducted with researchers having assumptions (Verma, 2019). The study's validity and accuracy is dependent on meeting these assumptions. For this research, I used secondary data. I assumed that this secondary data is representative of the population of Hawai'i. The accuracy of the data is essential in creating a reliable inference (Verma, 2019). I assumed that the respondent of the survey answered honestly, completely, and to the best of their knowledge. I could not prove this true given that it is a secondary data. For logistic regression, I assumed that sample size is large enough to create a powerful inference (see Verma, 2019).

Scope and Delimitations

I conducted this study using data retrieved from PRAMS in the State of Hawai'i. I chose to conduct this study with Hawai'i because of its unique population composition. While most of the U.S. states are predominantly White, the Hawai'ian population is predominantly Asian (U.S. Census, 2019). A difference in population composition may mean different risk factors for preterm birth. The findings of this study, however, may only be applicable to the population of Hawai'i. For this research, I also considered, but did not use, theory sprouting from the socioecological model: the social etiology model. The social etiology model can be used to test whether the occurrence of one disease or disorder is associated with social risk factors (Aneshensel, 2005). Social etiology is driven to identify these social risk factors (Aneshensel, 2005). I also limited my study to the population of Hawai'i given unique population diversity. I chose to focus on Phase 7 (2012 to 2015) of Hawai'i PRAMS. This phase is, so far, the most complete data Hawai'i PRAMS have that will allow this research to have sufficient sample size to create a powerful inference.

Limitations

The PRAMS is a voluntary survey. Despite the rigor that PRAMS may possess from its randomized methodology, it is still a voluntary survey. The limitation of this study arises from the plausible bias that might arise from the volunteer sample that may or may or may not represent the general population (Salkind, 2010). Being a secondary data analysis, respondent bias was a limitation that I could not address in this study. The results of this study have a limited generalizability to the population of the State of Hawai'i.

Significance

Preterm birth and the consequences attached to prematurity cost the government up to $26.2 billion in 2015 (March of Dimes, 2016). There is a wide array of reasons for preterm birth to occur, but studies have previously associated preterm birth with social determinants, such as maternal and social characteristics, household income, and social support (Snelgrove & Murphy, 2015). Though data and reports exist depicting the rates and prevalence of preterm birth in Hawai'i, there are no primary publications evaluating the risk factors associated with preterm birth. Hawai'i has a unique population demographic from the rest of the United States, with greater than 50% of its population consisting of Asian individuals (Hawai'i.gov, 2016). Despite advancement in technology, the prevalence of preterm birth has remained constant. One in 10 births in the state of Hawai'i has been observed to be preterm (March of Dimes, 2017). Kim et al. (2018), in their comparison birth outcomes between U.S. and foreign-born women, indicated that there is an impending need to evaluate the social factors associated with preterm birth in Hawai'i. Evaluating the social factors associated with preterm birth in the state of Hawai'i will serve as the original contribution of this research.

Public health organizations have an intrinsic social duty to enumerate the social inequalities associated with preterm birth. According to the Hawai'i State Department of Health (2015), their Perinatal Support Program, which screens for psychosocial, behavioral, and environmental risk factors and conditions, is designed to increase early prenatal care; decrease incidence of preterm, low, and very low birth infants; and improve the health of the participants. Pregnant women receive individual or group health education to address major risk factors that contribute to the incidence of preterm birth and low-birth weight infants (HDOH, 2015). Despite these programs in place, Hawai'i remains at a Level D for the March of Dimes Preterm Birth Scoring Criteria (March of Dimes, 2017). The potential positive social change implications of this research could be to alleviate the burden of preterm birth by addressing social risk factors in Hawai'i. Further observation and identification of these social risk factors could facilitate development of programs and projects that targets the individuals and groups that are most affected by such gradient and aid in reducing the rates of preterm birth.

Summary

Preterm birth is a multifactorial phenomenon that is influenced by biochemical mechanisms and social dynamics. This study examined the association of socioeconomic factors that affects the prevalence of preterm birth in the population of Hawai'i with the levels of socioeconomic model as a guiding theory. Using the PRAMS data, a quantitative secondary logistic regression analysis will be conducted to determine the significance of the relationship between social risk factors (race, age, education, income, marital status, county and district of residence) and preterm birth in Hawai'i's population. In Chapter 2, a review of literature examines the body of research related to preterm birth.

Chapter 2 Literature Review

Introduction

Preterm birth is the leading cause of neonatal mortality worldwide (Snelgrove & Murphy, 2015). The body of scholarly research has established that there is socioeconomic gradient associated with preterm birth. Identifying and quantifying such gradient related to preterm birth in Hawai'i could contribute to the improvement and rectification of current programs and policies that may lead to enhanced health outcomes for mothers and their newborn babies. The purpose of this research was to determine the association of social risk factors (maternal age, paternal age, race, marital status, education, annual income, and county and district of residence) and preterm birth in the state of Hawai'i for the years 2012 to 2015 using the Hawai'i PRAMS. In this chapter, I present the current body of literature that specifically expounds on the association between the different social variables and preterm birth and the theoretical framework for this research.

Literature Search Strategy

I conducted a thorough search of literature relevant to my study of preterm birth and social determinants of health. I incorporated peer-reviewed articles, reports of evidence-based practice, case studies, and systematic reviews in social sciences, behavioral sciences, epidemiological, medical, and nursing literature using CINAHL & MEDLINE Combined Search, ProQuest Health, and Medical Collection, and ScienceDirect database published between 1990 to 2021. I explored these databases using focused key terms that included: socioeconomic status, education, race, gender, preterm birth, premature birth, and adverse pregnancy outcomes. For this literature review, I reviewed over 50 articles, dating from 2013 until the present, depicting the association of the social determinants of health with preterm birth. I chose the articles in this review to relate to the variables of interest in this study (race, gender, age, education, income, and marital status).

Theoretical Framework

Social determinants of health are conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks (CDC, 2017). Link and Phelan (2002) suggested that an individual's ability to suffer from diseases and death is based upon their ability to draw out the benefits from the resources that are available to them such as "knowledge, money, power prestige, and social connections" (p. 730). Individuals can use such resources are able to achieve a health advantage. The availability of resources can directly shape individual health behavior by influencing whether people know about, have access to, can afford, and are supported in their efforts to engage in improving behaviors (Link & Phelan, 1995). These resources can also grant exposure and access to risk and protective factors of the disease (Link & Phelan, 1995).

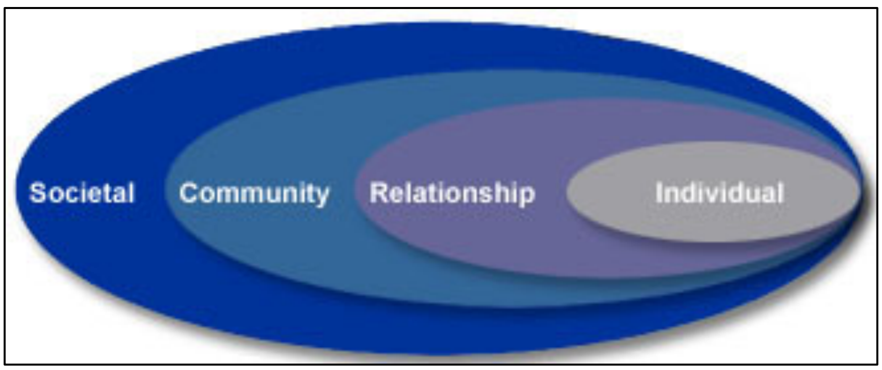
Social Ecological Model

With the idea of the social etiology of disease, I chose to use the SEM as the guiding framework for my research. SEM posits how the difference in exposure in risk factors ensues from intricate interactions at the individual, community, organizational, and policy levels (McLeroy et al., 1988). SEM provides a framework for identifying and understanding how different social variables influence the adverse outcome of preterm birth. I used the SEM to identify possible recommendations for interventions that are direct towards changes at the intrapersonal, interpersonal, organizational, community, and public policy levels.

McLeroy et al. (1988) imposed that an individual's health behavior can be influence at the following levels.

Figure 1

Levels of Determinants of Health



Note. Adapted from "The Social-Ecological Model: A Framework for Prevention" by The Center for Disease Control and Prevention, 2019, https://www.cdc.gov/violenceprevention/publichealthissue/social-ecologicalmodel.html

The first level of the SEM is the intrapersonal or individual level. At the individual level, one can examine factors that characterize an individual like knowledge, education, attitudes, and behavior. In analyzing this level into my research, I examined the individual risk factors, such maternal/paternal race, maternal/paternal age, maternal/paternal education, marital status, socioeconomic status and geographical demographic, that may influence preterm birth. Invention strategies at this level may target to affect behavioral and attitude changes in the individual (McLeroy et al., 1988). The second level is the interpersonal level. At this level, one can examine relationships that surrounds that individual and how these relationships influence health choices in the individual. Intervention strategies at this level aim to influence health behavior through these relationships (McLeroy et al., 1988).

