2023

Relationship Between Maternal Language and Use of Electronic Cigarettes in Pregnancy

Tara Halpern
Walden University

Walden University

College of Health Sciences and Public Policy

This is to certify that the doctoral dissertation by

Tara Halpern

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Nancy Rea, Committee Chairperson, Public Health Faculty
Dr. Patrick Tschida, Committee Member, Public Health Faculty
Dr. David Segal, University Reviewer, Public Health Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2023

Abstract

Relationship Between Maternal Language and Use of Electronic Cigarettes in Pregnancy

by

Tara Halpern

MS, Stony Brook University, 2015

MBS, Rutgers University, 2013

BS, William Paterson University 2011

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

Walden University

May 2023

Abstract

Tobacco use has been a long-standing known modifiable risk factor to maternal health. Although there have been many efforts to encourage smoking cessation, use of electronic cigarettes in pregnancy has been increasing over the years. Understanding potential factors that may play a role in the increased use of electronic cigarettes is important to improve maternal and fetal health outcomes. The social ecological model provides the theoretical framework for this study. The purpose of this study is to determine whether a woman's primary language and pregnancy health care factors (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy. After completing a retrospective logistic regression model of the Pregnancy Risk Assessment Monitoring Surveillance System data set for the state of New York, including New York City, it was found that Spanish-speaking mothers were significantly less likely to use electronic cigarettes compared to English-speaking mothers. Other key variables that were found to have a significant effect on maternal use of electronic cigarettes included marital status, health insurance, and postpartum care. This study shows the continued importance of understanding key sociodemographic variables that influence and relate to the use of electronic cigarettes in pregnancy. Implications for positive social change include creating impactful social media campaigns or increasing advertisements that educate individuals of the dangers of electronic cigarette use which can lead to healthier lifestyles for those that at greater risk for use.

.

Relationship Between Maternal Language and Use of Electronic Cigarettes in Pregnancy

by

Tara Halpern

MS, Stony Brook University, 2015

MBS, Rutgers University, 2013

BS, William Paterson University, 2011

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

Walden University

May 2023

Dedication

I dedicate this dissertation to my loving parents, sister, brother-in law, and nephew. I know that this was a long and arduous road, and I thank you for encouraging me when I needed it and putting up with my absence at times while I completed my research. To my parents Felix and Bonnie, thank you for giving me every opportunity to strive for my dreams from a young age. Thank you for providing the foundation I needed to pursue higher education and having instilled in me a strong work ethic. It taught me to persevere even when it was most difficult. To my sister, Heather, thank you for praying for me always and being ready with home baked food when I had time to come up for air.

To my patients that I see daily, I was motivated to learn more and find a different approach to help you when I saw your struggles exceeded beyond the physical illness itself. I saw the barriers you face daily that limited your ability to improve your health and knew I needed to do more. This pursuit of higher education is so that collectively with my peers, we can learn new ways to understand, reach, serve, and tear down those boundaries to improve your health.

Acknowledgments

This journey started with a completely different study, completely different committee chair prior to a pandemic that changed everything. I would like to thank my committee chair Dr. Nancy Rea who I was reassigned to and truly feel that it was the perfect match. Thank you, Dr. Rea, for having been a great motivator throughout the dissertation process and helping me navigate the roadblocks along the way, and all those calls where you reiterate your faith in me. I would also like to thank Dr. Patrick Tschida my committee member, who always answered and responded to my questions expediently and raised points that always made me see a different perspective. To Dr. Zin Htway for the countless sessions, we had together to finite the SPSS model and your positivity that inspired me throughout the process. To all the professors that I had along the way at Walden University that helped foster an environment of learning and cultivating an environment of wanting to create positive social change.

To Dr. Nadya Dimitrov, and Lynn Timko-Swaim, Clinical Associate Professors at Stony Brook University, dear mentors to me over the past 10 years as I practice daily as a Physician Assistant. Thank you for your encouragement, your passion for higher education, and for inviting me into the classroom to teach the next generation. Finally, I'd like to acknowledge my closest friends who I have subjected to reading this document numerous times, who always encouraged me and provided feedback.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Introduction

Improving pregnancy outcomes, maternal-child health and maternal mortality has been a vital campaign for public health initiatives in the United States. The focus to improve pregnancy outcomes from a public health perspective is mostly due to the importance and role in determining the health of subsequent generations (Office of Disease Prevention and Health Promotion [ODPHP], 2020). Major determinants of health outcomes during pregnancy include age, modifiable lifestyle factors such as alcohol and tobacco use, access to health care, economic status, and modifiable health conditions prior to pregnancy such as obesity and infections (Dagklis et al., 2020; Doherty et al., 2019; Homan et al., 2018).

This study focuses on the modifiable maternal behavior, tobacco use in pregnancy, primarily through the mode of electronic cigarette use. Modifiable lifestyle behaviors including tobacco use, account for 40% of deaths within the United States (Hooker et al., 2018). A collection of studies has previously highlighted the importance of maternal health behaviors and the effects on maternal child health, which has led to greater education and resources allotted for the promotion of health behaviors (Stephenson et al., 2018). In the United Kingdom, there are aims to better understand these modifiable risks, including tobacco use, even prior to pregnancy to help improve health outcome within their population (Flynn et al., 2021). However, in the United States, currently there is limited research on the many different factors (i.e., interpersonal/intrapersonal influence, stigma/perception, etc.) that can influence use of

electronic cigarettes during pregnancy (Calder et al., 2021, Lin et al., 2023). One way to better understand these at-risk behaviors and potential causal relationships is to better identify demographics and potential barriers for those at greatest risk.

In this chapter, I will contextualize the main variables being evaluated, including an overview of electronic cigarettes, language disparities in pregnancy, and the importance of accessing prenatal care. Understanding these variables will help define the research problem, research questions, and the purpose of the proposed study. After providing the theoretical framework for this study, I will further explain the design and rationale of the study, outline definitions of key terms, assumptions, scope and limitations, and significance of this study.

Background

General Trends in Tobacco Use in Pregnancy

Use of cigarettes in pregnancy is one of the greatest modifiable risk factors associated with poor maternal and neonatal outcomes within the United States (Kim, 2020). Overall, the prevalence of smoking has been declining in the United States but remains highest among younger women aged 20-24 of American Indian/Native Alaskan (AI/NA) descent, or with equal to less education than a General Education Development (GED) certificate (Azagba et al., 2020). In the year 2016, 7.2% of women had reported being a smoker; however, in other countries maternal smoking rates can be as high as 23%, such as in Brazil (Azagba et al., 2020; Kataoka et al., 2018). In Canada, similar patterns in tobacco use in pregnancy have been found to show a progressive decline between 1992 to 2008 (Azagba et al., 2020).

In a recent study conducted by Liu et al. (2021), 38 states were evaluated to determine use of electronic cigarettes before and during pregnancy to determine if there was a change in this pattern. It was found that among the women who had used electronic cigarettes prior to pregnancy, about 25% of those women continue to smoke electronic cigarettes during the pregnancy; however, there was a drastic decrease in percentage of use from beginning of pregnancy at 3.6% to the last 3 months of pregnancy at 1.1% of the population (Liu et al., 2021). Liu et al.'s study emphasized the continued need for further investigation into better understanding those at risk and potential barriers that may be modifiable such as the variables evaluated in this study.

The American College of Obstetrics and Gynecology (ACOG, 2020) has urged tobacco cessation at any point in pregnancy, but primarily before 15 weeks to have the greatest benefit. To do so, there is emphasis on the clinician to provide cessation materials, or to individualize care through psychosocial, behavioral and pharmacotherapy; however, current data imply that this is not currently being done. Regardless of the call for screening and management of substance use in pregnancy, including tobacco use, clinician screening rates have declined over time (Ko et al., 2020). Over the past two decades rates have declined from 92% in 2000 to 82% in 2010, and the use of validated screening tools decreased from 23% in 2000 to 11% in 2010 (Ko et al., 2020).

More recent data also show that 76% of ACOG physician members do not use a standard screening instrument, and only 11% stated using a validated screening instrument (Ko et al., 2020). Therefore, better understanding who is at greatest risk for

tobacco use, including electronic cigarettes, may provide clinicians with more information to better increase screening recommendations and adherence to practice guidelines to improve maternal child health outcomes and reduce disparities.

Preventative Services in Pregnancy

In recent decades, the United States has aimed to reduce the rates of adverse outcomes during pregnancy and maternal health in part solely by increasing access to prenatal care (Adams & Johnston, 2016; Margerison et al., 2021). The World Health Organization (WHO) instituted the commission on the social determinants of health to better understand the environments in which people engage through all stages of life to better understand health inequities and the role of social context on health outcomes (Crear-Perry et al., 2021). The availability and access to pre-pregnancy and prenatal care can help prevent poor maternal health outcomes during pregnancy and improve the health of mother and fetus (Leal et al., 2020; Nichols & Cohen, 2020; Robbins & Martocci, 2020). Access to health care only during pregnancy has been found to inadequately manage modifiable risk factors in pregnancy, including smoking (Margerison et al., 2020). It is important to determine if access to care early in pregnancy may help identify those who utilize electronic cigarettes, or if more use is associated with poor obstetrical care and access to health resources.

Current knowledge of access to prenatal care from the years 2017–2019 found 86.5% of White women to have early access to prenatal care compared to 74.6% of Hispanic women, and 67.3% of Black women (March of Dimes, 2021). This study helped

to further identify risk factors associated with electronic use in pregnancy, which ultimately can lead to health programs and policies and improvement of maternal health.

Language Disparities in Pregnancy

An additional barrier that needs further evaluation is the role and extent of language disparities and maternal health outcomes. There is limited data presently that target understanding the relationships between maternal language, modifiable risk factors, and maternal outcomes. Of the studies that have evaluated language barriers and pregnancy within the United States, Fryer et al. (2020) evaluated the current conditions in North Carolina. In their study, there were two emerging trends amongst Latina women in regard to language barriers: either lack of bilingual health care providers or insufficient translator services. Not only are exclusive Spanish-speaking Latina women currently a disadvantaged population accounting for 23% of female immigrants, but there are also more than 44.2% of women who claim diverse national origins (American Immigration Council, 2020). As of 2018, 87,300 women are living in the United States as refugees, and in 2019, an additional 14,651 female immigrants arrived (American Immigration Council, 2020; Statista, 2020). This shows the importance of determining if language barriers are a hindrance to use of tobacco use in pregnancy through the mode of electronic cigarettes.

This study will help depict the current trend in tobacco use in pregnancy primarily with electronic cigarettes with more recent data collected. Through the brief illustration of what is currently known between these variables alone, and the limited number of

recent published research within the last 5 years, this study will help to fill that gap, as well as investigate newer relationships that may exist.

Problem Statement

With an increase in the rise of electronic cigarette use during pregnancy due to misconceptions of safety, it is important to identify populations at risk and the relevant social determinants associated. Tobacco use in pregnancy has been known to be a harmful substance that can cause birth defects including tissue damage within the fetal lungs and brain, and can result in cleft lip (Centers for Disease Control and Prevention [CDC], 2020). Current advisement for smoking cessation in pregnancy may lead to alternative delivery forms such as electronic cigarettes, commonly referred to as electronic cigarettes, that may be marketed as less harmful (Chiang et al., 2020). According to the ACOG (2020), recent data show that 14% of pregnant women utilize electronic cigarettes with the impression that it would help with smoking cessation from traditional combustible cigarettes.

What is not as well-known is whether there is an association between maternal language, pregnancy health care related risk factors, and the use of electronic cigarettes while pregnant as a substitution for traditional nicotine cigarettes. It has been found that some pregnancy-related blogs and online forums encourage that vaping is safer, or that risks are unknown (Wigginton et al., 2017). However, in actuality, use of electronic cigarettes has been found to have similar amounts of nicotine as consumed to a regular cigarette and poses dangers to the developing fetus in a similar nature (Whittington et al., 2018) and therefore places pregnant women and their unborn child at risk. Within the

past 5 years, there has been an increase in use of electronic cigarettes during pregnancy compared to cigarettes increasing from 1.9% in 2016 to 3.8% in 2018 (Obisesan et al., 2020).

One way to measure population health of women has been through access to prenatal care and health insurance (Healthy People 2020). Risk stratification of behaviors such as tobacco use leading to early intervention can be achieved through early and easily accessible prenatal health care (American Academy of Pediatrics & ACOG, 2017). There is a current miseducation amongst pregnant women on the safety of electronic cigarettes and health care providers are urged to educate and advise all tobacco cessation at all gestational ages and provide behavioral interventions when needed (ACOG, 2020). This study aims to determine if pregnant women are at a greater risk of using electronic cigarettes due to maternal language barriers and other pregnancy heath care related factors (i.e., women who accessed care within 12 months prior to the pregnancy, received prenatal care in the first trimester, and health insurance status). This study results will be used to develop targeted early screening and educational interventions of pregnant women.

Purpose of the Study

The purpose of this quantitative study is to determine if a woman's primary language and pregnancy health care factors (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy.

Research Questions and Hypotheses

RQ1: Is there an association between primary language spoken (English vs. non-English) and use of electronic cigarette in pregnancy in relation to covariates age, number of pregnancies, education level, race, income, marital status and ethnicity in pregnant women?

$H_0$1: There is no statistically significant difference between primary languages spoken (English vs. non-English) and use of electronic cigarettes in pregnancy in relation to covariates: age, number of pregnancies, education level, race, income, marital status, and ethnicity in pregnant women.

$H_1$1: There is a statistically significant difference between primary languages spoken (English vs. non-English) and use of electronic cigarette in pregnancy in relation to covariates: age, number of pregnancies, education level, race, income, marital status and ethnicity in pregnant women.

RQ2: Is there an association between preventive services such as accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, health insurance status during prenatal and postpartum period, and use electronic cigarettes in pregnant women?

$H_0$2: There is no statistically significant association between accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, insurance status during prenatal and postpartum period) and use of electronic cigarettes.

$H_1$2: There is a statistically significant association between accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, insurance status during prenatal and postpartum period) and use of electronic cigarettes.

Theoretical Framework

The theoretical framework used for this study is the social ecological model (SEM). This theory is used to understand the interaction between people, the environment, and overall, how this affects perspectives, behavior and beliefs (Brown, 2015). The five levels within this model include the individual, interpersonal, organizational, community, and public policy levels (McLeroy et al., 1988). Within this model, there is the assumption that an individual is comprised of the combination of personal thoughts, interpersonal relationships, structures within the community, and exposures to policies in place (Brown, 2015). These relationships influence the behaviors and actions of the individual.