The third level is the organizational level. At this level, it is assumed that organizations in which an individual may belong to can influence their health choices. Intervention strategies at this level can promote health behavioral changes by having organizations endorse health-aiding choice (McLeroy et al., 1988).

The fourth level is the community level. The community level, as McLeroy et al. (1988) indicated is comprised of mediating structures that motivate the norms and beliefs of that individual and organization. Intervention strategies at this level may deem to make use of these mediating structures to further influence changes in behavioral health choices.

The final level is the public policy/societal level. At this level, laws and policies are analyzed to determine their influence on the health of the individual. Strategies at these levels make include revision of the policy or even creation of a new one to influence healthier behavior (McLeroy et al., 1988).

Alio et al. (2010) posited that the ecological model provides an ideal theoretical perspective in examining disparities in birth outcomes, including those that are impacted by maternal and family characteristics, which are in turn strongly influenced by the larger community and society.

Preterm Birth

A *preterm birth* is diagnostically considered as birth before 37 weeks of gestation (CDC, 2019). In the United States, preterm birth occurs in 1 out of every 10 birth (CDC, 2019). Throughout gestation, the fetus goes through important developmental milestones including the final weeks of pregnancy (CDC, 2019). Babies that are born too early are more vulnerable to infant death and disability (CDC, 2019).

Social Determinants of Health and Preterm Birth

Social determinants of health, according to the World Health Organization (n.d.), are the "conditions in which people are born, grow, live, work and age. (p.1)" Social inequities and disparities are attributed to the unfair distribution of money, power, and resources. Differences in health status are also a result of these social inequalities. Preterm birth, when a baby is born too early (CDC, 2019a), is also a consequence of disparity of health status. The CDC (2019a) claimed that 1 in 10 infants in the United States are born premature in 2018. Preterm birth is also considered to be second largest direct cause of child deaths in children younger than 5 years (Blencowe, 2012).

Race and Preterm Birth

Race as social determinant of preterm birth. Race and ethnicity are significant variables in the disparity in preterm birth. Researchers have studied the mechanisms and driving factors why race and ethnicity continues to affect the morbidity of preterm birth. In 2017, Margerison-Ziko et al. assessed changes in preterm delivery (PTD) in the United States from 2006 to 2012 by clinical circumstance, timing of delivery, and race/ethnicity using vital statistics natality data on all singleton live births from the 18 U.S. states from

2006 to 2012. They learned that despite late-preterm, early-term, and post-term deliveries decreased substantially, they still differ substantially by race and ethnicity (Margerison-Ziko et al., 2017). Non-Hispanic White, non-Hispanic Black, and Asian/Pacific Islander women exhibited larger declines in preterm deliveries compared with Hispanic and American Indian/Alaska Native women (Margerison-Ziko et al., 2017). Non-Hispanic White women displayed larger declines in late and medically indicated preterm deliveries, while non-Hispanic black women experienced larger declines in early and moderate and spontaneous preterm deliveries (Margerison-Ziko et al., 2017).

There is an association between race and preterm birth across the chasms of generations. Smid et al. (2017) recognized the that preterm birth is a complex and multifaceted phenomenon that included heritable genetic component. Hence, Smid et al. (2017) evaluated and compared intergenerational preterm birth risk among non-Hispanic Black and non-Hispanic White mothers in a population-based retrospective cohort study, using the Virginia Intergenerational Linked Birth File. All non-Hispanic Black and non-Hispanic White mothers born in Virginia 1960 through 1996. Using multivariable logistic regression, Smid et al. (2017) determined the odds of preterm birth and spontaneous preterm birth by maternal race and maternal gestational age after adjusting for confounders including maternal education, maternal age, smoking, drug/alcohol use, and infant gender. Smid et al. (2017) captured the intergenerational effect of preterm birth among non-Hispanic Black mothers but not non-Hispanic White mothers. Also, Smid et al. (2017) concluded that Black mothers born less than 34 weeks carry the highest risk of delivering their first child very preterm. Smid et al. (2017) denoted the linkage between race and intergenerational preterm birth.

Kim et al. (2018) examined the relationship between maternal nativity status and preterm birth (PTB) or low birth weight (LBW) for Hawaiʻi resident mothers, to compare these relationships across different maternal race/ethnicity groups, and to identify other potential risk and protective factors related to PTB and LBW. Kim et al. (2018) employed the 2004 Natality Birth Data from the National Vital Statistic System of the National Center for Health Statistics, crude and adjusted odds ratios were calculated using logistic regression to determine maternal racial/ethnic-specific nativity effects on PTB and LBW. Asian or Pacific Islander foreign-born mothers had higher unadjusted rates of PTB and Samoan foreign-born mothers had lower rates of LBW compared to their native-born counterparts (Kim Choi et al., 2018).

A linkage between paternal race adverse birth outcomes have been previously established. Li et al. (2018) examined adverse birth outcomes in the United States from 1989–2013 in relation to paternal and maternal race/ethnicity using the U.S. natality data for singleton births to women 15 to 44 with information on birthweight, gestational age, and covariates. Researchers were able to calculate the unadjusted and adjusted probabilities of preterm birth and small for gestational age among all combinations of maternal and paternal race/ethnicity: non-Hispanic Black (NHB), non-Hispanic White (NHW), Hispanic, and Asian, and where paternal race/ethnicity was missing. Li et al. (2018) revealed a linkage with paternal race and adverse birth outcomes like preterm birth and small for gestational age. Race and ethnicity can be a social determinant for preterm birth in Hawai'i. In this study, I determined the significance of this relationship.

Maternal Marital Status/Paternal Involvement and Preterm Birth

There is a limited amount of study that tackles paternal contribution as a risk factor for preterm birth. The existing literature, however, points to an association with paternal characteristic and preterm birth. Hibbs et al. (2018) evaluated association between paternal involvement and weathering in the context of preterm birth among non-Hispanic African-American and non-Hispanic White women with and without lifelong exposure to neighborhood poverty. Weathering is termed as the health of African-American women may begin to deteriorate in early adulthood as a physical consequence of cumulative socioeconomic disadvantage (Geronimus, 1996).They compared infants of women by degree of paternal involvement: married, unmarried with father named on birth certificate, and unnamed father, stratifying the data according to race and income classification. Hibbs et al. (2018) then concluded that weathering was not seen among married African Americans, independent of neighborhood income, indicating a plausible protective mechanism associated with paternal involvement. Paternal involvement is a plausible determinant for preterm birth in Hawai'i and I examined the significance of this association.

Maternal Education and Preterm Birth

Aside from race and ethnicity, Researchers have observed relationship between education and preterm birth. Bushnik et al. (2017) examined both maternal education and income, as contributing factors, and their association with the risk of small-for-gestational-age birth and preterm birth. Researchers studied 127,694 singleton live births from the 2006 Canadian Birth-Census Cohort. Unadjusted rates of small-for-gestational-age birth and preterm birth were estimated across selected maternal characteristics and logistic regression was implied to calculate risk ratios of both outcomes according to maternal education and income. Bushnik et al. (2017) depicted that small-for-gestational-age birth was correlated with both maternal education and income adequacy and preterm birth was associated with maternal education only. The researchers implied that the association between maternal education and adverse birth outcomes is independent of the effects of income.

In a similar manner, Cantarutti et al. (2017) assessed whether neonatal outcomes varied by maternal education in a setting where a healthcare system provides universal coverage of health services to all women notwithstanding of their socioeconomic status. Cantarutti et al. (2017) studied the population of Lombardy, Italy composed 383,103 singleton live births occurring from 2005 to 2010. They conducted a logistic regression analysis to establish the association between maternal education, birthplace and selected neonatal outcomes, controlling for sociodemographic, reproductive, and medical maternal traits. Cantarutti et al. (2017) indicated that the influence of maternal education on neonatal outcomes was confirmed among both, Italian-born and foreign-born mothers and how levels of education and maternal birthplace are important factors associated with adverse neonatal outcomes in Italy.

Ruiz et al. (2015) conducted a Europe-wide systematic review of child cohort studies has demonstrated the link between maternal education, and the risk of preterm and small for gestational age (SGA) birth, among other markers of fetal growth. Though inequalities have been reported among babies born to mothers with low levels of education in the UK, Denmark, Finland, Norway, and Greece, but Ruiz et al. (2015) sought to find congruencies for all European nations. Using a prospective cohort data of 75 296 newborns from 12 European countries, Ruiz et al. (2015) analyzed the relationship between maternal education, preterm and small for gestational age births using regression models within each cohort and meta-analyses were conducted to compare and measure heterogeneity between cohorts. Their analysis systematically assessed the association between maternal education and adverse birth outcomes between the European nation and concluded that poor health at birth is associated with mothers with low education (Ruiz et al., 2015). Maternal education can have an effect on the health of unborn babies. In this study, the association between maternal education and preterm birth will be determine.

Maternal Age and Preterm Birth

Another determinant for preterm birth is maternal age. A higher rate of preterm birth is observed both in adolescent pregnancies and advance maternal age (Vogel et al., 2018). Kozuki et al. (2013) tested whether parity and maternal age have been shown to increase the risk of adverse neonatal outcomes, such as intrauterine growth restriction (IUGR), prematurity, and mortality using data from 14 cohort studies conducted in low- and middle-income countries (LMIC). Kozuki et al. (2013) concluded that nulliparous women <18 years of age have the highest odds of adverse neonatal outcomes and in women with parity ≥ 3 /age ≥ 35 mothers.

Mayo et al. (2017) investigated the first half of conclusions made by Kozuki et al. (2013). They observed the association between teenagers and the risk of preterm birth (PTB) in a large and recent cohort study using 2007-2011 California birth certificate records linked with hospital discharge indices and United States census data for nulliparous 13–20-year-olds who gave birth to singletons (Mayo et al., 2017). Adjusted multivariable logistic regression was used to estimate odds ratios (OR) for preterm birth (Mayo et al., 2017). Mayo et al. (2017) concluded that nulliparous teenagers were at increased risk for spontaneous PTB, especially those 16 years or younger. All teenagers, excluding 19-year-olds, had elevated odds of spontaneous preterm birth at 32-36 weeks with the highest risk occurring the youngest age, 13 (Mayo et al., 2017).

Investigating the other half of the conclusion of Kozuki et al. (2013), Carola, (2013) conducted a review of literature depicting the association between preterm birth and advance maternal age (45 and older). Carolan (2013) derived to three main findings from this review: "(1) increased rates of stillbirth, perinatal death, preterm birth and low birth weight among women ≥45 years; (2) increased rates of pre-existing hypertension and pregnancy complications such as GDM, gestational hypertension (GH), pre-eclampsia and interventions such as caesarian section; and (3) a trend of favorable outcomes, even at extremely advanced maternal age (50-65 years), for healthy women who had been screened to exclude pre-existing disease" (p. 479).

Maternal age is a profound determinant of preterm birth. About 1.3% of live birth in Hawai'i are from mothers who are under the age of 18 (HHDW, 2017). About 3.7% of live births in Hawai'i are from mothers with advance age (HHDW, 2017). This study can demonstrate the prevalence of preterm birth in a significant percentage of the population.

Socioeconomic Status, Geographical Residence and Preterm Birth

Along with race and ethnicity, the association between socioeconomic status and preterm birth have been extensively discussed in previous literature. Glinianaia et al. (2013) inspected the changes in the associations between socioeconomic status (SES) and birthweight and gestational age in Newcastle upon Tyne during 1961-2000 using a population-based data from hospital neonatal records. Data was used to investigate the relationship between neighborhood SES and birthweight over the entire 40-year period and by decade using linear regression and associations with low birthweight and preterm birth using logistic regression (Glinianaia et al., 2013). Researchers depicted that there is a strong association between socioeconomic inequalities and adverse birth outcomes (Glinianaia et al., 2013). Glinianaia et al. (2013) indicated that the association between socioeconomic status and adverse health outcomes is parallel in other countries as well like, Canada and the United States.

Pearl et al. (2018) also aimed to test socioeconomic status in terms of neighborhood opportunity. Pearl et al. (2018) examined maternal early-life and adult neighborhood opportunity in relation to risk of preterm birth and racial-ethnic disparities in a population-based cohort of women under age 30 by linking census tract poverty data to 2 generations of California births from 1982-2011 for 403 315 White, Black, or Latina mothers-infant pairs. Researchers estimated the risk of preterm birth, and risk difference comparing low opportunity in early life or adulthood to high opportunity using targeted maximum likelihood estimation (Pearl et al., 2018). At both early life and adulthood, low opportunity was related to increased preterm birth risk compared to higher opportunity neighborhoods for White, Black and Latina mothers (Pearl et al., 2018). The authors concluded that early-life and sustained exposure to residential poverty is related to increased preterm birth risk, higher among African American women.

The risk of preterm birth has been observed in a geographical context. Kent et al. (2013), using logistic regression, indicated that population dense urban areas have increased rates of adverse birth outcomes. Using birth records and zip code census measures, Kent et al. (2013) analyzed whether adverse birth outcome time trends and associations between area-level variables and adverse birth outcomes differ by urban–rural status. Their analysis indicated that birth outcome disparities attributable to living in low-income African American communities were heightened in population dense urban areas, compared to less-dense areas. Further, Kent et al. (2013) claimed that high-poverty African American areas have higher odds of adverse birth outcomes in urban versus rural regions.

Several research studies have investigated the association of preterm birth in terms of environmental exposures. Gray et al. (2014) investigated the collective influence of air pollution and SES on pregnancy outcome in North Carolina. Gray et al. (2014) birth weight is highly associated with the concentration of particulate matter and ozone. In the same manner, Padula et al. (2018) linked risk of preterm birth with environmental exposures in Fresno County. The researchers surveyed environmental factors included air pollution, drinking water contaminants, pesticides, hazardous waste, traffic exposure and others along with social factors like area-level socioeconomic status (SES) and race/ethnicity. Padula et al. (2018) conveyed that risk of preterm birth was associated with higher exposure to cumulative pollution scores and drinking water contaminants: the risk of preterm birth was twice as likely for those exposed to high versus low levels of pollution.

There are also researchers that observed the connection of geographical distribution and socioeconomic status and how these variables contribute to a higher risk of preterm birth. Mehra et al. (2018) investigated the association between area-level deprivation and preterm birth by conducting retrospective cohort study using national, commercial health insurance claims data zip code-level data. Mehra et al. (2018) found that area-level deprivation/socioeconomic disadvantage was associated with increased risk of preterm birth. This connection is observed even among commercially insured population.

Mehra et al. (2018) attributed this association with area level distribution existing maternal mediators. Another researcher sought to illustrate the association between neighborhood deprivation and preterm birth using a Neighborhood Deprivation Index (NDI) with the application of Propensity Score Matching (PSM). Employing PSM, Ma, et al. (2015) was able to balance out confounders across racial groups. Ma et al. (2015) assigned all live births in 2008 and 2009 to an NDI quartile and determined the exposure of deprivation and prevalence of preterm birth. Living in neighborhoods with higher deprivation was associated with increased risk of PTB among Blacks compared with living in neighborhoods with lower deprivation among Blacks (Ma et al., 2015). In addition, Ma et al. (2015) indicated that their random-effect regression models showed that the most deprived Whites experienced 1.13 times the odds of having PTB than the least deprived whites.

Socioeconomic status and geographic residence in an important indication of preterm birth as the articles above depicted. The quantifying the prevalence of preterm birth in each of Hawai'i geographical designation can help determine the need programs and interventions for each region for maternal and fetal health.

Pregnancy Risk Assessment Monitoring System

PRAMS, the Pregnancy Risk Assessment Monitoring System, is a surveillance project of the Centers for Disease Control and Prevention (CDC) and state health departments (CDC, 2019b). It is a population-based dataset on maternal attitudes and experiences before, during, and shortly after pregnancy. PRAMS data is used to identify groups of women and infants at high risk for health problems, to monitor changes in health status, and to measure progress towards goals in improving the health of mothers and infants (CDC, 2019b).

In Hawai'i, A PRAMS questionnaire is mailed to approximately 200 new mothers per month on all the islands of Hawai'i (HDOH, 2019). The participants are randomly selected from the birth certificates of recently born infants (HDOH, 2019). The questionnaire incorporates questions that are queried by PRAMS programs in all states as well as Hawai'i-specific questions (HDOH, 2019).

Summary

Disparities in birth outcomes, particularly preterm birth, are a result of socioeconomic and other factors. The CDC (2019b) indicated that social, personal, and economic characteristics influence the propensity for preterm birth. Preterm birth, as Manuck (2017), conveyed is a complex phenomenon. Its etiology is multifaceted as displayed by existing literature. Due its complexity, preterm birth also requires a multifaceted solution. Researchers have established the influence of socioeconomic factors of race, age, education, income, and environmental settings have a profound influence on the prevalence of preterm birth. Using a multi-level approach of socioecological model, permits a researcher to see the multiple levels and multiple aspects of preterm birth. With the knowledge of these frameworks in hand, I analyzed the social determinants of preterm birth in the State of Hawai'i. This study may contribute to the need to identify social factors associated with preterm birth in Hawai'i. In chapter 3, I provide information about methodology, data collection, data analysis, and ethical considerations for this study.

Chapter 3 Research Methods

Introduction

The purpose of this research was to examine the association of social risk factors (maternal age, paternal age, race, marital status, education, annual income, and county and district of residence) and preterm birth in the state of Hawai'i for the years 2012-2015 using the Hawai'i PRAMS. In this chapter, I will explain the research design, study rationale, and resource constraints of this study. I also discuss the methodology and relevant operational constructs related to key variables in the study. I also explain the data analysis plan, threats to validity, and ethical procedures.