The intrapersonal factors that align with this study are the demographic variables race, ethnicity, age, knowledge of need for prenatal care in the first trimester, and the recommendations that would follow. The interpersonal skills relate to the social support systems including family, work groups, and friendships. The organizational variables that may influence disease risk include medical establishments such as hospitals and clinics (McDaniel et al., 2018).

It has already been shown that there are racial disparities affecting maternal outcomes, which aligns with the intrapersonal level of the SEM. In other studies, researchers have aimed to understand the intrapersonal factors and maternal outcomes

using the SEM (Timmermans et al., 2020). Understanding how a specific intrapersonal factor such as language relationships and the social ecological determinants influence behavior, such as use of electronic cigarettes, can be used as targets to help improve perinatal outcomes and potential reduction in maternal and neonatal complications (Timmermans et al., 2020). Further detail of the theoretical framework of this study will be provided in Chapter 2.

Nature of the Study

The target population for this study included women who had recently delivered a live infant during the years 2017–2021 in New York, including New York City. Through birth records, mothers were identified and called and asked to participate in the Pregnancy Risk Assessment Monitoring (PRAMs) surveillance system during the year 2017–2021. This research was conducted as a nonexperimental design, with the goal to explore the relationships and correlation if any between electronic cigarette use in pregnancy, maternal language, and accessing preventive health care services such as prenatal care services.

The research design chosen was a retrospective cross-sectional design utilizing secondary data from the PRAMS data set. A cross sectional study was chosen due to the nature of investigating outcome and exposures of the participants at the same time using inclusion and exclusion criteria (Setia et al., 2016). Through the observational nature of the cross-sectional study, no variables were altered. I retrieved the pertinent data for this study in the PRAMs surveillance system, including primary maternal language based upon proficiency (i.e., English, Spanish, or Chinese), and preventive services in

pregnancy (i.e., accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester) and use of electronic cigarettes.

For the first research question, the dependent variable was electronic cigarette use, which is dichotomous (i.e., no use at all = 0, yes = 1). The independent variables were maternal language with English being the comparative language, and Spanish and Chinese comprised the non-English speaking variable. The variables of age, number of total pregnancies, education obtainment, race and ethnicity were considered covariates. To determine the influence of the relationship between these variables, I performed a statistical analysis using a logistic regression model to ascertain the relationship of primary language of pregnant women and the use of electronic cigarettes.

In the second research question, the dependent variable remains use of electronic cigarette use, and the independent variable was use of preventative services in pregnancy. Preventative services encompass the mother having responded "yes" or "no" to having accessed health care within the 12 months prior to pregnancy or not, receiving prenatal care in the first trimester or not, and health insurance status during prenatal and postpartum period. All of the coding for these variables will be further explained in Chapter 3. Through use of statistical analysis, particularly logistic regression model, a quantification of the relationship between maternal use of preventive services and electronic cigarette use will be revealed.

Definition of Key Terms

Electronic cigarette: Battery-operated device that when used produces an aerosol by heating a liquid (containing flavorings, chemicals, and usually nicotine). Usual

appearance is similar to traditional cigarettes, cigars, however some may appear to be like a pen, or USB device (National Institutes of Health [NIH], 2021).

Non-English: For the sake of this study, non-English will refer to Spanish-speaking or Chinese-speaking women collectively.

Prenatal care: The care a woman receives during pregnancy, that offers physical exam, weight checks, blood tests, imaging, and counseling/advisement by a health care provider (USDHHS, 2021).

Primary language: For the sake of this study refers to the spoken language that is more dominantly used in daily life for communication. This differs from someone's first language, in which they may not be as proficient in, or may not use daily. Primary language is often the most used to communicate inside and outside of the home by an individual.

Postpartum: The period for which the mother has already delivered the baby and the placenta and includes three distinct phases. The acute phase from 6–12 hours from delivery where there is increased risk for immediate medical crises. The second phase is 2–6 weeks, where the body undergoes changes in physiologic processes, and emotional state. The third phase can last up to 6 months, where the body continues to revert to the prepregnant state (Romano et al., 2010).

Assumptions

The primary assumption that can be made from this study, based upon the PRAMS data obtained from the CDC, is that all data are representative of real pregnancies within the state of New York. I assume that all samples of the participants

are true representations of actual pregnancies and accurate reporting of social demographics. I also assume that the electronic PRAMS database has been well established with recording data since 1987, and that no data have been lost or admitted in error till present. This study has not stored any personal identifiers within the database, or within the analyzed data set.

Scope and Delimitations

Identifying key social determinants of health and populations that may be at greater risk to continue high risk behaviors such as smoking electronic cigarettes in pregnancy is important. Highlighting and identifying which group of pregnant women are at greater risk to continue negative behaviors, may be based upon maternal primary language, and this study aims identify those populations if they exist. Identifying whether non-English-speaking pregnant women are at risk is crucial to ensure that greater infrastructure is provided to clinics, including translator services. The scope of this study expands the understanding of at-risk behaviors and how the role of access to care may be involved. Identifying the number of women who use electronic cigarettes and determining the relationship, if any, between access to prenatal care and use of electronic cigarettes, can help to improve health education of risks even during pre-conception time period.

Limitations

Limitations of this study include the retrospective nature, which does not relay real time data or perceptions of harm due to electronic cigarette use during pregnancy. The study is also limited to data from one state, New York, and cannot make larger

claims on the nation. Since this data set is from a national registry of questions asked to pregnant or postpartum participants, there is the potential for response bias and fears of judgement if questions related to substance use in pregnancy are shared.

Significance of Study

The results of this study determined whether there is an association between primary language spoken by pregnant women, pregnancy health care related opportunities and the use of electronic cigarettes during pregnancy. Understanding the relationships between pregnant women, maternal primary language and other pregnancy health care factors and the influence they may have on the use of electronic cigarettes can lead to improving maternal and neonatal outcomes. Understanding potential adverse health outcomes due to the use of electronic cigarettes can allow for public health professionals at all levels to create programs to help raise awareness, advocate for public policy and to place stricter warnings on packaging to help women understand the risk of poor health outcomes as a result of electronic cigarette use during pregnancy. The positive social change that this study brings about includes help to improve maternal health and disease prevention by highlighting a key patient population that may be at risk for continued use of electronic cigarettes in pregnancy. Ultimately, this research and the outcomes measured aimed to improve maternal health and reduce social determinants of health and inequalities.

Social Change Impact of Study

The social change and impact of this study is to gain more insight into an area that has been under researched to improve maternal outcomes. With the understanding

between language barriers, electronic cigarette use, pregnancy and access to healthcare, greater striders can be made to correct or limit inequalities. A goal target goal for Health People 2030 is to raise the percentage of females giving birth reporting to not have smoked during pregnancy from 93.5% to 95.7% (ODPHP, 2021). Through understanding the potential relationship of these social determinants of health, initiatives to create more education tools and resources regarding electronic cigarette use in pregnancy in multiple languages can be implemented. This would then reduce a language barrier and illustrate the importance to initiate counseling prior to pregnancy to at risk population groups if possible. By the creation of these public health programs, or education material, maternal and neonatal health would improve by reducing exposure to harmful substances. Another positive outcome that can come from this study is revealing the need to expand access to prenatal care in all states. If there is a relationship between modifiable risks including electronic cigarette use, and language barriers, and poor access to prenatal care, states may change current Medicaid expansion or programs to increase access.

Summary

The use of tobacco in pregnancy has been found to have deleterious effects for both maternal and child outcomes. Little research has recently been conducted that further evaluates the use of electronic cigarettes and pregnancy. This study provides a more current insight into electronic cigarette use in pregnancy, as well as a unique look into the potential influence of maternal primary language and use of preventive services in pregnancy. The improvement in maternal outcomes, maternal education, and increased detection of those at risk to use electronic cigarettes, and creation of new public health

initiatives can be created from the understanding gained within this study. In Chapter 2, I present a review of the literature to provide greater insight into what is currently known.

Chapter 2: Literature Review

Introduction

Understanding the use of tobacco or nicotine products during pregnancy is an important public health issue due to the potential health implications for both the mother and the developing fetus. It has been known that tobacco or nicotine use in pregnancy can cause orofacial clefts, fetal growth restriction, placenta previa, abruptio placentae, preterm pre-labor rupture of membranes, low birth weight, increased perinatal morality, ectopic pregnancy, and decreased maternal thyroid function (ACOG, 2020; Chiang et al., 2019; Kurti et al., 2018). One of the largest modifiable risk factors for maternal and child health has been found to be smoking in pregnancy (Gould et al., 2020; Obisesan et al., 2020). Current ongoing initiatives from Healthy People 2030 include increasing smoking cessation during pregnancy, with a target to increase the number of female's cessation rates within the first trimester (ODPHP, 2020).

There has been limited research on the current trends in electronic cigarette use in pregnancy, the changes in rates of use over the past 16 years, as well as health care related risk factors that may influence use in pregnancy (Bowker et al., 2020; Wang et al., 2020; Wiggington et al., 2017). Since maternal-fetal health has been an indicator of population health, it is important to understand the impact of current disparities present among pregnant women that may influence maternal behaviors and maternal health outcomes, as well as those of the future generations (ODPHP, 2020). This literature review highlights what is known about the current knowledge of electronic cigarette use, as well as language disparities and health care related risk factors during pregnancy.

There is however a gap in the literature on the role of language disparities and use of electronic cigarettes in pregnancy, which is what the current study aimed to provide greater insight into.

Due to the minimal research currently available, in this quantitative cross-sectional study, I explored whether a woman's primary language, health care related risk factors during pregnancy (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy. Determining whether there is an association within this target population can assist in creation of improved health promotion campaigns, policies, and screening methods to better target those at risk of adverse pregnancy outcomes due to the use of electronic cigarettes.

This chapter contains the following major topics: a clear description of the literature search strategy utilized to identify research that has been conducted, the theoretical foundation of this study, a synthesis of the conceptual model depicting the relationship between the distinct variables of this study, and a current analysis of the literature review related to key variables and concepts. The chapter will end with a summary of the major findings from the literature review and the relevance of how this study intends to fill the gap in the literature and conclusions.

Literature Search Strategy

Information for the literature review was obtained by searching electronic databases, theses and dissertations published electronically, as well use of references lists from research articles found to be relevant. Electronic databases used for this literature

review included Embase, ProQuest Health and Medical Collection, Sage Knowledge, Google Scholar, CINAHL, Medline. Publishing databases utilized for this search included Elsevier, Springer. Journal websites included *PLoS ONE*, *The New England Journal of Medicine*, and the *American Journal of Public Health*. National and international health organizations such as the CDC and the WHO were also sources of information. Both full-text and partial-text options were utilized. Peer-reviewed journals were selected to optimize search of publications with high standards and ensure quality of research reviewed (see Kiron et al., 2018).

Publications for the literature review were limited to those published within the previous 5 years, 2015–2020, primarily within the United States of America, but open to all other international publications. For foundational studies included in my theoretical framework and conceptual frameworks, I used studies published prior to 2015 without any parameters on date of publication. The following key terms were used for all searches: *e-cigarettes or electronic cigarettes, vapor cigarettes, vapes, electronic nicotine delivery device or Juul, language barriers or communication barriers or non-English speaking or limited English proficiency, access to health care or access to health service or health access or access to healthcare*, *first trimester of pregnancy,* and *pregnancy or pregnant or prenatal or antenatal or perinatal or maternal.* Although the research was not limited to only the United States of America, I did restrict to articles published in the English language only. Research articles with the most relevance to the research topic were selected and will be discussed in this literature review.

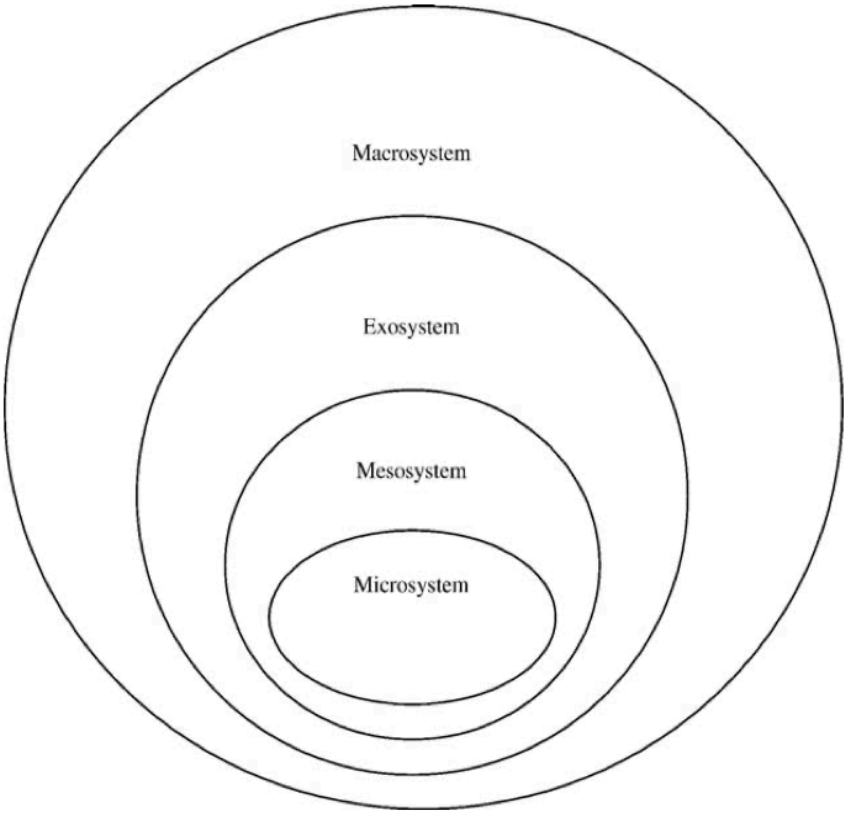
Theoretical Foundation

To better understand the relationships between use of electronic cigarettes, health care related risk factors, and language disparities within pregnancy, the SEM served as the theoretical foundation for this study. The SEM as a theoretical framework is used to understand how different aspects of social environment relate to health problems (Coreil, 2010). The earliest adaptation of the concepts within this framework was seen in 1947, when the WHO (1947) stated that "health" should include physical, mental, and social well-being.