Research Design and Rationale

I used a cross-sectional research design in this quantitative study. I measured the outcome and the exposures in the study participants at the same time. A cross-sectional design is commonly applied in a prevalence study (Creswell, 2018; Setia, 2016). It was therefore appropriate to apply a cross-sectional design in evaluating the difference, if any, in the prevalence of preterm birth using a particular set of socioeconomic indicators. A cross-sectional design can also be used to calculate the odds ratio (Creswell, 2018; Setia, 2016). In this study, the dependent variable was preterm birth, which is at the nominal/categorical level of measurement. The independent variables, socioeconomic factors, are categorical. There were no anticipated time or resource constraints. I did not use a cohort research design in this study because study does not follow the same set of study participants through a period (see Creswell, 2018). I also did not choose a case control study because it could not be used to compare two study groups: case and control (see Creswell, 2018).

Methodology

For this research, the PRAMS data was used. PRAMS is an ongoing state-level, population-based surveillance system of selected maternal behaviors and experiences that occur before, during, and shortly after pregnancy. It is conducted by participating state, territorial, tribal, or local health departments in partnership with CDC's Division of Reproductive Health (Shulman et al., 2018). The CDC provides annual funding to participating sites through a cooperative agreement, with supplemental funding contributed by recipients (Shulman et al., 2018). I used of secondary data in this study to save time and reduce costs. The sample population, size, and parameters are also limited by the secondary data. The Hawai'i Health Data Warehouse have granted me limited access to Phase 7 (2012 to 2015) Hawaii PRAMS data. The data are currently stored in a password protected computer.

Population

The PRAMS questionnaire is mailed to approximately 200 new mothers per month on all the islands of Hawai'i. The new moms are randomly selected from the birth certificates of recently born infants. During 2012 to 2015, an average annual estimate of 18,400 births occurred to residents in the State of Hawai'i. Three-quarters of all births occurred to women ages 20 to 34 years. Approximately 18.8% of births were to mothers ages 35 years and older, while 4.8% were to mothers ages 19 years or younger (State of Hawai'i, 2019).

Sampling and Sampling Procedures

Between 1300 and 3400 women were sampled per year from each of the participating states (CDC, 2019). Women from high-risk populations were targeted more than those with low risk factors such as income, age, race, education, and marital status (CDC, 2019). The sampling technique ensures adequate representation of the participants for the data analysis (CDC, 2019). The population of interest consists of mothers who were residents of the state they gave birth to a live-born infant during the surveillance period of 2012 to 2015. Vital records and birth certificate files served as the best available source of sampling frame representing live births (CDC, 2019). PRAMS included mothers whose infants died in the sampling frame because of the importance of learning about the maternal behaviors of mothers as it related to infant deaths (CDC, 2019).

In Hawai'i, there are approximately 18,400 births each year and about 200 surveys are sent out each month to mothers 2 months after delivery, with regular follow-up by mail and telephone up to 6 months postpartum. Historically, the survey is completed by 70 to 75% of mothers contacted, but response rates can vary slightly year to year. Weighted estimates from Hawai'i PRAMS are generalizable to all pregnant women who have a live birth in the state (State of Hawai'i, 2019). The estimates are weighted based on information from the birth certificate such as maternal age, maternal race, and county of residence. This weighting accounts for differences in characteristics between those mothers that did and did not respond to develop estimates representative of the population (State of Hawai'i, 2019). Using G* Power 3.1.9.7 for this logistic regression, the appropriate sample size for this study, with an α value equal to 0.05 (95% confidence interval), medium effect size, and power set at 95%, was at a minimum 988 participants. I used sample size calculation to choose enough subjects to keep the chance of these errors at an acceptably low level (see Sihoe, 2015). The α value and statistical power of 95% are chosen to avoid Type II errors from occurring (a false negative result) was less likely to occur (Creswell, 2009).

Procedures for Data Collection

The data collection process for this study entailed the access of secondary data by the State of Hawai'i Department of Health. The data collection process is still a continuous state-based surveillance system intended to capture information about maternal behavior, attitudes, and experiences among women during the prenatal and postpartum periods of the pregnancy. For my study, I used the 2012 to 2015 Hawai'i PRAMS data set. The specifics of the 2012 to 2015 Hawai'i PRAMS data used for this study included some customized information, which were restricted from public access. The customized information required a special review and approval process by the Hawai'i Health Data Warehouse (HHDW) IRB team who assessed the rationale for this study before data were accessed.

PRAMS nationwide generally used the following universal methodology (CDC, 2019):

- "Preletter: Introduced PRAMS to the mother and informed her that a questionnaire would soon arrive.

- Initial Mail Questionnaire Packet: All sampled mothers received the packet three to seven days after the preletter and contained the contents as described below.
- Tickler: Served as a thank you and a reminder note and sent seven to ten days after the initial mail packet.
- Second Mail Questionnaire: I: If the mother did not respond within seven to fourteen days the tickler was sent, the nonrespondents would receive this packet.
- Third Mail Questionnaire Packet: All remaining nonrespondents would receive the packet seven to fourteen days after the third mail questionnaire packet was sent.
- Telephone Follow-up: A Telephone follow-up was initiated for all mail nonrespondents seven to fourteen days after mailing the last questionnaire.

Those who showed interest upon receiving the initial letter were selected and contacted for the initial recruitment interview via the phone and if there was no response upon repeated mailings or participation requests, the nonrespondent women were contacted and interviewed by telephone (CDC, 2017). The data collection procedures and instruments were standardized for comparisons between states (CDC, 2017).

Operationalization of Variables

The following variable were included in this research:

- Gestational age: According to Preterm birth is described as birth occurring before 37 weeks of gestation. In the PRAMS data this variable is indicated as numerical input in weeks. For the purposes of this analysis, the data for this variable will be transformed to a nominal binary response (Yes: birth less than 37 weeks or No: birth greater than 37 weeks).

- Maternal and Paternal Race: Race is categorical variable. The categories in these two variables are simply unique to the State of Hawai’i: White, Black, American Indian,
- Maternal and Paternal Age: Age, in this data set, is a at the ratio level. This variable will be transformed to reflect a categorical variable for the purposes of this analysis.
- Maternal and Paternal Education: Education is also a categorical variable reflecting the years of education achieved by either the mother or the father.
- Marital Status: Marital status in the PRAMS data set is nominal variable indicating a yes or no response.
- Household Income: The Hawai’i PRAMS questionnaire included a survey question addressing total household income. Income is an interval or categorical variable.
- Geographical Location: This indicator for preterm birth will be assessed using three variables in the PRAMS data set: maternal county of residence, district of residence, and urban or rural category.

Table 1

Operational Variables from Hawai'i PRAMS Data Set

Variable Name	Survey Variable Type	Variable Type	Level of Measurement	Categories
Gestation Age (Preterm Birth: <37 weeks)	Birth Certificate Variable	Dependent	Nominal	Yes: < 37 weeks No: >37 weeks
Maternal Race	Birth Certificate Variable	Independent	Categorical	U= Unknown 1 = Other Asian 2 = White 3 = Black 4 = AM Indian 5 = Chinese 6 = Japanese 7 = Filipino 8 = Hawaiian 9 = Other Race 10 = AK Native 11 = Mixed Race
Maternal Age	Birth Certificate Variable	Independent	Categorical	1= Under 17 2 = 18 – 19 years old 3 = 20 – 24 years old 4 = 25 – 29 years old 5 = 30 – 34 years old 6 = 35 – 39 years old 7 = 40 and above
Maternal Education	Birth Certificate Variable	Independent	Categorical	U= UNKNOWN 1= 0-8 YRS 2= 9-11 YRS 3= 12 YRS 4= 13-15 YRS 5= >16 YRS
Maternal Marital Status	Birth Certificate Vari	Independent	Categorical	U= Unknown 1= Married 2= Other
Income	Survey Question		Categorical	0 = Unknown

Variable Name	Survey Variable Type	Variable Type	Level of Measurement	Categories
				1 = $0 - $30,000 2 = $30,000-$60,000 3 = $60,000 - $90,000 4 = $90,000 +
Maternal District of Residence	Birth Certificate Variable	Independent	Categorical	1 = City of Hilo 2 = Hawaii County 3 = City of Honolulu 4 = Honolulu County 5 = Island of Kuaui 6 = Island of Lanai 7 = Island of Maui 8 = Island of Molokai
Urban or Rural Category	Birth Certificate Variable	Independent	Categorical	N= Not Applicable U= Unknown 1 = Rural 2 = Urban
Paternal Race	Birth Certificate Variable	Independent	Categorical	U = Unknown 1 = Caucasian 2 = Hawaiian 3 = Part- Hawaiian 4 = Chinese 5 = Filipino 6 = Japanese 7 = Puerto Rican 8 = Korean 9 = Samoan 10 = Portuguese 11 = Guamanian 12 = American Indian 13 = Black 14 = Vietnamese 15 = Other Asian 16 = Other Pacific 17 = Cuban 18 = Mexican 19 = Asian Indian 77 = All Others
Paternal Age	Birth Certificate Variable	Independent	Categorical	1= Under 18 2 = 19 -25 3 = 26 – 35 4 = 35 – 40 5 = Above 40

Variable Name	Survey Variable Type	Variable Type	Level of Measurement	Categories
Paternal Education	Birth Certificate Variable	Independent	Categorical	U= UNKNOWN 1= 0-8 YRS 2= 9-11 YRS 3= 12 YRS 4= 13-15 YRS 5= >16 YRS

Data Analysis

I retrieved the Hawai'i PRAMS data via the Hawai'i Health Data Warehouse approval system. In this secondary data set, independent variables (maternal age, race, marital status, education, income, county/district of residence, paternal race, age, and education) were analyzed for their predictive association with preterm birth. The Statistical Package for Social Sciences (SPSS) software version 27 was used for the statistical stepwise logistic regression analysis.