The origin of this theoretical foundation stems from psychologist Urie Bronfenbrenner who had early works studying child psychology and human development. The primitive foundation for this theory was three individual aspects: an individual's perspective on the external environment, the external environment surrounding the individual, and the dynamic interaction between the two (Reifsnider et al., 2005). A visual representation of this early framework involves the microsystem, mesosystem, exosystem, and macrosystem (Reifsnider et al., 2005), as seen in Figure 1.

Figure 1

Early Ecological Model



Note. The four levels and main influences involed in Bronfenbrenners early ecological model, the microsystem, mesosystem, exosystem, and macrosystem. From "Using Ecological Models in Research on Health Disparities" by E. Reifsnider, M. Gallagher, and B. Forgione, 2005, *Journal of Professional Nursing*, *21*(4), p. 217. (https://doi.org/10.1016/j.profnurs.2005.05.006).

The microsystem in this model is representative of the individual. The mesosystem is a compilation of social interactions and relationships with social structures such as religious organizations or work. The exosystem is comprised of organizational structures that influence the smaller circles such as school board administration, city council, and community infrastructure. The macrosystem is all-encompassing society; it is the level culture, the belief systems, language, and ideologies that form society (Reifsnider et al., 2005; WHO, 2020). There are important relationships between these different levels, and each interaction can influence a particular individual, either strengthen or weaken social structures or shape individuals (WHO, 2020).

Understanding the interrelations between diverse intrapersonal factors, environmental factors, and health is at the core of the social ecological theoretical framework (Stokols, 1996). The basis of epidemiology in the 1960s had a rise in evaluating physical, chemical, and biological environments that led to further investigation into the behavioral determinants of health during the 1980s (Green, 1996). This focus grew to greater depths to determine the social, economic, organizational, and political influences on public health, and areas for public health interventions (Green, 1996). Stokols (1996) argued that the effects on health are a culmination of the social, physical, and cultural aspects within an environment, and that this environment may influence different individuals with different social and economic constructs differently with unique outcomes. Since the 1990s, institutions such as the CDC have promoted the SEM for understanding population health (CDC, 2015; Golden & Earp, 2012). As the field of epidemiology has grown, adaptation of this four-part theoretical model has

resulted in renamed levels with the individual, relationship, community, and societal (CDC, 2007; Krug et al., 2002; Stokols, 1996).

Social-ecological theoretical frameworks have served to understand the influences of people, and organizations, the interactions between resources, institutions and pre-existing social constructs and norms (Golden et al., 2015). This framework allows researchers to better visualize a causal pattern the relationship between biological, physical and social factors that influence health outcomes and trajectories both upstream and downstream over time (Woolf & Aron, 2013).

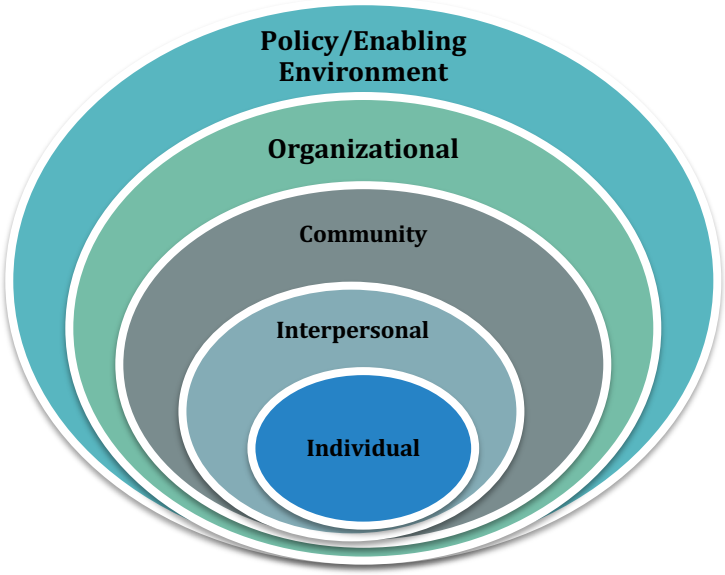
The application of this theoretical foundation in this public health research study, can lead to better understanding of population health, and potential health disparities that can be used to influence and create health guidelines, programs, and health promotion interventions (Stokols, 1996). The implementation of the SEM in this study helped to identify the intrinsic factors within an individual and the relationship to health outcomes, and behaviors that may allow for a greater understand of where targeted interventions can be focused (Williams & Swierad, 2019). As it relates to this research study, the SEM framework helped allow for greater understanding of the relationship between individual characteristics such as language barriers for pregnant women, community-based influences such as health insurance accessibility, and health behaviors such as electronic cigarette use.

A multilevel framework, expanded from the original Bronfenbrenner model, was developed to best relate the different levels of influence on health behaviors (McLeroy et al., 1988). The SEM visually displayed the dynamic interactions amongst an individual,

groups, and the environment (Bronfenbrenner, 1992). The levels in the SEM used for this study involve a focus on the bottom two tiers within the five-tier model (see Figure 2). This model focuses on the core, the individual, including such variables as socioeconomic factors, commonly known as social determinants of health. Healthy People 2030 differentiates social determinants into five domains: economic stability, education access and quality, health care access and quality, neighborhood and the built environment, and social and community context (ODPHP, 2020). It is within these domains where there is a dynamic interaction between individuals that are influencers and influenced upon and were targets for specific health behaviors can be identified (Bronfenbrenner, 1992; Golden et al., 2015).

Figure 2

Social Ecological Model (SEM)



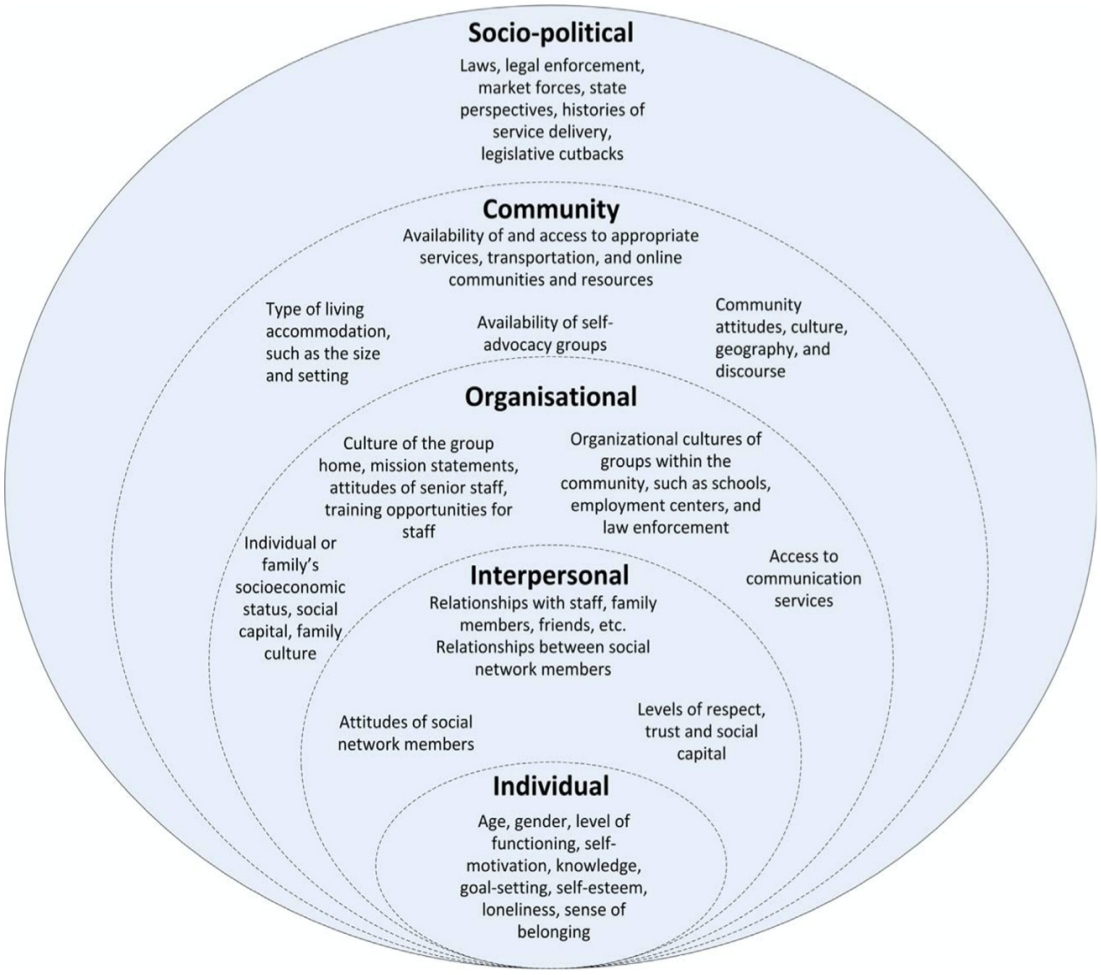
Note. This figure is an adaptation of the multiple levels of the SEM. Adapted from "*UNICEF 2017 Report on communication for development (C4D): Global*

progress and country level highlights across programme areas", by UNICEF, 2018. (https://www.unicef.org/media/47781/file/UNICEF_2017_Report_on_Communication_for_Development_C4D.pdf)

The specific levels used in this model are the individual, interpersonal, organizational, community and lastly the societal and political level (UNICEF, 2018). Within the first level of this model, the individual, is comprised with characteristics such as knowledge, attitudes, gender, age, social demographics i.e., race, ethnicity, socioeconomic status, literacy, and language. The interpersonal level relates to formal and informal networking systems between friends, family, peers or coworkers, religious organizations, and cultural customs. The community level includes the physical built environment such as business, transportation, institutions, and community leaders, whereas organizational level rules and regulations set forth by organizations or social institutions that affect services provided to an individual. An example of this would be a school board that determines the curriculum, which will then affect the information learned for a young child. The societal and political level include the designated officials representing local, state, national and global laws, including accessing health services, societal norms, broad level culture, and media (UNICEF, 2018). Figure 3 visually conceptualizes the description of each level with the SEM (Simplican et al., 2015).

Figure 3

Descript Levels of the Social Ecological Model (SEM)



Note. Ecological pathways of social inclusion to depict the influence of individual, interpersonal, organizational, community and sociopolitical variables to create an enabling or disabling environment. From "*Defining social inclusion of people with intellectual and developmental disabilities: An ecological model of social networks and community participation"* by Simplican, S. C., Leader, G., Kosciulek, J., & Leahy, M., 2015**,** *Research in Developmental Disabilities, 38*, 18-29. (https://doi.org/10.1016/j.ridd.2014.10.008)

Within these social determinants, language and literacy are two factors that make up the intrapersonal level within the social ecological framework that impacts health in a major way (ODPHP, 2020). Current research has found that modifiable risk factors such as tobacco use, unhealthy food, and alcohol use are linked to the demographics within this tier of the pyramid (Frieden, 2010). In the past, in reference to traditional combustible tobacco cigarettes, use of all levels the five-tier SEM have been integral to the creation of tobacco control and cessation programs due to a more robust understanding of those with the greatest risk of use (Frieden, 2010). Implementation of SEM in research regarding tobacco use has shown influences in cessation or continued use dependent upon socioeconomic influences and social constructs (Huisman et al., 2012). Further examining individual and environmental determinants allows for a full comprehension of cultural, social, and dynamic relationships that relate to one's health (McElfish et al., 2017). It is with this SEM that this study aims to gain a greater insight into the socioecological variables such as language that influence electronic cigarette use in pregnancy.

Literature Review

In the literature review, I will discuss the current body of knowledge within the past several years as it pertains to the key variables within the study. I will first review general knowledge of electronic cigarettes, including current trends of use of in adults, both pregnant and non-pregnant. To better understand factors that may influence the use of electronic cigarette, and emphasize the importance to better understand population use, an overview of the perceptions of safety of electronic cigarettes will be explained. Also

elaborated upon will be social disparities and health care related risk factors during pregnancy to include language barriers, race and ethnicity, education level and health insurance status.

Electronic Cigarettes and Prevalence in Adults

Electronic cigarettes have increased in use amongst adults rapidly since first entering the United States market after their creation in 2004 (Wagner et al., 2017). Electronic cigarettes according to the Surgeon General have been classified as the most-used tobacco product especially in young adults aged 18–24 years old (CDC, 2016). The CDC has vague and nondescript recommendations on electronic cigarette use and calls for the need for additional research to better understand use and health effects (CDC, 2020). Currently electronic cigarettes are being marketed as less harmful to health as compared to regular cigarettes since there is not combustion of tobacco which has been linked to adverse health effects (Owusu et al., 2019; Stroud et al., 2019). The CDC (2020) has stated that electronic cigarettes have the potential to benefit current non-pregnant smokers acting as substitutions for regular cigarettes or in conjunction other tobacco products.

There is very little research on the long-term effects of the specific chemicals and environmental toxins used within electronic cigarettes (Ebersole et. al., 2020; Kahr et al., 2015). Nicotine is the known addictive substance present in combustible cigarettes and has been linked to many known health consequences such as effects on the cardiovascular system, reproductive system, lung, and kidneys (Mishra et al., 2015). The nicotine within the liquid of electronic cigarettes is not synthetic but derived from

tobacco extracts and can vary in concentrations (England et al., 2015; Kesimer 2019). Nicotine levels within electronic cigarettes have been found to vary significantly from 21%–85% nicotine, a concentration as high as 87.2mg/mL were found in some devices (National Academies of Science, 2018; Obesisan et al., 2020; Wagner et al., 2017).

Even though there is the presence of nicotine within electronic cigarettes, there is lack of combustion, minimizing one of the known health risks related to combustible cigarettes alone (Benowitz & Fraiman, 2017; Chen et al., 2017). Other known constituents present within the liquid suspension are propylene glycol or glycerin and added flavorings which can contain harmful ingredients such as diacetyl and acetyl propionyl (England et al., 2015, Huerta et al., 2017; Stroud et al., 2019). In addition to the aerosol solution present within electronic cigarettes, the disposable mouthpiece also may be subject to thermal decomposition and add additional unknown levels of toxins to the user (Chen et al., 2017). Studies conducted by Krishnan-Sarin et al. (2015) and Yingst et al. (2017) have revealed that a popular flavoring in both combustible cigarettes, and electronic cigarettes is menthol. The use of menthol has been found to modulate nicotine metabolism by slowing it down, and causing an analgesic affect, which may be leading to increased use of mentholated tobacco products (Giovino et al., 2015; Krishnan-Sarin et al., 2017). Unfortunately, there is lack of concrete evidence regarding the health effects of the chemicals and toxins utilized in electronic cigarettes, primarily due to a great variation among manufacturers of electronic cigarette devices (Kahr et al., 2015).

Regulation of the electronic cigarette varies greatly between countries. Laws regarding tobacco regulation within the United States have only been in place since 2009,

after the signing of the Family Smoking Prevention and Tobacco Control Act under the Obama administration (Kaufman et al., 2015). Prior to 2016 within the United States there were no regulations until the U.S Food and Drug Agency (U.S. FDA) extended coverage to include electronic cigarettes (Wagner et al., 2017; Wiggington et al., 2017). The U.S. FDA's extended coverage and creation of regulations regarding electronic cigarettes were not uniform, and only placed on devices marketed for therapeutic purposes such as smoking cessation and or electronic cigarettes if they are being used for other therapeutic use (Alcala et al., 2016; U.S. FDA, 2020). One of the regulations put forth by the U.S. FDA stipulate that electronic cigarette manufacturers need to disclose ingredient lists as part of packaging material (McCubbin et al., 2017). Despite the new regulations implemented by United States, forty-one countries ban the selling of electronic cigarettes, sixty-six countries enforce restrictions and regulations of sales, and thirty-two countries regulate the contents of the electronic cigarettes (Global Center for Good Governance in Tobacco Control, 2020).

In the United States alone in 2016, it was found that 4.5% of the overall adult population reported current electronic cigarette use (Wang et al., 2019). Researchers have evaluated not only the trends within the United States over time but have included the United Kingdom and Australia. In a 2013 combined study between Australia, Canada the United States, and the United Kingdom awareness of electronic cigarettes as 46.6%, individuals having ever tried to 7.6%, and current use among individuals to be 3% (Wiggington et al., 2017). Trends of use over time has been shown to be increased with a greater prevalence within the United Kingdom compared to Australia with rates of use

18% and 6% respectfully (Young et al., 2015). In a study evaluating use within the population of 15-19-year-old individuals, the highest of the European countries were France and Poland with rates of use 13.3% and 8.8% respectively (Jankowski et al., 2020). According to the CDC, current electronic cigarette users amongst high school students increased from 220,000 students in 2011, to 3.05 million students in 2018, which accounts for a 20.8% increase (Cullen et al., 2018). The importance of this value, is the potential risk that these individuals of reproductive age, may have long term habits and at-risk behaviors that extend into early reproductive stages.

In the United Kingdom alone, a survey revealed that, “61.1% of current adult smokers, 18.8% of ex-smokers and non-smokers have tried electronic cigarettes” (Chen et al., 2017, p. 1). For adults aged 18 and older within the United States based on the National Health Interview Survey (NHIS) of 2016, the percentage of those ever-having used e-cigarettes was 15.4% an increase from 12.6% in 2014 (Livingston et al., 2019). Twenty-nine percent of current U.S. smokers tried electronic cigarettes as a means for cessation of combustible cigarettes in 2016 (Chen et al., 2017).

Prevalence within the United States in adults has been found to have a swift uptrend of use with an increase in ever-use of 1.8% in 2010 to 15.3% in 2016 and current use of 0.3% in 2010 to 4.5% in 2016 (Obisean et al., 2020). Amongst this population it has been found that Hispanics and Whites are more likely to use electronic cigarettes compared to Black non-Hispanics (CDC, 2016).

Another measure showing the increase of electronic cigarettes within the United States is market sales. During a 5-year period spanning from “2009 to 2014, electronic

cigarette market share for all tobacco products more than doubled each year" (Huerta et al., 2017, p. 339). In comparison to the banning of combustible cigarette campaigns from television and other media, marketing of electronic cigarettes in the media has not been banned due to their claim to be an assistive device for smoking cessation (Huerta et al., 2017; Yang, 2020). Assessment of electronic cigarette sales within the United States between the years 2014–2015, revealed an increase in sales in 18 states of 48 total, representative of a 37.5% increase, compared to cigarette sales that only increased in 15 states out of 48% for 31.3% (Marynak et al., 2017). The global markets reported an increase in sales for electronic cigarettes to be 1.5% of the global nicotine market, and a growth in sales to be 50.7% compared to that of combustible cigarettes at only 2.8% (Gravely et al., 2019). This market size has been forecasted to increase with projection rates between 17%–22% worldwide over the next 3–4 years (Cerrai et al., 2020).

It is important to understand the trends in electronic cigarette use for the general population, in comparison to the trends within a minority population such as pregnant women. Difference in patterns of use, and perceptions that ultimately lead to use, can help identify risk factors that can help create preventive services, as well as distinguish unique characteristics and social constructs.

Electronic Cigarette Use and Prevalence in Pregnancy

Literature studies currently involving pregnant women and use of electronic cigarettes within the past 5 years with use of a national representative sample is very limited and stresses the importance of conducting current studies aimed to better identify this population. Currently, the US Preventive Services Task Force (USPSTF) along with

ACOG, and the American Academy of Family Physicians (AAFP) recommend cessation of tobacco use during pregnancy however no current guidelines exist to screen for use of electronic cigarette use specifically (Northrup et al., 2017).

ACOG (2020) has informed that there is increased health risk for the developing fetal brain and lungs due to exposure to nicotine in any measurable form. Learning the most current statistics and current literature on rates of electronic cigarette use during pregnancy, is a necessary measure of current public health initiatives including current Healthy People 2020. The main objectives of this initiative included abstinence from cigarette use, increase the number of live births from women who had not been smoking prior to pregnancy, and to reduce a relapse of smoking in the postpartum period for women who had previously quit during pregnancy (Hansen et al., 2018). There is an immense discrepancy between current electronic cigarette use in pregnancy due to variance in sample size and limited studies utilizing national data (Obesisan et al., 2020). The current estimates of electronic cigarette use vary greatly, and are between 0.6% to 15% (Kapaya et al., 2019; Obisesan et al., 2020; Wagner et al., 2017; Whittington et al., 2018). This section will discuss what is known about current electronic cigarette use during pregnancy.

Understanding relationships and identifying risk-reducing factors associated with tobacco use in pregnant and non-pregnant women of reproductive age has been of great importance for maternal child health outcomes (Brown et al., 2016). One of the earlier studies evaluating prevalence of tobacco use within this population was Brown et al. (2016). Utilizing the National Survey of Drug Use and Health (NSDUH), researchers

found that one social determinant, health insurance status, was not significantly associated with a decreased use of tobacco including electronic cigarettes in pregnancy and did not mediate use in any of the subsequent trimesters (Brown et al., 2016). Overall percentage of women using tobacco within the first trimester was 22%, and 14% within the third trimester, which can indicate a potential lack of appropriate screening and prevention explained at prenatal visits (Brown et al., 2016). This study shows the importance of understanding the relationship between individual sociodemographic and community level as it relates to the SEM, and how they relate to health outcomes and behaviors such as tobacco use.

The CDC's PRAMS database, which originated in 1987, is state- and population-based self-reported generated through mail or telephone survey (CDC, 2022). The data generated represents close to 83% of all maternal attitudes, and experiences within the United States (CDC, 2020). One research study conducted by Kapaya et al. (2019) performed state-based analysis of current trends in electronic cigarette use before pregnancy, during pregnancy, and postpartum. Data was collected using PRAMS data for the year 2015, with focus on the states of Oklahoma and Texas. These states were chosen due to the additional electronic cigarette supplemental questionnaire. Of total participants, 1,955 women were from Oklahoma, 1,322 were from Texas. When asked about electronic cigarette use 3 months or greater prior to pregnancy, 10.4% stated use, 7% stated use around the time of pregnancy, and 1.4% during the last 3 months of pregnancy (Kapaya et al., 2019). To further differentiate use of electronic cigarettes with

nicotine use in pregnancy, 38.4% of respondents reported use in the last 3 months of pregnancy, and 26.4% were unsure if nicotine was present (Kapaya et al., 2019).

A similar study using the PRAMS data set from the year of 2016 measured pregnancy outcomes and maternal complications including preterm birth and small for gestational age in pregnant women who have stated use of electronic cigarettes while pregnant (Wang et al., 2020). Of this population, 6,005 mothers, 14% of all mothers utilized cigarettes, 16% of all smokers were dual users with electronic cigarettes. 1% of all mothers had been solely electronic cigarette users in this population (Wang et al., 2020). The researchers also evaluated the trend within this population, of the 976 pregnant dual users 49% quit smoking altogether, 18.4% remained dual users, while 6.8% had converted to use of electronic cigarettes alone (Wang et al., 2020). Greater risk for poor maternal outcomes including small for gestational age was also present in this population of concurrent electronic cigarette use in pregnancy, which has been shown in studies conducted in the earlier 2000's. An additional study that utilized the PRAMS data set between the years of 2016-2018, with approximately 80,000 respondents, revealed a greater rate of preterm deliveries and low birth rates linked to electronic cigarette use in the third trimester (Regan et al., 2021)

A highlight of these two studies conducted by Brown et al. (2016), and Kapaya et al. (2019) is the evaluation of electronic cigarette use at specific time frames within pregnancy. It has also been shown that pregnant women who self-report late pregnancy use of electronic cigarettes, as well as dual users with combustible cigarettes are at a higher risk of complications in pregnancy such as fetal growth restriction (Wang et al.,

2020). These studies had specific limitations, in self-reported data which can increase risk for bias, as well did not report the sociodemographic of the women interviewed.

A second U.S nationwide database to assess electronic cigarette use is the Population Assessment of Tobacco and Health (PATH). In 2011 the U.S. FDA collaborated between multiple organizations including the National Institute on Drug Abuse (NIDA), NIH, and the Center for Tobacco Products (CPT) for a longitudinal national cohort sample including tobacco and nontobacco users (U.S. FDA, 2020). Using this data set for the years 2013–2014, 388 women were evaluated on current use of tobacco and other nicotine delivery systems such as electronic cigarettes (Kurti et al., 2017). For pregnant women with an average gestational age of 21 weeks, it was found that 18.4% had reported former e-cigarette use prior to pregnancy, and 4.8% had reported electronic cigarette use during pregnancy (Kurti et al., 2017). This national sample denotes a greater use of electronic cigarettes in women prior to pregnancy, as well as a greater amount during pregnancy compared to the PRAMS study conducted by Kapaya et al. (2017). Key sociodemographic were associated with greater electronic cigarette use including race and ethnicity, economic status, education level (Kurti et al., 2017, 2018). Those who had less than a bachelor's degree, who also self-identified as white, black, or non-Hispanic, had a greater likelihood to also smoke electronic cigarettes (Kurti, et al., 2017, 2018).

The most recent data regarding electronic cigarette use patterns during pregnancy from a national data set was conducted by Obisesan et al. (2020). The Behavioral Risk Factor Surveillance System (BRFSS) survey has collected U.S. national data through

telephone surveys since 1984, conducting more than 400,000 interviews yearly related to health-related risk behaviors, use preventive services, presence of chronic health conditions in adults >18 years old in all 50 states (CDC, 2020). For the years 2016-2018, 7,434 women between the ages of 18-49 years old stated they were currently pregnant during the interview. Within this population roughly 54% were between 18–29 years old, 50% were white, 56% were married, 57.6% employed, and more than half were living 200% above the poverty line (Obisesan, 2020). Of the pregnant women using electronic cigarettes, 2.2% used in general during pregnancy, but 0.6% of individuals stated daily use.

Over the three years of this study, the prevalence of electronic cigarette uses in pregnancy increased from 1.9% in 2016 to 3.8% in 2018 which was a statistically significant increase in use. Of these participants, 63.3% had identified as white, 61.7% as employed, and nearly 70% under the age of 30 (Obisesan, 2020). The translation of these percentages and statistics to general public and number of potential births affected by electronic cigarette use in pregnancy is nearly 88,000 babies from 2016 to 2017. An additional important area of concern that this study emphasized, is of the pregnant women using electronic cigarettes in pregnancy, 30% had never used a combustible cigarette previously, indicating that increased used is regardless of previous smoking status. This is an important finding for maternal health in pregnancy, with naïve users of electronic cigarettes increasing during pregnancy (Obisesan et al., 2020). These are important socioeconomic factors to take into consideration when looking for associated

relationships and risk factors that could be targets for health care promotion, awareness, and change in policies or recommendations by public health agencies.

Perception of Harm: Factors That Influence Use of Electronic Cigarettes in Adults

Perceptions of how adults perceive the risk of harm due to electronic cigarette use, social patterns, and the corresponding levels of the SEM are important variables involved in at risk behavior. Understanding these perceptions can allow for appropriate strategies to be implemented to reduce initiation or current use of tobacco products (Nguyen et al., 2018). Within the United States there are many misguided, and unclear recommendations surrounding electronic cigarette use. A large portion of information related to electronic cigarettes is through media advertisements and word of mouth (Wada et al., 2017). Such information surrounding their ability to "deliver lower levels of harmful chemicals" and less harm due to lack of combustion as stated previously, may negate to some the fact that they still contain ingredients known to be carcinogens, or cancer-causing agents (Benowitz & Fraiman, 2017; Chen et al., 2017; Owusu et al., 2019).

Risk and harm perceptions of a product are direct influences on the risk management beliefs of the consumer (Nguyen et al., 2018). Currently the U.S. FDA plans to create a new regulation to lower nicotine levels to minimal or less addictive levels; however, nicotine has been the primary link to disease caused by tobacco products (Yang et al., 2020). This false perception that these devices will be "healthier" alternatives, may lead to differences in trends of electronic cigarettes, compared to the evidence-based cessation aids available (Yang et al., 2020). This section will focus on current perceptions

that influence electronic cigarette use amongst non-pregnant electronic cigarette users. This is an important understanding, as the use of electronic cigarettes continues to increase, as well as to better understand this behavior that may start prior to pregnancy.

A study conducted by Owusu et al. (2019), evaluated a trend in participants trust ratings from 13 sources of health information utilizing the Tobacco Products and Risk Perception Survey at Georgia State University. This study calculated data from 5,389, 5,273, and 5,389 participants in 2015, 2016, and 2017, with completion rates of 74.3%, 74%, and 72.8%, respectively (Owusu et al., 2019). Regarding information about electronic cigarettes, most trusted sources were personal doctors/medical providers, health organizations, the CDC was marked as the 3rd most reliable source of information followed by health experts, the NIH, FDA, lastly family and friends, with most distrust found to be vape-shop employees and electronic cigarette companies (Owusu et al., 2019).