I used the following research questions and hypotheses to guide my analysis:

RQ1: Using the Hawai'i PRAMS, is there an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015?

$H_0$1 There is no association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a1 There is an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

RQ2: Using the Hawaii PRAMS, is there an association between household income or county/district of residence in Hawai'i and preterm birth for the years 2012-2015?

$H_0$2 There is no association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015.

H_a2 There is an association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015.

RQ3: Using the Hawai'i PRAMS, is there an association between paternal age, race, and education in Hawai'i for the years 2012-2015?

$H_0$3 There is no association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a3 There is an association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

A decision will be made on whether to reject or fail to reject the null hypothesis based on the significance level at the p value of 0.05.

Threats to Validity

Internal and external validity issues are inherent in a cross-sectional design (Creswell, 2018). Internal validity of a study is connected to how the study is designed (Creswell, 2018). The internal validity of this study can be influenced by other variables, known as confounders (Creswell, 2018). The causality of each of the variables can be affected by the other variables that are outside the scope of this study. Even the variables within this study may have a confounding effect on each other. The validity of this study can also be linked to the validity of its measure. The PRAMS survey is a robust survey

(CDC, 2019). However, it is a voluntary survey which can limit the inferential power and generalizability of this study. External validity of this study is dependent upon the generalizability of this study (Creswell, 2018). The generalizability of this study is limited to the State of Hawai'i. The statistical conclusion from study is uniquely applicable only to the population of Hawai'i.

For the statistical analysis, my significance level was set at 95% (α=0.05). If the analysis results in a *p* value less than 0.05, the null hypothesis will be rejected. If the analysis results in a *p* value greater than or equal to 0.05, then the null hypothesis cannot be rejected. Type I and Type II errors can occur in any given statistical analysis that can lead a researcher to reach an incorrect conclusion. Type I error occurs when a researcher rejects a null hypothesis that should not be rejected (Banerjee et al., 2009). In this analysis, there is a 5% chance that a type I error can occur. A type II error (beta) occurs when a researcher fails to reject a null hypothesis that is false (Banerjee et al., 2009). Type II error is related to the power of a statistical analysis. In this analysis the power is set at 0.95. The probability of a type II error occurring for this analysis is 5%.

Ethical Procedures

To be granted access to the Hawai'i PRAMS data set, a request must be submitted and approved by the Hawai'i Health Date Warehouse (HHDW). Before this study was conducted, approval was granted by the HHDW IRB and Walden University IRB (#02-15-22-0441221). The de-identified data will be kept in a password protected laptop and will only be accessible by the researcher and dissertation committee. The data will be kept until 5 years after the completion of this research.

Summary

Prior researchers have established the correlation between preterm births and socioeconomical factors of race, age, education, income, and geographic locale (Smid, et al., 2017; Mayo, et al., 2017; Padula et al., 2018). This study aimed to explore this phenomenon in Hawai'i. A cross-sectional study design was used in this quantitative analysis. The data for this study was collected from a secondary source, PRAMS by the state health department. This chapter outlined the research design that was used for this study and the rationale for the use of a cross sectional study design. It also outlined the population, sampling, and data analysis that was implemented in this study. In chapter 4, I will provide the results of this study.

Chapter 4: Results

Introduction

The purpose of this quantitative research study was to test the association of social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal education, annual income, county, and district of residence) and preterm birth in the state of Hawai'i for the years 2012 to 2015 using the Hawai'i PRAMS. I used the following research questions and hypotheses to guide the study:

RQ1: Using the Hawai'i PRAMS, is there an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015?

$H_0$1 There is no association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a1 There is an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

RQ2: Using the Hawaii PRAMS, is there an association between household income or county/district of residence in Hawai'i and preterm birth for the years 2012-2015?

$H_0$2 There is no association between household income or county/district of residence in Hawai'i and preterm birth in Hawai'i for the years 2012-2015.

H_a2 There is an association between household income or county/district of residence preterm birth in Hawai'i for the years 2012-2015.

RQ3: Using the Hawai'i PRAMS, is there an association between paternal age, race, and education in Hawai'i for the years 2012-2015?

$H_0$3 There is no association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a3 There is an association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

In this chapter, I will describe the data collection methods and present the results of the data analysis for this study.

Data Collection

The data collection process for this study entailed the access of secondary data by the State of Hawai'i Department of Health. For my study, I used the 2012 to 2015 Hawai'i PRAMS data set. I retrieved the Hawai'i PRAMS retrieved via the Hawai'i Health Data Warehouse approval system.

Table 2 depicts the distribution of data collected in the years 2012 to 2015 (PRAMS phase 7). Table 3 indicates the frequency of preterm birth in Hawai'i for the year 2012 to 2015.

Table 2

PRAMS Phase 7 Data Distribution

Year	Frequency of Cases	Percentage
2012	1488	26.7%
2013	1479	26.5%
2014	1309	23.5%
2015	1296	23.3%

Table 3

Preterm Birth in Hawai'i in 2012 to 2015

	Frequency of Births	Percentage
Preterm	993	17.8%
Term	4218	75.7%
Missing Values	361	6.5%
Total	5572	100.0%

Results

Using the Hawai'i PRAMS data set, independent variables (maternal age, race, marital status, education, income, district of residence, paternal race, age, and education) was analyzed for their predictive association with preterm birth. I used the Statistical Package for Social Sciences (SPSS) software version 27 was used for the statistical stepwise logistic regression analysis.

Descriptive Statistics

The following tables (Tables 4, 5. 6, and 7) portray frequencies of predictor variables maternal race, maternal age, maternal education, and marital status.

Table 4

Maternal Race Distribution

	Frequency	Percentage
Other Asian	457	8.2%
White	1405	25.3%
Black	98	1.8%
AM Indian	49	0.9%
Chinese	181	3.2%
Japanese	395	7.1%
Filipino	909	16.3%
Hawaiian	982	17.6%
Other Races	6	0.1%
Unknown	1083	19.4%
Missing	7	0.1%
Total	5572	100.0%

Table 5

Maternal Age Group Distribution

Age Groups	Frequency	Percentage
17 & Under	85	1.5%
18 to 19	192	3.4%
20 to 24	1087	19.5%
25 to 29	1538	27.6%
30 to 34	1567	28.1%
35 to 39	863	15.5%
40+	240	4.3%
Total	5,572	99.9%

Table 6

Maternal Education Distribution

Years of Education	Frequency	Percentage (%)
0 to 8 years	36	0.6
9 to 11 years	163	2.9
12 years	1099	19.7
13 to 15 years	727	13.0
16+	902	16.2
Missing	2645	47.5
Total	5572	99.9%

Table 7 *Marital Status Distribution*

Marital Status	Frequency	Percentage
Unknown	455	8.2%
Married	3286	59.0%
Other	1831	32.9%
Total	5572	100.1%

Table 8 *Crosstabulation of Preterm Birth and RQ1 Variables*

	Term		Preterm		Total	
	N	%	N	%	N	%
Maternal Race						
White	1170	27.3%	203	19.3%	1373	25.7%
Other Asian	320	7.5%	102	9.7%	422	7.9%
Black	72	1.7%	26	2.5%	98	1.8%
Native American	37	0.9%	12	1.1%	49	0.9%
Chinese	144	3.4%	35	3.3%	179	3.4%
Japanese	306	7.1%	78	7.4%	384	7.2%
Filipino	667	15.6%	214	20.3%	881	16.5%
Hawaiian	739	17.2%	188	17.9%	927	17.4%
Other Race	4	0.1%	2	0.2%	6	0.1%
Mixed Race	829	19.3%	193	18.3%	1022	19.1%
Total	4288	100.0%	1053	100.0%	5341	100.0%
Maternal Age						
17 & Under	59	1.4%	21	2.0%	80	1.5%
18 to 19	135	3.1%	40	3.8%	175	3.3%
20 to 24	876	20.4%	160	15.2%	1036	19.4%
25 to 29	1204	28.0%	278	26.4%	1482	27.7%
30 to 34	1233	28.7%	279	26.4%	1512	28.3%
35 to 39	637	14.8%	198	18.8%	835	15.6%
40+	149	3.5%	79	7.5%	228	4.3%
Total	4293	100.0%	1055	100.0%	5348	100.0%
Maternal Education						
0 to 8 years	25	1.1%	6	1.1%	31	1.1%
9 to 11 years	121	5.3%	31	5.6%	152	5.4%
12 years	857	37.5%	203	36.8%	1060	37.4%
13 to 15 years	563	24.7%	143	25.9%	706	24.9%
16+	717	31.4%	169	30.6%	886	31.3%
Total	2283	100.0%	552	100.0%	2835	100.0%
Marital Status						

Unknown	354	8.2%	78	7.4%	432	8.1%
Married	2545	59.3%	638	60.5%	3183	59.5%
Other	1394	32.5%	339	32.1%	1733	32.4%
Total	4293	100.0%	1055	100.0%	5348	100.0%

The following tables (Table 9 10, 11and 12) illustrate the frequency of income distribution, district of residence of participants, and geographical distinction of residence respectively.