It is important to see that the electronic cigarette companies are low on the list of trustworthiness for information related to health and safety of their devices. It has been found that the chemical additives to flavorings such as carcinogenic carbonyl, formaldehyde, acetaldehyde, diacetyl, and acetyl propionyl have been linked to respiratory diseases, yet some manufacturers emphasize less delivery of harmful chemicals compared to regular cigarettes (Huerta et al., 2017; Wada et al., 2017).

Use of the Health Information National Trends Survey (HINTS), which is a biennially administered survey for the years 2012-2014 measured respondent awareness and perception of electronic cigarette use and potential harm (Huerta et al., 2017). Key

findings revealed that overall awareness of electronic cigarettes by respondents across all demographic groups increased over time with 77.1% in 2012 to 94.3% in 2014. Perception of harm from electronic cigarettes declined from 50.7% to 43.1% in the same respective years. This reveals that as more time progressed, the perception of harm decreased for respondents. Other key sociodemographic variables related to risk assessment were those who self-identified as White, who had attained less formal education with only a high school level or below, lower income status < $20,000, who were younger in age (18–35 years of age) and males were more likely to believe electronic cigarettes were less harmful (Huerta et al., 2017). Although this study determines trends in perceptions, it does not discuss actual risk or how this information will impact trends in use.

Despite the new expansion regulatory authority over electronic cigarettes by the U.S. FDA, a large proportion of individuals are unaware that the U.S. FDA regulates traditional cigarettes (Nguyen et al., 2018). Through analysis of data from the HINTS survey of 2013, only 41% of respondents were aware of the U.S. FDA involvement in regulation of tobacco products, 23.6% of individuals believed that the FDA was not involved, and 35% were unsure altogether (Kaufman et al., 2015). Despite a two-year difference, only 45% respondents were aware the U.S. FDA was involved in regulation, and only 15% believing the agency was qualified to regulate when asked during the HINTS survey of 2015 (Nguyen et al., 2018).

In order to evaluate whether respondents' perceptions of harm would change when given an educational fact sheet, a study conducted by Yang et al. (2020) enrolled

current smokers, and former smokers to participate in an online survey. Questions pertaining to perceived addictiveness of nicotine, perceived risk of nicotine, perceived risk of electronic cigarettes, absolute risk of developing a chronic health condition, comparative risk between cigarette types, intentions to switch to electronic cigarette, dual use, as well as information seeking intentions were asked in the survey (Yang et al., 2020). From this study, only 14% believed that nicotine is not the major cause of smoking related health problems, and 44% believed that electronic cigarettes were less harmful than traditional (Yang et al., 2020). The same respondents were also given a fact sheet on nicotine and then given a posttest where nicotine risk beliefs increased from 12.7% to 26.2% (Yang et al., 2020). Even after given facts about the harm, the percentage of individuals who believed nicotine increases risk was not a greater increase pretest. A benefit of this study was that the pretest and posttest did determine that after having the fact sheet present, the information-seeking intentions regarding electronic cigarettes increased significantly (Yang et al., 2020).

The exploration of learning current individual knowledge on the safety and risks associated with electronic cigarette use is important. The study by Yang et al. (2020), illustrated the limited research on the knowledge of risks and dangers of electronic cigarettes and nicotine use by adults. Yang et al. (2020) also highlighted the need to investigate potential barriers in communicating fact-based information regarding nicotine use and electronic cigarettes including accessing appropriate education, and promotion of reducing disease associated modifiable behaviors.

Perception Factors that Influence Use of Electronic Cigarettes in Pregnancy

Public health initiatives to increase cigarette smoking cessation have led pregnant women to turn to different smoking cessation aids such as marketed electronic cigarettes (Chiang et al., 2019). It is important to understand the current literature, perceptions of pregnant women and use of electronic cigarette in pregnancy and how it pertains to the increased prevalence of use as previously described. Studies that have been conducted on this topic often have limited sample sizes, preventing broad conclusions and applicability of findings to the public (Rollins et al., 2020; Wagner et al., 2017). However, use of electronic cigarette and their safety as a smoking cessation agent have been found to be inconclusive amongst the United States Preventative Services Task Force (Cooper & Pesko, 2017; Siu, 2015).

Although many studies evaluated prevalence of use of electronic cigarettes and measured sociodemographics within pregnancy, Stroud et al. (2019), evaluated an additional variable that may influence the perceptions of safety of electronic cigarettes in pregnancy. Stroud et al. (2019), addresses an association between electronic cigarette use, the flavoring of the cigarette, as well as prevalence and perception of harm in pregnancy. One hundred English speaking only pregnant women, primarily of low income, between the ages of 18–40, of which, 45 were electronic cigarette users, and 55 were non-users. The average gestational age was found to be 21 weeks, within the second trimester, however interviews took place during the second and third trimester. Preference of electronic cigarette flavorings, perceptions of harm using a 7-point scale (1 being least likely to use/lowest risk, 7 being highest likely to use/highest risk) relating to electronic

cigarette use alone, and as well as risk of electronic cigarette flavorings were asked. Key findings from this study, indicated that pregnant women were most likely to use fruit flavors, or sweet flavors (candy), and the weakest preference for tobacco flavors, however there was no variance between perceptions of harm among the different tobacco flavorings (Stroud et al., 2019).

Despite the increased perception of general risk, pregnancy related risk and fetal risk among all flavorings for both users and non-users with values > 6, with non-users having a higher perception of harm (Stroud et al., 2019). This is an additional variable that helps create a more robust sense of why there is an increased use of electronic cigarettes in pregnancy as well as a potential difference in harm perceptions amongst populations. One variable that was not evaluated in this study, that is important, is whether there were population differences between English-speaking participants, and non-English-speaking participants. This additional variable could have improved upon the robustness of the study and highlights the lack of evaluation of language disparities and electronic cigarettes use.

A cross-sectional survey of 101 pregnant and 94 non-pregnant women from a clinic within Kentucky between the ages of 18–45, found 69% of women to believe that electronic cigarettes posed only a minor or moderate health hazard, and 20% believed there was no hazard at all. Within this population, half stated that use of electronic cigarettes was initiated as attempts for smoking cessation (Ashford et al., 2016). A similar study performed a qualitative study with pregnant women, and recent postpartum women found that electronic cigarettes were to be used for tobacco smoking cessation,

and that there was great uncertainty of the health effects (Fallin et al., 2016). Although the sample size from this study was very small, with only 12 participants, the nature of the interviews, and the transcripts from the session show candid discussion of mixed and inappropriate information being told to patients. For instance, one participant had shared a first-hand experience that a "preferred choice would be to smoke a couple of regular cigarettes a day, then use an electronic cigarette during pregnancy" (Fallin et al., 2016, p. 4). This study helps to illustrate a general breakdown in affective communication strategies between the different levels of the SEM. With current guidelines from ACOG advises cessation of all forms of tobacco use including electronic cigarettes and provide appropriate smoking cessation services and resources (ACOG, 2020).

An additional qualitative study aiming to better understand the perceptions of risks associated with electronic cigarettes, within Houston Texas, created eleven focus groups with participants from three clinics. Of the total 87 pregnant women that participated, included were both, English or Spanish proficiencies, and only those enrolled in the CenteringPregnancy care group. CenteringPregnancy is a prenatal care group for women of similar gestational age to participate in their own care at each visit which range from 90–120 minutes in length over 10 prenatal visits, giving these women more time with providers, and group discussion (Centering Healthcare Institute, 2020). Transcripts were kept from each session, discussing topics such as knowledge of electronic cigarettes, a comparison to combustible cigarettes, use in pregnancy, stigma of electronic cigarette us in pregnancy or stigma of smoking, and other names utilized. It was found that common beliefs to be that use of electronic cigarettes in pregnancy does

have potential risks to both mother and fetus, however, fewer risks when used as a cessation device (Kahr et al., 2015). A limitation and area for potential bias within this study is that this focus group is a very unique experience, and already has within its health promotion model, set discussions for tobacco use and recommendations. These timely sessions are not representative of populations who may have limited exposure to prenatal care, or even those who may, discussions regarding tobacco use may be absent (Kahr et. al., 2015). The researchers for this study highlight the importance of differentiating language, as well as exposure to prenatal care and conversations regarding tobacco use.

An online survey of 445 pregnant women assessed habits and perceptions of tobacco use before and during the current pregnancy (Wagner et al., 2017). Within this study 353 women had identified as never having used any form of tobacco, 25 used only cigarettes, 29 only electronic cigarettes, and 38 were dual users. Overall perceptions from 286 participants, 64%, had viewed an increased safety in electronic cigarettes in comparison to combustible cigarettes (Wagner et al., 2017). However, when specified risk perception of use in pregnancy, only 35% of participants felt that electronic cigarettes were still safer (Wagner et al., 2017). Of the individuals who had converted from combustible cigarettes to electronic cigarettes after finding out they were pregnant, 46% had done so due to perception of less harm to the fetus, and only 18% for cessation purposes (Wagner et al., 2017). This addition specification of harm, to oneself, or the fetus can help improve education material, and public health initiatives at many levels of the SEM, including the organizational and community levels.

Although these studies have primarily focused on the United States population, there is an international debate on safety and perceptions regarding electronic cigarette use in pregnancy. An Australian based study analyzed online forums in Australia, the United Kingdom and the United States discussing electronic cigarette us in pregnancy, where debates regarding safety during pregnancy occurred. Safety of electronic cigarette use in pregnancy comparative to combustible cigarettes was a trend present in each of the 13 forums and categorized as "the lesser of two evils" (Wigginton et al., 2017). When relating back to the conceptual model, Wiggington et al. (2017), highlights an important relationship that impacts health outcomes. Communication and discussions with peers whether in an online forum or with friends and family, are important aspects that influence use of electronic cigarettes in pregnancy (Bowker et al., 2016; Wigginton et al., 2017). A strength of this study shows that this is not only a common theme amongst pregnant women in the United States, but that there is a lack of appropriate education and quality research internationally as it relates to the newer use of electronic cigarettes.

Understanding additional factors such as recognition of harm of electronic cigarettes within the United States and internationally can help identify populations at greatest risk of use, illuminate the gaps in research and the relationships that need to be assessed further. Such relationships include those between the intrapersonal level such as language, and the interpersonal and organizational level such as health insurance status and the timing of access in pregnancy.

Language Barriers in Pregnancy

Racial and ethnic disparities amongst pregnant women internationally have been associated with poor maternal outcomes (Anekwe, 2020). The literature on racial and ethnic disparities in maternal and obstetrical outcomes is vast (Holdt Somer et al., 2017). This section will highlight the key findings as it relates to the intended study. For countries that have a very diverse population such as the United States and the United Kingdom, measure such outcomes based on language barriers and other disparities can be performed. Language has been integral to the effectiveness of interactions between health care providers and patients, with limited language proficiency linked to negative health outcomes and misunderstandings (Higginbottom et al., 2015).

Research conducted evaluating population health in pregnant women between the years 2014 and 2016 revealed stark differences in maternal outcomes (Anekwe, 2020). Maternal death rates varied greatly between race; where Asian women were almost twice as likely and black women five times more likely to have negative outcomes as compared to white women per 100,000 (Anekwe, 2020). Understanding the role of language in maternal health outcomes and health related risk is important to help identify those at greater risk, to better improve upon policies, and public health initiatives.

A recent study focused on the relationship between immigrant status, English proficiency, and prenatal counseling amongst primarily Hispanics and non-Hispanic Asians within the United States (Green et al., 2018). The Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), a national cohort of children born since 2001 that specifically identifies immigrant status, and English proficiency was the source of 8100

mothers used for this study (Green et al., 2018). Outcome measures included comparison between the types of prenatal counseling received, immigrant status, and language proficiencies. Relevant findings included immigrant mothers had lower rates of prenatal care, however there was no association between immigrant status, English proficiency, and prenatal counseling (Green et al., 2018). Despite the absence of mediating effects on prenatal counseling, one significant difference remained that for Asian women who were interviewed in a non-English language, there was a greater report of counseling on smoking (Green et al., 2018). This difference is important to recognize the potential difference in quality and type of counseling based upon language difference in pregnant women, especially related to smoking.

A broader application and relevancy for evaluation of language barriers in pregnancy is to better understand the potential barriers and relationships between immigrant populations, migrant populations, as well as refugees that may be displaced (Fair et al., 2020; Higginbottom et al., 2015). Common themes amongst migrant pregnant women and their experiences with health care providers, is poor communication due to an inability to converse in the local language led to misunderstanding of information, and poor relationships with providers (Fair et al., 2020). Within the United States, these similar trends exist. One population greatly affected by racial and ethnic barriers such as limited access to language services, includes the Marshallese community within Arkansas (Ayers et al., 2018). A qualitative study had been conducted with 40 pregnant female participants demonstrated that the greatest challenge to prenatal care was language

barriers which led to perceptions of fear to ask follow-up questions even if the patient spoke some English (Ayers et al., 2018).

Electronic Cigarette Use and Language Barriers

Literature related to electronic cigarette use, language barriers, and other social determinants of health is very limited. Broadening the search to include adult populations involving language and electronic cigarette revealed a narrow set of studies primarily focusing on immigrants, or solely the Latino/a community. Studies examining tobacco use in general have found that U.S. immigrants were less likely to use tobacco compared to U.S. natives, with difference based upon gender and ethnicity (Wang et al., 2016). However, despite the lower rates of use, use of general tobacco products has been shown to be linked to length of residency, and language (Wang et al., 2016).

To better understand electronic cigarette, use amongst immigrants Wang et al. (2016), evaluated the prevalence of use by U.S immigrants through the NHIS. Although the data from this study captures self-reported information based upon a questionnaire, primary language was not a variable recorded. The outcome measure of current self-reported electronic cigarette uses from this study found no statistically significant difference between naturalized U.S. citizens, and U.S. natives after adjusting for (Wang et al., 2016). These findings revealing no significant difference in current use of electronic cigarettes despite immigrant status raises the question of whether those individuals were English proficient. Wang et al. (2019) highlighted a study performed in 2008 that found a correlation between higher English proficiency amongst Blacks and a 2.6 times greater use electronic cigarette compared to those with lower proficiency,

however, for Asian immigrant's language proficiency was not related to use. Evaluating the differences between racial ethnicities and role of language is also important to differentiate between populations at greater risk. A gap in the current body of research includes better understanding of not only outcomes in adults, but particularly pregnant women and how language proficiency may affect electronic cigarette use.

One study evaluating the association between primary language spoken amongst native English, non-native English, and non-English, and self-identified adult Hispanics (>18 years old), and the awareness of electronic cigarettes was conducted by Wada et al. (2017). Participants were asked to complete a survey upon arrival in an emergency room department in Los Angeles County. Of the portion of participants who were non-English speakers were more likely to be female, have obtained less college education, and were more likely to have been born in another country (Wada et al., 2017). When asked how participants found out about electronic cigarettes, native English speakers reported through friends and family, whereas non-English speakers reported the news as a main source (Wada et al., 2017). The rate of ever having used electronic cigarettes was significantly higher in in native English speakers compared to non-English speakers with 25.7% and 2.0% respectively (Wada et al., 2017). An additional study evaluating the same data set as Wada et al. found that of the 1476 participants surveyed in an emergency room department, with 81% of individuals reported Spanish speaking were less likely to have ever tried electronic cigarettes compared to English-speaking adults (Lam et al., 2016). The ever-use rate of electronic cigarettes was found to be higher than previous

years with 7.6%, and of that 25% of individuals reported use had been as a cessation device (Lam et al., 2016).

These studies relate to the SEM model and individual, interpersonal, and community levels of communication highlighting difference in language proficiency. A limitation to the study conducted by Lam et al. (2016), and Wada et al. (2017), although both highlighted significant differences in awareness, and ever-use of electronic cigarettes and language, it did not assess current use or specify differences between gender. Another limitation was use of self-reported data, which may lead to response bias, as well as having only limited the survey to those who spoke English or Spanish only, evaluation of non-English speakers could not fully be performed (Lam et al., 2016; Wada et al., 2017).

Understanding the relationship between English- and Spanish-speaking individuals and use of electronic cigarettes is important; there may be other languages of importance as well. Focusing on immigrant populations in particular, including those from Mexico, Central and South America, Asia and Europe, the NHIS was used to determine the relationship between language and electronic cigarette use (Wang et al., 2019). The purpose of this research was to better understand acculturation, which is when an immigrant maintains their cultural origin while adapting to the new culture of their environment which can lead to changes in health behaviors (Wang et al., 2019). The survey was conducted by analyzing 7,954 immigrants, 7.4% of which had reported using electronic cigarettes. Of this percentage, 10.7% of males were ever users, 2.1% were current users, while female users were 4.3% and 0.7% respectively (Wang et al., 2019).

When evaluating for language proficiency and likelihood of using electronic cigarettes, key findings were immigrants who spoke English well and very well had 2.22 and 3.24 higher adjusted odds of using compared to those with limited proficiency (Wang et al., 2019). Length of stay within the United States and language proficiency was not found to have any statistical significance on use of electronic cigarettes for males or females, however prior studies have shown substance use in women is more likely to increase if the behavior is more widely accepted in the new environment (Wang et al., 2019). This is an important relationship to access, and to determine rates of use within female population alone that may be more likely to change due to removal of potential cultural and social stigma present within their country of origin.

The importance of further exploring the relationships between language and electronic cigarette use and pregnancy is important to understand health behaviors and outcomes. Understanding what is already known of the social determinants such as language and health care status is important as part of the conceptual model.

Health-Care-Related Risk Factors During Pregnancy

Two determinants of health associated with maternal child outcomes includes insurance coverage and access to health care for women of reproductive age (Brown et al., 2016; D'Angelo et al., 2016; ODPHP, 2020). In the United States there have been many challenges to acquire and maintain health insurance both prior to pregnancy and during pregnancy. These challenges include dependence upon employment for insurance, difficulties purchasing insurance due to high premiums, or pre-existing conditions that restrict coverage (D'Angelo et al., 2016). It is important to evaluate pre-conception health

insurance status, and potential mediating relationship due to the impact on maternal child outcomes (Robbins et al., 2018).

Before passage of the Affordable Care Act (ACA) in 2009, 20% women between the ages of 18-64 did not have health insurance despite the expansion of Medicaid services for low-income women during pregnancy (D'Angelo et al., 2016; Margerison et al., 2020). This disparaging lack of health insurance can lead to difficulty accessing preventive health services, which would delay important screening of high-risk behaviors such as substance use including tobacco or nicotine use and alcohol use by obstetric care professional (ACOG, 2017; Brown et al., 2016; D'Angelo et al., 2016). In a more recent study evaluating use of electronic cigarettes between the years 2015–2016, it was found that associated demographics linked to higher use if they were not married, started prenatal care in the second or third trimester, or used Medicaid insurance (Hawkins et al., 2020). This previous study highlights some key demographics that may be related to electronic cigarette use in pregnancy, however, is limited by a very narrow time frame over 7 years ago.

Using the PRAMS data set from the reporting period of 2009 prior to ACA, represented 78% of all live births, 30% of these women across 29 different states within the United States reported having experienced at least one lapse in health insurance coverage from one month prior to pregnancy and delivery (D'Angelo et al., 2016). The PRAMS questionnaire asks respondents three questions regarding insurance status with a list of insurance companies following:

- During the month before you got pregnant with your new baby, were you covered by any of these health insurance plans?
- Did any of these health insurance plans help you pay for your prenatal care?
- Did any of these health insurance plans help you pay for the delivery of your new baby? (D'Angelo et al., 2016, p. 4).

After evaluating all 29 states estimates on health insurance one month prior to pregnancy, 76.6% of women had health insurance, of those 16.6% were under the coverage of Medicaid, and 23.4% were without insurance (D'Angelo et a., 2016). The reported insurance coverage from private insurers compared to Medicaid varied greatly between states, as did the number of those uninsured (D'Angelo et al., 2016). However, during the prenatal period, there was a greater increase in those covered by Medicaid from 16.6% as previously stated, to 40.1% of women covered. However, states like Georgia still experienced high rates of uninsured status (8.5%) in comparison to rather low levels of uninsured status of 0.6% in Maine during the prenatal care (D'Angelo et al., 2016).

D'Angelo et al. (2016) highlighted the use of the PRAMS database to assess health insurance status and pregnancy prior to the ACA being implemented, however other national data sets also investigated this relationship as well. The NHIS between the years 2010-2016 served as the data source for Daw and Sommers (2019). Research objectives included evaluating the association between the ACA, barriers to health care and insurance coverage for women of reproductive age, including pregnant women (Daw & Sommers, 2019). Decreases in reports of delay of care or not having received medical care due to cost decreased 11% from baseline in the subsequent two years after the ACA

was put into effect (Daw & Sommers, 2019). More recent research using the BRFSS data from 2013-2015, has shown that when health insurance status is combined with current cigarette smoking in women, cigarette use was lower in women who were insured compared to those uninsured *(*Robbins et al., 2018). Although access to health insurance has increased with provisions by Medicaid, the duration of time that it takes for approval can delay healthcare significantly for minority populations (Ayers et al., 2018). Although this study did not evaluate electronic cigarette use, or pregnancy, it does pose the need for additional research due to potential disparities in pregnancy health care factors.

Summary and Conclusion

The current base of knowledge pertaining to a woman's primary language in pregnancy and use of electronic cigarettes is limited. The attitudes and knowledge related to electronic cigarette use are controversial and there is limited knowledge on the long-term effects especially in pregnancy (Devito & Krishnan-Sarin, 2018; Gravely et al., 2018; Schilling et al., 2019). The current understanding of electronic cigarette use within the United States has revealed the greatest increase in market sales compared to other countries (McCubbin et al., 2017; Obisesan et al., 2020). A great factor that has influenced use within pregnant women is the perception of less harm (Obisesan et al., 2020; Wigginton et al., 2017), however it is not known if this misconception is due to language barriers. An additional factor that may relate to outcomes between electronic cigarette use in pregnancy is access to health care. Health insurance status and prenatal visits before 15 weeks gestational age has been shown to greatly reduce perinatal risks during pregnancy (ACOG, 2020). However, it has not been evaluated whether health

insurance status for maternal women and primary language influence electronic cigarette use. The majority of the studies conducted used small population sizes and were qualitative in nature (Kahr et al., 2015; Schilling et al., 2019; Wigginton et al., 2017). Very few researchers conducted studies using national data sets, as well as recent data for pregnant women within the past 5 years (Kapaya et al., 2019; Kurti et al., 2018; Obisesan et al., 2020)

The current gaps within the literature involve a lack of studies that explore electronic cigarette use in pregnancy data and related risk factors within the past 5 years (Rollins et al., 2020). Due to the introduction of electronic cigarettes in the United States in 2004, the long-term effects on maternal-fetal health are still unknown (Wagner et al., 2017; Whittington et al., 2018). This leads to a large gap of clear and concise recommendations from evidence-based studies. The articles that did relate, did not address language barriers as part of the sociodemographic covariates in any of the studies performed. Use of the PRAMS data set has been shown to be useful to identify trends in health insurance status and identifying women who may experience barriers to accessing health insurance (D'Angelo et al., 2016).

In this study, I utilized the 2016–2020 PRAMS data set to explore the mediating affect health insurance has on electronic cigarette use in pregnancy and a better understanding of the impact of covariates and modifiable at-risk behaviors associated with electronic cigarette use during pregnancy. Chapter 3 will go into the depth of the methods used for this new research which will help to increase knowledge on a subject that is under researched and help fill the gap present as described above.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study is to determine whether a woman's primary language and pregnancy health care factors (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy. Use of electronic cigarettes in pregnancy is a public health issue that has been understudied with little evidence of associated risk factors that may lead to use (Rollins et al., 2020). Identifying a population that may be at greater risk to utilize electronic cigarettes surrounding the time pregnancy can help public health practitioners to provide specific screening recommendations, as well as preventive interventions and changes in clinical practice.

In this chapter, I state the research questions that were answered in this study, explain the study design, and present the research methodology that I utilized. This chapter will review the methodology protocol for the surveillance project of the CDC and state health departments, the PRAMS project. A detailed description of the variables in this study will be reviewed, the population used, the sampling methods and procedures, as well as how recruitment was performed. An overview of the data collection, statistical analysis, threats to validity both internal and external, and an overview of ethical considerations.

Research Questions

RQ1: Is there an association between primary language spoken (English vs. non-English) and use of electronic cigarette in pregnancy in relation to covariates: age,

number of pregnancies, education level, race, income, marital status and ethnicity in pregnant women?

$H_0$1: There is no statistically significant association between primary language spoken (English vs. non-English) and use of electronic cigarettes in pregnancy in relation to covariates: age, number of pregnancies, education level, race, income, marital status and ethnicity in pregnant women.

$H_1$1: There is a statistically significant association between primary language spoken (English vs. non-English) and use of electronic cigarettes in pregnancy in relation to covariates: age, number of pregnancies, education level, race, income, marital status and ethnicity in pregnant women.

RQ2: Is there an association between preventive services: accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, health insurance status during prenatal and postpartum period and use of electronic cigarettes in pregnant women?

$H_0$2: There is no statistically significant association between accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, insurance status during prenatal and postpartum period) and use of electronic cigarettes.

$H_1$2: There is a statistically significant association between accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, insurance status during prenatal and postpartum period) and use of electronic cigarettes.

Research Design and Rationale

In this study, the variables I evaluated included one dependent variable of interest (use of electronic cigarettes in pregnancy), independent variables of interest (primary language spoken, accessing health care within the 12 months prior to pregnancy, prenatal care in the first trimester, health insurance during prenatal and postpartum period) and confounding variables (age, number of pregnancies, education level, race and ethnicity). Each variable, the type of variable, the corresponding level of measurement, and category within this study are presented in Table 1.

For this study, I conducted a retrospective analysis of the secondary data collected from the state-based surveillance data system known as the PRAMS. This data system was first implemented in 1987 as a method to collect information on maternal behaviors, attitudes and experiences during the preconception, prenatal, and postpartum period (Shulman et al., 2018).

The PRAMS data set allows for complete evaluation of the specific variables of interest listed in Table 1. To understand the relationship between language and maternal behaviors such as electronic cigarette use, this data set adequately compiles and records respondents' answers that may not have been found in one general record or medical record, creating a more robust data set. The only time constraints that arose was gaining access to the data from the CDC and complying with the protocol to request data, including completion of the application, submission of a 350-word abstract, data sharing agreement. The CDC only reviews proposals on the 1st of every month, with approvals

returned approximately 6 weeks after original submission. Permission was granted on December 12, 2021.

Conducting this retrospective analysis of select PRAMS variables, appropriately allowed for the examination of a large subpopulation (recent mothers), over a long period of time (2016–2020) to be conducted relatively efficiently and in a timely manner. This research design aligns with the ability to advance knowledge within the field of public health to help influence policies, procedures, initiatives, and protocols.

Table 1

Study Variables, Categories and the Measurement Scale

Variables	Type of variable	Categories	Scale of measurement
Electronic cigarette uses in pregnancy	Dependent	0 = no use at all (before pregnancy, during pregnancy or after); 1 = having answered yest to use in the past 2 years, or 3 months before pregnancy, during pregnancy or last 3 months of pregnancy	Binomial
Language spoken	Independent	1 = English speaking; 2 = Spanish speaking, 3 = Chinese speaking	Nominal
Age	Independent	Continuous	Interval
Race	Independent	0 = unknown; 1= other Asian; 2 = White; 3 = Black; 4 = American Indian; 5 = Chinese; 6 = Japanese; 7 = Filipino; 8 = Hawaiian; 9 = Other Non-White, 11 = mixed race	Nominal
Ethnicity	Independent	0 = unknown; 1 = Hispanic; 2 = non-Hispanic	Nominal
Marital status	Independent	1 = married, 2 = other	Binomial
Education level	Independent	1 = 0–8 yrs; 2 = 9–11 yrs; 3 = 12 yrs; 4 = 13–15 yrs; 5 ≥ 16 yrs	Nominal
History of other pregnancies	Independent	0 = no (no previous live births; 1 = yes (has had at least 1 previous live births)	Binomial
Did you have any healthcare visits 12 months before you got pregnant?	Independent	0 = no; 1 = yes	Binomial
Did you receive prenatal care during the first trimester?	Independent	0 = no (no prenatal care, or visits starting after 12 weeks gestational age); 1 = yes (admitted to visits between 0 and 12 weeks gestational age)	Binomial
Did you have health insurance for prenatal care?	Independent	0 = no health insurance; 1 = yes health insurance (private or Medicaid, or state-specific option	Binomial
Did you have health insurance for postpartum care?	Independent	0 = no health insurance; 1 = yes health insurance (private or Medicaid, or state-specific option)	Binomial

Methodology

In this section, I discuss the protocol for the selection of the population, how the sample size was determined, the power analysis implemented, and further describe the background of the PRAMS project and data source.