Table 9

Income Distribution

Annual Income Grouping	Frequency	Percentage
$0 to $30,000	2239	40.2%
$30,001 to $60,000	1305	23.4%
$60,001 to $90,000	836	15.0%
$90,001 +	686	12.3%
Missing	506	9.1%
Total	5572	100.0%

Table 10

Urban/Rural Distribution

Urban/Rural	Frequency	Percentage
Urban	3070	55.1
Rural	2501	44.9
Missing	1	
Total	5572	100.0%

Table 11

Maternal Residence Distribution

District of Residence	Frequency	Percentage
City of Hilo	325	5.8%
Balance of Hawai'i County	809	14.5%
City of Honolulu	896	16.1%
Balance of C&C Honolulu	1617	29.0%
Island of Kauai	863	15.5%
Island of Lanai	22	0.4%
Island of Maui	983	17.6%
Island of Molokai	57	1.0%
Total	5572	99.9%

Table 12

Crosstabulation of Preterm Birth with RQ2 Predictor Variables

	Term		Preterm		Total	
	N	%	N	%	N	%
Annual Income Grouping						
$0 to $30,000	376	8.8%	106	10.0%	482	9.0%
$30,001 to $60,000	1737	40.5%	395	37.4%	2132	39.9%
$60,001 to $90,000	989	23.0%	267	25.3%	1256	23.5%
$90,001 +	651	15.2%	157	14.9%	808	15.1%
Missing	540	12.6%	130	12.3%	670	12.5%
Total	4293	100.0%	1055	100.0%	5348	100.0%
Urban/Rural						
Urban	2632	61.3%	332	31.5%	2964	55.4%
Rural	1661	38.7%	723	68.5%	2384	44.6%
Total	4293	100.0%	1055	100.0%	5348	100.0%
Maternal Residence						
City of Hilo	261	6.1%	45	4.3%	306	5.7%
Balance of Hawai'i County	676	15.7%	89	8.4%	765	14.3%
City of Honolulu	595	13.9%	250	23.7%	845	15.8%
Balance of C&C Honolulu	1071	24.9%	478	45.3%	1549	29.0%

	Term		Preterm		Total	
	N	**%**	**N**	**%**	**N**	**%**
Island of Kauai	751	17.5%	78	7.4%	829	15.5%
Island of Lanai	20	0.5%	1	0.1%	21	0.4%
Island of Maui	875	20.4%	104	9.9%	979	18.3%
Island of Molokai	44	1.0%	10	0.9%	54	1.0%
Total	4293	100.0%	1055	100.0%	5348	100.0%

The following tables (Table 13, 14, 15, and 16) illustrate the frequencies of socioeconomic factors pertaining to the father, respectively race, age, and education.

Table 13

Paternal Race Distribution

Paternal Race	Frequency	Percentage
Unknown	422	7.6%
Other Asians	402	7.2%
Mixed Race	1007	18.1%
White	1448	26.0%
Black	153	2.7%
American Indian	58	1.0%
Chinese	122	2.2%
Japanese	325	5.8%
Filipino	766	13.7%
Hawaiian	857	15.4%
Other Races	12	0.2%
Total	5572	99.9%

Table 14

Paternal Age Distribution

Paternal Age Group	Frequency	Percentage
under 18	26	0.5%
18-25	946	17.0%
26-35	2714	48.7%
36-45	1231	22.1%
46+	241	4.3%
Missing	414	7.4%
Total	5572	100.0%

Table 15

Paternal Education Distribution

Paternal Education	Frequency	Percentage
Missing	2605	46.8%
Unknown	299	5.4%
0 – 8 years	22	0.4%
9-11 years	147	2.6%
12 years	1215	21.8%
13-16 years	663	11.9%
16+ years	621	11.1%
Total	5572	

Table 16 *Crosstabulation of Preterm with Paternal Race, Age and Education*

	Term		Preterm		Total	
	N	%	N	%	N	%
Paternal Race						
Unknown	301	7.0%	88	8.3%	389	7.3%
Other Asians	293	6.8%	87	8.2%	380	7.1%
Mixed Race	783	18.2%	168	15.9%	951	17.8%
White	1163	27.1%	245	23.2%	1408	26.3%
Black	115	2.7%	36	3.4%	151	2.8%
American Indian	44	1.0%	13	1.2%	57	1.1%
Chinese	95	2.2%	24	2.3%	119	2.2%
Japanese	247	5.8%	68	6.4%	315	5.9%
Filipino	571	13.3%	173	16.4%	744	13.9%
Hawaiian	675	15.7%	147	13.9%	822	15.4%
Other Races	6	0.1%	6	0.6%	12	0.2%
Total	4293	100.0%	1055	100.0%	5348	100.0%
Paternal Age						
under 18	46	1.2%	11	1.1%	57	1.1%
18-25	725	18.1%	149	15.4%	874	17.6%
26-35	2123	53.1%	494	51.0%	2617	52.7%
36-45	645	16.1%	167	17.2%	812	16.3%
46+	460	11.5%	148	15.3%	608	12.2%
Total	3999	100.0%	969	100.0%	4968	100.0%
Paternal Education						
Unknown	220	5.1%	56	5.3%	276	5.2%
0 – 8 years	18	0.4%	3	0.3%	21	0.4%
9-11 years	112	2.6%	26	2.5%	138	2.6%
12 years	943	22.0%	240	22.7%	1183	22.1%
13-16 years	519	12.1%	120	11.4%	639	11.9%
16+ years	503	11.7%	112	10.6%	615	11.5%
Total	4293	100.0%	1055	100.0%	5348	100.0%

Inferential Statistics

For the inferential analysis in this study, I used a binary logistic regression approach to predict the probability of a risk factor influences the dichotomous variable of preterm birth. To analyze data using a binary logistic regression the data was tested for four assumptions: the dependent variable was measured in dichotomous scale;

independent variables were either continuous or categorical; independence of errors and mutually exclusive and exhaustive categories; and linear relationship between any continuous independent variables and the logit transformation of dependent variable. The assumptions were tested using a crosstabulation analysis, Chi- square test, and Negelkerke psuedo R square analysis for each of the predictor variables.

Preterm Birth and Maternal Race, Maternal Age, Maternal Education, and Marital Status

The following research questions and hypotheses guided the regression analysis:

RQ1: Using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS), is there an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015?

$H_0$1: There is no association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a1: There is an association between maternal age, race, marital status, education, and preterm birth in Hawai'i for the years 2012-2015.

The crosstabulation analysis (Table 7) indicated that White mothers displayed the least percentage of preterm birth (13.9%). White mothers were used as reference category for the logistic regression. Maternal race had a strong, positive association with preterm birth when White mothers are used a reference category. Other Asian (p = <0.001; OR = 1.837), Black (p = 0.002, OR = 2.081), Japanese (p = 0.009, OR = 1.469), Filipino (p = <0.001, OR =1.849), Hawaiian (p = 0.001, OR = 1.466), and Mixed Race (p = 0.008; OR = 1.342) mothers displayed significant association (Table 17). Black mothers were twice as likely to experience preterm birth than White mothers. Other Asian and Filipino mothers were1.8 more likely to experience preterm birth than White mothers. Japanese, Hawaiian, and Mixed-Race mothers were 1.3 to 1.4 times more likely to experience preterm birth than White mothers. The pseudo R-squared value (Nagelkerke R Square) indicates that 1.3% of Preterm Birth is explained by maternal race.

Table 17

Logistic Regression Analysis of Preterm Birth and Maternal Race

Predictor Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Maternal Race								
White (Ref)			42.447	9	.000			
Other Asian	.608	.137	19.771	1	.000	1.837	1.405	2.402
Black	.733	.241	9.242	1	.002	2.081	1.297	3.339
Native American	.626	.341	3.369	1	.066	1.869	.958	3.645
Chinese	.337	.203	2.752	1	.097	1.401	.941	2.086
Japanese	.385	.148	6.766	1	.009	1.469	1.099	1.963
Filipino	.615	.109	31.616	1	.000	1.849	1.493	2.291
Hawaiian	.383	.112	11.761	1	.001	1.466	1.178	1.825
Other Race	1.058	.869	1.482	1	.223	2.882	.524	15.836
Mixed Race	.294	.110	7.104	1	.008	1.342	1.081	1.666
Constant	-1.752	.076	530.711	1	.000	.174		

The examination of RQ1 also illustrated that maternal age (Table 18) had a weak, negative association with preterm birth. A significant association was distinctively present at the 20 – 24 years old category (*p* =0.013; OR = 0.513). The analysis indicated that mothers at 20 – 24 years of age were 48 % least likely to suffer from preterm birth.

Table 18

Logistic Regression Analysis of Preterm Birth and Maternal Age

Predictor Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Maternal Age								
17 and Under			56.186	6	.000			
18 - 19 years	-.183	.311	.347	1	.556	.832	.452	1.533
20 - 24 years	-.667	.268	6.186	1	.013	.513	.303	.868
25 - 29 years	-.433	.263	2.714	1	.099	.649	.388	1.086
30 - 35 years	-.453	.263	2.975	1	.085	.636	.380	1.064
36 - 39 years	-.135	.267	.258	1	.612	.873	.518	1.473
40 years	.399	.290	1.892	1	.169	1.490	.844	2.628
Constant	-1.033	.254	16.527	1	.000	.356		

The analysis of RQ1 also depicted that maternal education and marital status have no significant association with preterm birth.

Table 19

Logistic Regression Analysis of Preterm Birth and Maternal Education and Marital Status

Predictor Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Maternal Education								
0 - 8 years (Ref)			.518	4	.972			
9 - 11 years	.065	.497	.017	1	.895	1.067	.403	2.829
12 years	-.013	.461	.001	1	.977	.987	.400	2.437
13 - 15 years	.057	.464	.015	1	.903	1.058	.426	2.628
16 years	-.018	.463	.002	1	.969	.982	.397	2.432
Constant	-1.427	.455	9.855	1	.002	.240		
Marital Status								
Unknown			.993	2	.609			
Married	.129	.133	.946	1	.331	1.138	.877	1.476
Other	.099	.139	.504	1	.478	1.104	.841	1.449
	-1.513	.125	146.236	1	.000	.220		

A second binary logistic regression analysis was also conducted to assess the association between income and geographic distinctions with preterm birth. I sought to answer the following research question:

RQ2: Using the Hawaii Pregnancy Risk Assessment and Monitoring Systems (PRAMS), is there an association between household income or county/district of residence and preterm birth for the years 2012-2015?

$H_0$2 There is no association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015.

H_a2 There is an association between household income or county/district of residence and preterm birth in Hawai'i for the years 2012-2015.

The binary logistic regression of the predictor indicated income (Table 19) no association with preterm birth.

Table 20

Logistic Regression Analysis of Preterm Birth and Income

Predictor Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Income								
Unknown			5.440	4	.245			
$0 - $30,000	-.215	.123	3.038	1	.081	.807	.633	1.027
$30,000 - $60,000	-.043	.130	.111	1	.739	.958	.743	1.235
$60,000 - $90,000	-.156	.141	1.219	1	.270	.855	.648	1.129
$90,00+	-.158	.147	1.152	1	.283	.854	.640	1.139
Constant	-1.266	.110	132.561	1	.000	.282		

The binary logistic regression of the predictor variables used for geographic distinction indicated a significant inference (Table 20). Mothers living in urban areas had a strong, positive correlation with preterm birth (p = <0.001; OR = 3.451). Congruently, preterm birth had a strong, positive association with mothers who are living in the County of Honolulu (*p* = <0.001; OR = 2.589) and the City of Honolulu (*p* = <0.001; OR = 2.437). Mothers living in the county of Honolulu and the city of Honolulu had a greater than 2 times the odd of preterm birth morbidity than mothers living in the city of Hilo. In addition, preterm birth had a weak, negative association with mothers living in the Island of Kauai (*p* = 0.011; OR = 0.602) and the Island of Maui (*p* = 0.53; OR = 0.689). Mothers living in Kauai and Maui were 39% and 31% less likely to suffer from preterm birth.

Table 21

Logistic Regression Analysis of Preterm Birth and Geographic Distinction

Predictor Variable	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Urban/Rural								
Urban	1.239	.073	285.304	1	.000	3.451	2.989	3.984
Constant	-2.070	.058	1263.686	1	.000	.126		
Maternal Residence								
City of Hilo			295.531	7	.000			
Hawai'i County	-.270	.197	1.876	1	.171	.764	.519	1.123
City of Honolulu	.891	.178	25.003	1	.000	2.437	1.719	3.455
Honolulu County	.951	.171	31.109	1	.000	2.589	1.853	3.616
Island of Kauai	-.507	.201	6.389	1	.011	.602	.407	.892
Island of Lanai	-1.238	1.037	1.424	1	.233	.290	.038	2.215
Island of Maui	-.372	.192	3.759	1	.053	.689	.473	1.004
Island of Molokai	.276	.386	.513	1	.474	1.318	.619	2.807
Constant	-1.758	.161	118.604	1	.000	.172		

I also tested the association between preterm birth and socioeconomic factors relating to the father. Preterm birth and predictor variables of paternal race, paternal age, and paternal education were analyzed by binary logistic regression which aimed to answer the following research question:

RQ3: Using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS), is there an association between paternal age, race, and education in Hawai'i for the years 2012-2015?

$H_0$3 There is no association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

H_a3 There is an association between paternal age, race, education, and preterm birth in Hawai'i for the years 2012-2015.

The logistic regression analysis (Table 22) indicated a weak, negative of preterm birth with paternal race: Mixed Race (p = 0.037; OR = 0.734), White (p = 0.019, OR = 0.721), and Hawaiian (p = 0.052, OR = 0.745). Fathers from these racial group were least likely to suffer preterm birth by 25% to 27%. Meanwhile, fathers from "Other Race" (p = 0.37, OR = 3.420) are 3 times more likely to suffer from preterm birth. Paternal age and paternal education did not have significant association with preterm birth.

Table 22

Logistic Regression Analysis of Preterm Birth and Paternal Race, Age, and Education

Predictor Variables	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Paternal Race								
Unknown			27.886	10	.002			
Other Asians	.016	.172	.008	1	.928	1.016	.725	1.423
Mixed Race	-.309	.148	4.368	1	.037	.734	.549	.981
White	-.328	.140	5.472	1	.019	.721	.548	.948
Black	.068	.226	.091	1	.762	1.071	.687	1.668
American Indian	.011	.338	.001	1	.975	1.011	.521	1.961
Chinese	-.146	.259	.319	1	.572	.864	.521	1.434
Japanese	-.060	.183	.108	1	.742	.942	.658	1.348
Filipino	.036	.149	.057	1	.811	1.036	.774	1.388
Hawaiian	-.295	.152	3.776	1	.052	.745	.553	1.003
Other Race	1.230	.590	4.346	1	.037	3.420	1.076	10.870
Constant	-1.230	.121	102.979	1	.000	.292		
Paternal Age								
18 and under			13.576	4	.009			
19 years to 25 years	-.151	.347	.190	1	.663	.859	.435	1.698
26 years to 35 years	-.027	.339	.006	1	.936	.973	.500	1.892
36 years to 40 years	.079	.347	.053	1	.819	1.083	.549	2.136
40 years and above	.297	.349	.724	1	.395	1.345	.679	2.665
Constant	-1.431	.336	18.172	1	.000	.239		
Paternal Education								
Unknown			2.232	6	.897			
0 to 8 years	.011	.158	.005	1	.945	1.011	.742	1.378
9 to 11 years	-.413	.626	.435	1	.510	.662	.194	2.256
12 years	-.081	.223	.132	1	.716	.922	.595	1.429
13 to 15 years	.011	.088	.015	1	.902	1.011	.851	1.201
16 years	-.085	.113	.568	1	.451	.918	.736	1.146
16+ years	-.123	.116	1.124	1	.289	.884	.705	1.110
Constant	-1.379	.050	756.808	1	.000	.252		