Population of the Study

The target population for PRAMS is confined to the pregnancies resulting in a live-born infant within the participating state of interest given a particular year. For the sake of this study, data focused solely on New York City were selected. Excluded from this analysis were any stillbirths, fetal deaths, or abortions, out-of-state births to residents, in-state births to nonresidents, adoptions, surrogate births, multiple gestations of more than four siblings (one member from a twin or triplet set was included), birth certificates lacking the mother's last name, or those birth certificates that are delayed 6 months from time of delivery. Birth certificates processed in the sampling frame less than 2 months from time of birth were temporarily excluded. The withholding of the records for this temporarily excluded sample was included in the sampling frame 2 months after the birth, so as to have a more robust sampling population.

Sample Size and Power Analysis

The PRAMS data set utilized for this study was the most recent published data for the year 2016–2020 for New York City. The recorded number of respondents for those years 2016–2020, which included a total sample size of women subjects, with completed respondents of 10793 women subjects (CDC, 2018). G*Power (Version 6.7) was used to calculate a minimal sample size needed. The parameters selected including *z* test from the

test family options, logistic regression as the statistical test. Additional parameters included the historical use of significance level of $\alpha = 0.05$, a desired power of 0.95 (1-β), one tail, and a standard deviation of 0.5, which indicated that the total sample size must be at least 4,311 participants when performing a bivariate regression according to G*power. The data set utilized for this study exceeded the minimum number of participants calculated and was an adequate sample size to conduct the study.

Procedures for Participation and Data Collection

PRAMS data originate from the combination of three different sources including infant birth certificate data, operational data, and questionnaire data. The use of birth certificate data allows for data stratification, and ability to weight the survey data ensuring the adequate representation of the general population. Operational data allow for response rates to be analyzed accordingly, and questionnaire data are the source of self-reported data via mail, web, and telephone for maternal behavioral information (CDC, 2018).

To achieve the minimum allowed weighted response rate of 65% from the individual mothers surveyed, larger sample sizes must be utilized and to do so, a mixed-mode survey methodology is implemented. The tailored design method (TDM) which was originally formed in the 1970s, is a model for designing interesting questions for mail and telephone surveys to enhance responses (Dillman, 2000). The TDM helps improve response rates through creating a more personalized mailing package, multiple attempts of contact used, including telephone follow up for nonrespondents, and use of rewards for completions such as gift cards (CDC, 2018; Dillman, 2000).

Each mailing packet includes a cover letter and a consent document with all the components needed for informed consent. Consent is inferred with the completion of a questionnaire and a signed consent is not needed for participation. For questionnaires accessed via the internet, a randomly generated passcode must be entered, inferring that the mother has read the elements of informed consent, and are standard between all participating states.

The mail questionnaire is 14 pages, and can be completed in 20 minutes, phone interviews conducted can take up to 30 minutes. Item nonresponse rates are low 1%-2%, and many states perform 100% verification of mail surveys. PRAMS states make up to five additional attempts to contact responders via mail, and 15 call attempts if necessary, and complete data collection 21–35 days following initiating phone calls (CDC, 2018). For returned questionnaires that are less than 75% complete, a follow-up telephone call is made. Complete methodology of the PRAMS surveillance system can be downloaded from the CDC domain in a zip file including data collection procedures, instruments in-depth (CDC, 2018).

Data Cleaning and Variable Recording

For the intent of this research study, variables that were originally collected as part of the PRAMS data set underwent recoding to group together particular answers to create a dichotomous response option. The original method of recording language based upon the PRAMS questionnaire included three possible languages: English, Spanish, and Chinese. The variable related to receiving prenatal care during the first trimester, PRAMS had asked for the timing of the first prenatal care visit in weeks or months; for this study,

I reclassified those values to a binomial variable either having had prenatal care in the first trimester 0–12 weeks or not. PRAMS record number of previous live births as a nominal category; in this study, I changed this to a binomial variable of either having had prior live births or no prior live births. Another variable that I re-classified was the status of health insurance. PRAMS data query originally presents insurance status for prenatal and postpartum as classified by determining the source of payment for insurance (employment, parent, health care exchange, Medicaid, state children's health insurance program or other government plan, Tricare or military, or other), no insurance. All other variables followed coding by PRAMS.

Missing data if any were evaluated first by identifying the number of missing values by coding discreet missing variables based upon the original data set from the PRAMS surveillance system. Then, by performing a missing value analysis, I determined which variables were missing data, with the foundational notion that a missing rate of 5% or less is inconsequential, and bias is likely to be present when there is greater than 10% of data missing (Dong & Peng, 2013). Based upon the data report analysis, multiple imputation strategies would be implemented due to the ability to account for ordinal and nominal data. In SPSS, this was completed by selecting multiple imputation, impute missing data values, and then select all variables that were found to have missing values, selecting monotone method and perform five imputations in sequence. Then using the pooled data set from the imputation models, a new data set was be created and used for analysis.

Statistical Analyses

The software that I used to analyze the data set was SPSS (Version 27). The statistical test that I performed to measure the association between electronic cigarette use was multiple logistic regression analysis. When using logistic regression analysis, the first assumption is the need for a dichotomous dependent variable. In this study the dependent variable is use of electronic cigarettes which aligns. In addition, multiple independent variables are used and can be either categorical or nominal.

The statistical analysis conducted were descriptive statistics for all variables (i.e., frequencies percentage for categorical variables and mean/standard deviation for continuous variables) and bivariate analysis and chi-square test for independent variable (IV), dependent variable (DV) place of delivery for Research Questions 1, 2, and 3. Multivariable analysis (i.e., binomial logistic regression) was conducted for Research Questions 1, 2, and 3 (see Table 2).

Table 2

Description of Research Questions and Variables by Level of Measurement and Statistical Analysis

Research question	IVs and measurement	DVs and measurement	Statistical analysis
RQ1	Language spoken (categorical/nominal) Maternal race (categorical/nominal) Maternal age (ordinal) Maternal ethnicity (categorical nominal) Number of pregnancies (ordinal) Education Level (ordinal) Marital status (categorical/nominal) Maternal income (ordinal)	Use of electronic cigarettes (categorical/nominal)	Descriptive (frequency distribution) Multivariate logistic regression (binary logistic regression)
RQ2	Accessing health care prior to pregnancy (categorical/nominal) Receiving prenatal care in the first trimester (ordinal) Health insurance status-prenatal (categorical/nominal) Health care visit- postpartum (categorical/nominal)	Use of electronic cigarettes (categorical/nominal)	Descriptive (frequency distribution) Multivariate logistic regression (binary logistic regression)

Note. The statistical significance level was set at $p < .05$. IV = independent variable; DV = dependent variable.

For this study as shown in Table 1, the independent variable of language is nominal classified into two groups, English speaking, and non-English speaking. The third assumption is that there should be an independence of observations and that the dependent variable should have mutually exclusive and exhaustive categories (Laerd Statistics, n.d.). To perform a logistic regression, binary logistic was selected in SPSS, the dependent variable would be selected, and the covariates including the independent variable, number of pregnancies, age, education level, race and ethnicity. Each

categorical covariate would be defined, and the options of statistics and plots would be chosen. The addition of covariates to the analysis will help define and clarify the strength of relationship being evaluated, and to determine if there are other variables that influence the dependent variable. Use of the Cox and Snell R Square, and Nagelkerke R Square will explain the variation in use of electronic cigarette use based upon the model. The Wald test was performed be able to determine the statistical significance of each independent variable within the model. This allowed for greater insight into the relationships between the dependent and independent variables within this study. Exp(B) output is the odds ratio, which helped to determine if there is a greater likelihood of use of electronic cigarettes based upon language as in RQ1. For RQ2, similar analysis was conducted by performing logistic regression.

Advantages and Disadvantages of the Data Source

The advantage of using the PRAMS data set, is that it allows for a comprehensive evaluation of vital maternal, perinatal, and social issues needed to improve maternal infant health. By acquiring data from the population using three different modalities, mail, telephone and web, there is a greater likelihood of completing the survey for a multitude of reasons. Telephone interviews allow for women with low literacy to participate, mailed and web response may reduce response bias or interview bias, and greater convenience to complete on respondent's time (CDC, 2018). Another advantage is that this surveillance system has been implemented for 30 years, undergoing a series of revisions to help improve or modify or enhance topics based upon health care trends and feedback from a variety of stakeholders.

The survey has only been implemented after extensive review by the CDC'S National Center for Health Statistics Questionnaire Design Research Laboratory for cognitive testing to ensure there is ease in comprehension of the survey (Schulman et al., 2018). A limitation to this data source would be that this secondary data analysis, which means that the data collected was not solely intended for the research questions at hand and is being re-analyzed as defined by Glaser (Johnson, 2014). Another limitation is that the original data set, the conversations with the interviewer and respondent cannot be retrieved or the manuscript reviewed at this time due to the data set having been finalized by the CDC, compared to a primary study that may allow for those direct transcripts to be reviewed first-hand by the principal investigator. As a secondary data set, I cannot see which data was omitted, and cannot determine if errors were made, or specific nuances to the data collection period (Cheng and Phillips, 2014).

Threats to Validity

Validity is important in determining how confident the study findings are representative of the general population and the strength of the application of the findings to daily life. It is essential to evaluate the potential internal and external threats to this study, and the method in which data was collected, and processed. This section will highlight key components that threaten the validity of the claims this study may make.

Internal Validity

In this level of validity, understanding influences that may lead to a weaker relationship between the dependent variables and independent variables and the outcomes measured (Garcia-Perez, 2012). For claims that this study makes regarding the

relationship between maternal language and use of electronic cigarettes a high level of internal validity is needed. One approach to limit threats to the internal validity of a study and ensuring that the associations found are truly representative of the relationship being evaluated is to control for confounding variables. This was accomplished by controlling for variables such as age, education status, number of pregnancies, so as to define the relationship of language and electronic cigarette use without potential confounding effects.

External Validity

This form of validity is important in evaluating whether the results of the study can be observed again. The CDC during the initial data collection step, tried to minimize threats to external validity by ensuring that the same questionnaire can be utilized again, as well as adequately trained research staff. This helps to minimize interviewer bias. An additional measure that the CDC took to ensure reproducibility of the study and generalizability of the results was to evaluate for sampling frame bias, selection bias. Another way to ensure selection bias was minimized, since the pregnancies included are based upon complete infant birth certificates for the year, any ineligible records, or those that were omitted due to delays in registration were adjusted for to compensate for bias.

Ethical Procedures

In order to complete this study, ethical considerations were made at all levels of the study. All data that has been reviewed and edited in this study has been de-identified, anonymous and all documents and data will be kept under a password protected server. The PRAMS data set from the CDC had achieved approval from the ethics committee

and approval from the federal institutional review board (IRB) as well as local IRB was received due to the need to protect human participants. Informed consent was collected or inferred from every participant. Consideration to special populations were strictly upheld by the CDC during data collection, with no additional concerns identified. During the collection of data by the PRAMS surveillance team, all data contained restricted access, password-protected files, and data files were kept under lock and key, with access granted only by authorized personnel. This study also obtained IRB approval from Walden University, as well as an additional review through the CDC to utilize the PRAMS data set for secondary analysis.

Summary

The purpose of this quantitative study was to determine if a woman's primary language and pregnancy health care factors (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy. The data that was utilized was obtained from the CDC PRAMS study for a retrospective secondary data analysis. This data was collected through surveying recent mothers who had delivered a live infant within the year of 2017 in the state of New York. Understanding maternal health, health practices, and socioeconomic demographics has become an important indicator for population health. Although this study focuses on only one region of the United States, and has its own limitations, the information that can be gleaned from this study may show the importance for the public. The information revealed between the variables analyzed

and the associations made in this study can lead to improvements in public health initiatives, health outcomes, and potential change in current policies and guidelines.

The following chapter will discuss the results of the analysis. The results will include descriptive statistics of the findings, probabilities, confidence intervals, statistical testing in tabular form, and graphically.

Chapter 4: Results

Introduction

In this chapter, I discuss the data collection process and the results from rigorous data analysis, portrayed in tables, graphs, and charts corresponding to each research question. The purpose of this quantitative study was to determine whether a woman's primary language and pregnancy health care factors (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy. I developed the first research question and hypothesis to explore the relationship between use of electronic cigarettes, maternal language, and social determinants of health (i.e., income, race/ethnicity, and education level). In the second research question, I further evaluated the relationship between electronic cigarette use in pregnancy and access to preventive services (i.e., accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, health insurance status during the pre- and post-partum period). The research questions and hypotheses are as follows:

RQ1: Is there an association between primary language spoken (English vs. non-English) and use of electronic cigarette in pregnancy in relation to covariates: age, number of pregnancies, education level, race, income, marital status, and ethnicity in pregnant women?

$H_0$1: There is no statistically significant association between primary language spoken (English vs. non-English) and use of electronic cigarettes in pregnancy in relation

to covariates: age, number of pregnancies, education level, race, income, marital status, and ethnicity in pregnant women.

$H_1$1: There is a statistically significant association between primary language spoken (English vs. non-English) and use of electronic cigarettes in pregnancy in relation to covariates: age, number of pregnancies, education level, race, income, marital status, and ethnicity in pregnant women.

RQ2: Is there an association between preventive services (accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, health insurance status during prenatal and postpartum period) and use of electronic cigarettes in pregnant women?

$H_0$2: There is no statistically significant association between accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, insurance status during prenatal and postpartum period, and use of electronic cigarettes.

$H_1$2: There is a statistically significant association between accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, insurance status during prenatal and postpartum period, and use of electronic cigarettes.

Descriptive statistics will be revealed to better illustrate the social determinants of the population of women used for this study from New York State PRAMs data set. To determine the relationship and probability of a causal inference, I used logistic regression due to the categorical nature of the dependent variable. I used Cox and Snell R^2 to determine the portion of variance in the dependent variable that could be explained by the

independent variable. I also utilized the Hosmer and Lemeshow test to determine the goodness of fit for the model.