Summary

After testing the association between social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal education, annual income, and county/district of residence) and preterm birth in the state of Hawai'i for the years 2012 to 2015 using the Hawai'i Pregnancy Risk Assessment, the analysis indicated that maternal race, maternal age, geographical location, and paternal race were found to have to a significant association with preterm birth. For each of the research questions, I was able to reject the null hypothesis that there is no association between preterm birth and the predictor variable. For RQ1, RQ2, and RQ3, there is at least one predictor variable that was found to have significant association with the outcome variable, indicating partial rejection of the null for each of the research questions. Mothers who indicated Other Asian (OR = 1.837), Black (OR = 2.081), Japanese (OR = 1.469), Filipino (OR =1.849), Hawaiian (OR = 1.466), and Mixed Race (OR = 1.342) were more likely to experience preterm birth than White mothers. Moreover, RQ1 analysis indicated that mothers who were in the 20 to 24 years age group were 48% less likely to have preterm birth. Maternal education and maternal marital status were found to have no association. In RQ2, Mothers living in the county of Honolulu and the city of Honolulu had greater than 2 times (with OR of 2.437 and 2.589, respectively) the odds of preterm birth morbidity than mothers living in the city of Hilo. Preterm birth had a weak, negative association with mothers living in the Island of Kauai (OR = 0.602) and the Island of Maui (OR = 0.689). Mothers living in Kauai and Maui were 39% and 31% less likely to suffer from preterm birth. Income was found to have no relationship with preterm birth. In looking at paternal predictor variables in RQ3, paternal race was found to have an association with preterm birth. Fathers belonging in Mixed Race (OR = 0.734), White (OR = 0.721), and Hawaiian (OR = 0.745) were least likely to suffer preterm birth by 25% to 27% and fathers belonging in Other Race (OR = 3.420) had 3 times greater odds of experiencing preterm birth. Paternal age and paternal education were found to have no association with preterm birth. Chapter 5 will include further discussion of interpretation of findings, limitations of the study, implications for social change, and recommendations for future research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Preterm births in Hawai'i from 2012 to 2015 were documented at 17.7% of births (Table 3) and continue to be the leading cause of neonatal deaths, being associated with birth defects and long-term health morbidities. The purpose of this quantitative research study was to test the associations of social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal education, annual income, county, and county/district of residence) and preterm birth in the state of Hawai'i for the years 2012 to 2015 using the Hawai'i Pregnancy Risk Assessment and Monitoring Systems (PRAMS). Key findings of the study were that maternal race, maternal age, county/district of residence, and paternal race had a significant association with preterm birth.

Interpretation of Findings

After conducting a binary logistic regression test with the outcome variable of preterm birth, the data analysis resulted in the partial rejection of the null hypothesis in RQ1, RQ2, and RQ3.

Preterm Birth and Race

The findings of the study align seamlessly with the information presented in the existing literature. Smid et al. (2017), Kim et al. (2018), and Li et al. (2018) claimed an association between race and preterm birth. A significant disparity is evident in preterm birth among the ethnicities surveyed in the Hawai'i PRAMS: Other Asian ($p = <0.001$), Black ($p = 0.002$), Japanese ($p = 0.009$), Filipino ($p = <0.001$), Hawaiian ($p = 0.001$), and

Mixed Race (*p* = 0.008) participants were more likely to suffer from preterm birth than White mothers. The disparity in preterm birth as a function of race is not only seen in the mothers, but also in fathers. Table 22 indicated a significant association of preterm birth with paternal race: Mixed Race (*p* = 0.037), White (*p* = 0.019), and Hawaiian (*p* = 0.052) were least likely to suffer from preterm birth and Other Race (p = 0.037) fathers had 3 times greater odds of their children suffering from preterm birth.

Preterm Birth and Age

Maternal age is a profound determinant of preterm birth (Fuchs et al., 2018). This study showed a congruency with the claims made by Fuchs et al. (2018), where age was a significant determinant of preterm birth. A significant negative association was distinctively present in the 20 to 24 years old category (*p* = 0.013). There is plausible protective association against preterm birth at this age group. This age group had a 48% lower likelihood of experiencing preterm birth.

Preterm Birth and Education and Marital Status

Bushnik et al. (2017) and Cantarutti et al. (2017) claimed an association between education and preterm birth. El-Sayed et al. (2012) reported an increased risk of preterm births among unmarried mothers throughout all maternal age groups. However, the analysis in this study showed that maternal education and paternal education had no significant association with preterm birth.

Preterm Birth and Income

According to the WHO (2023), in low-income settings, half of the babies born at or below 32 weeks (2 months early) die due to a lack of feasible, cost-effective care such as warmth, breastfeeding support and basic care for infections and breathing difficulties. However, the binary logistic regression of income and preterm birth in Hawai'i depicted no significant association.

Preterm Birth and Geographic Distinction

Kent et al. (2013) claimed that high-poverty African American areas have higher odds of adverse birth outcomes in urban versus rural regions. This research indicated similar results where preterm birth is significantly associated with county/district of residence. The binary logistic regression of the predictor variables used for geographic distinction indicated a significant inference (Table 20). Mothers living in urban areas had a strong, positive correlation with preterm birth (p = <0.001; OR = 3.451)). Correspondingly, preterm birth was found to be more likely in the county of Honolulu (p = <0.001; OR = 2.589) and the city of Honolulu (p = <0.001; OR = 2.437), which are classified as urban areas.

Study Findings and the Social Ecological Model (SEM)

The SEM is used to explain how the difference in exposure in risk factors ensues from intricate interactions at the individual, community, organizational, and policy levels (McLeroy et al., 1988). Health is impacted by measures of individuals' socioeconomic resources, social position, income, education, and socioeconomic status (Braveman & Gotllieb, 2014). Although preterm birth is a phenomenon that can be explained by biomedical indices, this study has allowed the examination of such phenomenon under the lens of the SEM framework. Alio et al. (2010) posited that the ecological model provides an ideal theoretical perspective in examining disparities in birth outcomes, including those that are impacted by maternal and family characteristics, which are in turn strongly influenced by the larger community and society. The results from current study have identified the population (race and age groups) that is vulnerable to preterm birth. This identification of the vulnerable can influence the implementation and modification of current health programs in Hawai'i that encourages behavioral and attitude changes in these racial/ethnic group and age groups to further minimize the risk of preterm birth at the individual level. In keeping with the SEM precepts, the disparity in preterm birth is influence by the surrounding community as well. This study's results can be used to support the examination of existing programs and targeted initiatives in urban communities where higher prevalence of preterm birth is detected.

Limitations of the Study

Despite the established rigor that PRAMS may possess, it is still a voluntary survey. The limitations of this study arise from the plausible bias that might arise from the volunteer sample that may or may not represent the general population (Salkind, 2010). The data generated from the voluntary responses are also limited by missing or unknown data points. It is possible that missing data can reduce the statistical power of a study and can produce biased estimates (Kang, 2013). Missing and unknown data can reduce the power and effect size of a given sample and lead to a Type I error, a false positive conclusion, or a Type II error, a false negative conclusion. Take for instance the predictor variable of maternal education, the crosstabulation analysis indicated that out of 5572 data count only 2835 cases were used in the analysis. The missing data resulted in failing to reject the null hypothesis of no association. The data itself, despite the missing data point, reflects a normal distribution on each of the predictor variable. Since the secondary data solely contain responses from the State of Hawai'i, the results of this study will have a limited generalizability to only the population of the State of Hawai'i.

Recommendations

Although there is an extensive amount of literature detailing the influence of socioeconomic factors on preterm births, there is a limited amount of study conducted with the population of Hawai'i. The statewide PRAMS was being used to survey the prevalence of adverse outcomes during pregnancy. There are several recommendations that can result from the findings in this study. This study can act as baseline to identify the vulnerable populations and communities. Identification of vulnerable populations can trigger the creation, implementation, funding, assessment, and evaluation of programs, policies, and service available in Hawai'i.

Race, age, and geographic distinctions were deemed to be significant predictors of preterm birth in this study. Race is an intriguing determinant in Hawai'i. Data depicted a significant negative, association with race. It would be interesting to delve deeper into protective effect of each race and culture on preterm birth morbidities. Similarly, age and income are also significant determinants in preterm birth according to the current study. Research regarding the age-specific behaviors, morbidities, and covariates are needed to determine the full influence of age on preterm birth.

Moreover, the current research suggest that preterm birth is influenced by geography. Hawai'i is a state of separated by islands. The prevalence and significance of preterm birth in a particular locale may suggest a disparity in the distribution of maternal health initiatives and interventions. The results of this study indicate that comprehensive investigation and reassessment of the maternal health delivery system in each of the island counties of Hawai'i is needed.

Implications

The potential social change implications of this research are that findings of this study could help alleviate the burden of preterm birth by addressing social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal education, annual income, and county/district of residence) in Hawai'i. Understanding the factors that affect preterm birth creates the potential for evaluation of existing and creation of novel programs and policies that supports the elimination of the disparity in birth outcomes and the possible disparity in the health delivery system throughout the State of Hawai'i. At the individual level and interpersonal level, positive social change can sprout from igniting awareness of the risk factors in vulnerable populations. The awareness of risk factors in these vulnerable population can aid public health professionals in designing targeted strategies and task force to offset the effects of preterm birth. At the policy level, positive social change can emerge from collaborative and comprehensive strategies at the local and state level to establish programs and legislation that directly address the disparities in birth outcomes across social economic chasm.

Conclusion

Hawai'i ranks 18th amongst the states with the highest rate of preterm birth. In this research, I examined the association between social risk factors (maternal age, paternal age, maternal race, marital status, maternal education, paternal race, paternal education, annual income, county/district of residence) and preterm births in Hawai'i for the years. The analysis revealed that race, both maternal and paternal, and maternal age are key social factors significantly associated with preterm birth. County/district of residence is also a key factor in predicting preterm birth in the State of Hawai'i. Further analysis of these social risk factors could facilitate development of programs, funding, and projects that are targeted toward the regions most affected by this disparity in birth outcomes and aid in reducing the rates of preterm birth.

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