Data Collection

Permission and approval to conduct the study (IRB Approval No. 09-29-21-0730029) was granted by Walden University on September 29, 2021, with conditional approval of partner approval with CDC PRAMS. I submitted an application to CDC PRAMS on October 1, 2021, and approval to utilize the PRAMS data set was granted on October 20, 2021. Walden University IRB was then notified of the agreement and permission granted by CDC PRAMS and approved the study on October 27, 2021. I received the CDC PRAMS data set electronically on December 21, 2021.

Initial Collection of Secondary Data

The data used were provided by the CDC PRAMS surveillance project and were originally collected by the CDC PRAMS in conjunction with PRAMS delegated research sites including New York City and New York. The dates of maternal records obtained from the PRAMS Phase 8 questionnaire set include the years 2016, 2017, 2018, 2019, and 2020.

Demographic Characteristics of the Study Sample

The PRAMs data set included a total of 10,793 responses in their PRAMS Phase 8 questionnaire data, collected between January 1, 2016, and December 3, 2020. The overall response rate for the survey varied by year and by region, as the CDC PRAMS had categorized New York City separately from New York (New York: 2016 = 65.8%, 2017 = 56.4%, 2018 = 50.8%, 2019 = 52.8%, 2020 = 49.5%; New York City: 2016 =

72.5 %, 2017 = 67.2%, 2018 = 64.7%, 2019 = 60.8%, 2020 = 61.3 %; CDC PRAMS, 2022). The CDC PRAMS designated thresholds for allowing data to be distributed; the 2015–2017 overall response rate threshold was 55%, and 2018–2020 threshold was 50%, indicating that this study reveals a good representation of the intended population of interest. The number of total respondents per region, per year is presented in Table 3.

Table 3

Total Number of Respondents for New York and New York City (NYC) for Data Collected by CDC PRAMS Survey Years 2016–2020

Region	2016	2017	2018	2019	2020
New York	949	848	776	762	703
New York City	1,436	1,293	1,543	1,269	1,214

Note. Adapted from CDC PRAMS, 2022.

Data Cleaning

Of the 10,783 total responses for the years 2016–2020, no respondents were removed entirely. However, due to the robust questions asked to mothers during the PRAMS survey, it was important to only utilize variables essential to this study. I kept a total of 15 variables, there were no signs of duplicate entries, and no charts were omitted for missing cases (missing cases were defined as missing one or more variable responses); however, the potential impact of missing cases will be discussed in Chapter 5. For RQ1, there were 8,967 respondents included in the analysis and 1,826 missing cases. For RQ2 there were 7,014 respondents included in analysis and 3,779 missing cases. According to the statistical power analysis, to reach the standard statistical power for each research question, 4,311 completed respondents were needed to have reached an appropriate statistical power. The calculated power requirements for this study were met.

Data Collection Discrepancies

During the actual collection and analysis, there were some discrepancies from the plan for data collection and analysis, as outlined in Chapter 3. The primary discrepancy that arose during the data collection and cleaning process was having to make several clarifications in the coding and analysis of the data from the original data set to be more functional to use in this analysis. The initial PRAMs variable, smoking electronic cigarettes, was originally classified in relation to timing of use, frequency of use and the timing related to the pregnancy. Use of electronic cigarette 3 months before pregnancy how often, 3 months after pregnancy how often, which had been coded as 1 = *more than once day*, 2 = *once a day*, 3 = *2–6 days a week*, 4 = *1 day a week or less*, and 5 = *no use of electronic cigarettes*. To recode this variable for the purpose of this study, any response of 1–4 was recoded to 1 = *yes electronic cigarette use*, and a response of 5 would become 0 = *no electronic cigarette use*, with removal of the frequency of use to only include any or no use at all during pregnancy. The purpose of this was to catch any electronic cigarette use in pregnancy and focus on the relationship between maternal language and other determinants of health, and not focus on the frequency of use.

The second variable that was recoded was prenatal care visits in the first trimester. The CDC PRAMs codebook coded month of first prenatal care visit as the numeric value of the month = *1–12 months* or 88 = *no prenatal care*. The prenatal care in the first trimester variable was recoded to 0 = *no prenatal care in the first semester* (any value after 4–12, and 88), 1 = *yes prenatal visit in the first trimester* (any value 1–3 months).

Results

Demographics of the Sample

The descriptive statistics and frequency for the data analyzed can be seen in Tables 4 and 5. The most common maternal race was White (47.4.7%, *n* = 5,120). Table 4 also shows data on language, whether someone identified as Hispanic, and marital status. The percentage of women speaking English as their primary language was 87.8% (*n* = 7,876), Spanish was 9.4% (*n* = 847), and Chinese was 2.7% (*n* = 244). There were 7,052 respondents who identified as non-Hispanic, and 1,915 identified as Hispanic. Most respondents were between 30–34 years old (*n* = 3,496), and the majority of years of education was greater than 16 years (*n* = 4,444), followed by 13–15 years (*n* = 2,567).

Table 4

Descriptive Statistics of Key Variables

Variable	Subcategories	Number of respondents
Electronic cigarette use	Yes	8,725
	No	238
Maternal race	White	1,520
	Black	1,668
	American Indian	9
	Chinese	502
	Japanese	30
	Filipino	73
	Hawaiian	2
	Other non-White	762
	Mixed Race	218
	Other Asian	583
Language	English	7,876
	Spanish	847
	Chinese	244
Hispanic ethnic group	Not Hispanic	7,052
	Yes Hispanic	1,915
Marital status	Married	5,854
	Other	3,113

Table 5

Key Independent Variable Descriptive Statistics and Percentages

Variables	Subgroupings	Frequency	%	Valid %	Cumulative %
Years of education	0–8 yrs	462	4.3	4.3	4.3
	9–11 yrs	976	9.0	9.1	13.4
	12 yrs	2,294	21.3	21.4	34.7
	13–15 yrs	2,567	23.8	23.9	58.6
	≥ 16 yrs	4,444	41.2	41.4	100.0
Income (USD)	$0–$16,000	1,699	15.7	18.1	18.1
	$16,001–$20,000	746	6.9	8.0	26.1
	$20,001–$24,000	549	5.1	5.9	32.0
	$24,001–$28,000	395	3.7	4.2	36.2
	$28,001–$32,000	471	4.4	5.0	41.2
	$32,001–$40,000	530	4.9	5.7	46.9
	$40,000–$48,000	411	3.8	4.4	51.3
	$48,001–$57,000	395	3.7	4.2	55.5
	$57,001–$60,000	250	2.3	2.7	58.2
	$60,001–$73,000	390	3.6	4.2	62.3
	$73,001–$85,000	413	3.8	4.4	66.7
	≥ $85,001	3,113	28.8	33.3	100.0
Maternal age	<=17	68	.6	.6	.6
	18-19	178	1.6	1.6	2.3
	20-24	1,440	13.3	13.3	15.6
	25-29	2,546	23.6	23.6	39.2
	30-34	3,496	32.4	32.4	71.6
	35-39	2,377	22.0	22.0	93.6
	40+	688	6.4	6.4	100.0
Health insurance status	Medicaid	5,230	48.5	48.7	48.7
	Private insurance	5,165	47.9	48.1	96.8
	Self-pay	77	.7	.7	97.5
	Champus/Tricare	60	.6	.6	98.1
	Other gov	132	1.2	1.2	99.3
	Other	76	.7	.7	100.0
No. of prenatal care visits	≤ 8	2,357	21.8	22.6	22.6
	9–11	3,565	33.0	34.2	56.8
	12+	4,507	41.8	43.2	100.0
Visit with OBGYN	No checkup	2,299	21.3	29.6	29.6
	Yes checkup	54,65	50.6	70.4	100.0
Postpartum visit (PPV)	No PPV check	1,117	10.3	10.6	10.6
	Yes PPV check	9,375	86.9	89.4	100.0

Assumptions

I used logistic regression to evaluate the relationship between electronic cigarette use in relation to covariates: age, number of pregnancies, education level, race, income, marital status, and ethnicity in pregnant women. When performing logistic regression, it is important to consider the assumptions. The first is that logistic regression does not need to follow a linear relationship between the dependent and independent variable (Statistic Solutions, 2022). Second, the dependent variable needs to be binary, which has been satisfied in this study. The third assumption is that each observation or recorded intake should be independent of each other, indicating that there should not be multiple responses on the behalf of one individual, which has been satisfied as there is no repeated measurements or matched data and no duplication of respondents. The fourth assumption is that independent variables should not exhibit multicollinearity, or be too correlated with each other, and although there does not need to be a linear relationship between the dependent and independent variables, they should be linearly related to the log odds. This means that any independent variable that is continuous should be linear to the logit of the outcome (Towards Data Science, 2022). Collinearity studies for the variables used in RQ1 (see Table 6) revealed that there was less dependence of independent variables upon one another, and that there was little to no multicollinearity. Collinearity studies were also conducted for RQ2 (see Table 7). Pearson correlation values for all variables in RQ1 and RQ2 were less than 0.80, and tolerance values for all variables were greater than 0.1 the conventional threshold, and VIF, which is the inverse of tolerance for all values, was found to be less than 10, satisfying the fourth assumption (Crowson, 2021).

Table 6

Collinearity Diagnostics RQ1

Model	Unstandardized coefficients		Standardized coefficients			Collinearity statistics	
	B	*SE*	Beta	*t*	*Sig.*	Tolerance	VIF
(Constant)	.054	.014		3.962	< .001		
Marital status	.024	.004	.072	5.902	< .001	.748	1.337
Years of education	-.003	.002	-.021	-1.478	.140	.544	1.840
Maternal race	-.002	.001	-.041	-3.793	< .001	.934	1.070
Income	-.001	.001	-.025	-1.673	.094	.514	1.947
Language	-.010	.004	-.027	-2.291	.022	.818	1.222
Number of previous live births	-.003	.002	-.020	-1.775	.076	.906	1.104
Hispanic ethnic	-.016	.005	-.040	-3.416	< .001	.799	1.252

Note. Dependent variable: electronic cigarette use. The statistical significance level was set at $p < .05$.

Table 7

Collinearity Diagnostics RQ2

Model	Unstandardized coefficients		Standardized coefficients			Collinearity statistics	
	B	*SE*	Beta	*t*	*Sig.*	Tolerance	VIF
(Constant)	.082	.028		2.883	.004		
Health insurance status	.005	.002	.030	2.502	.012	.989	1.011
Health care type—checkup with my OB/GYN	-.011	.004	-.031	-2.566	.010	.977	1.023
Postpartum visit	-.026	.007	-.042	-3.486	< .001	.986	1.014
Prenatal care visit	-.006	.004	-.016	-1.322	.186	.999	1.001
Pre-pregnancy health care visit	.005	.012	.005	.404	.686	.981	1.019
Number of prenatal care visits	-.001	.003	-.007	-.555	.579	.988	1.012

Note. Dependent variable: electronic cigarette use. The statistical significance level was set at $p < .05$.

Research Question Results

Research Question 1

A multiple logistic regression analysis was conducted to investigate whether there is an association between primary language spoken (English vs. non-English) and use of electronic cigarette in pregnancy. The possible predictor variables were age, number of pregnancies, education level, race, income, marital status, and ethnicity in pregnant women. When evaluating the overall model compared to a null model, the Omnibus Chi-Square Test of model coefficients was statistically significant, $p < .001$, which indicates that the current model is a significant improvement of fit compared to a null model. The Hosmer and Lemeshow Test were revealed to be statistically significant 0.079 ($p > .05$), which indicated a good model of fit. For the evaluation of the statistical significance of specific variables in relation to use of electronic cigarettes (see Table 8).

Table 8

Logistic Regression Model for Research Question 1

Variable	*B*	*SE*	*Wald*	*df*	*Sig*	*Exp(B)*	95% CI for *Exp(B)*	
							Lower	Upper
English			6.131	2	.047			
Spanish	-.974	.394	6.118	1	.013	.374	.175	.817
Chinese	.068	.766	.008	1	.929	1.071	.239	4.803
Hispanic ethnicity	-.779	.233	11.130	1	< .001	.459	.291	.725
Number of previous live births grouped	-.106	.068	2.400	1	.121	.899	.786	1.029
Maternal years of education	-.103	.081	1.621	1	.203	.903	.771	1.057
Income—12 months before, total income	-.053	.021	6.296	1	.012	.949	.910	.989
Non-married (Other)	1.043	.159	42.789	1	< .001	2.839	2.077	3.880
White			64.725	9	< .001			
Black	-1.701	.239	50.648	1	< .001	.182	.114	.292
American Indian	.647	1.078	.360	1	.549	1.909	.231	15.788
Chinese	-1.276	.583	4.796	1	.029	.279	.089	.875
Japanese	-17.558	7318.596	.000	1	.998	.000	.000	.
Filipino	-17.876	4595.196	.000	1	.997	.000	.000	.
Hawaiian	-18.491	28032.205	.000	1	.999	.000	.000	.
Other Non-White	-.702	.363	3.725	1	.054	.496	.243	1.011
Mixed Race	-.302	.397	.577	1	.447	.740	.340	1.610
Other Asian	-1.424	.461	9.554	1	.002	.241	.098	.594
Constant	-2.623	.339	59.808	1	< .001	.073		

Note. Variable(s) entered on Step 1: language - English/Spanish/Chinese, Hispanic ethnic group, number of previous live births grouped, maternal years of education, income - 12 months before, total income, marital status, maternal race. CI = confidence interval.

Due to the categorical nature of maternal language, maternal race, and ethnicity, the baseline variables would be English language, White race, and non-Hispanic ethnicity as the reference values for the model. In the model generated there were statistically significant findings for mothers whose primary language was Spanish. Women whose primary language was Spanish were nearly two-thirds less likely to smoke electronic cigarettes compared to those who were primarily English speaking. The unstandardized *B* = -.974, *SE* = .394, Wald = 6.118 ($p < .05$). The estimated odds ratio favored a negative relationship with a 62.2% decrease, *Exp*(*B*) = 0.378, 95% CI (.175, .817) for ever one unit increase of electronic cigarette use as shown in Table 8. Mothers whose primary language was Chinese were found to be 7.9% more likely for every one-unit increase, although this was not statistically significant, *Exp*(*B*) = 1.079. An individual who was of Hispanic ethnicity was found to be 54.1% less likely to smoke electronic cigarettes *Exp*(*B*) = 0.459 ($p < .05$). Number of previous births and maternal years of education were not statistically significant. Maternal income was found to be statistically significant, with the higher the income, the less likely to smoke electronic cigarettes by 99.05% *Exp*(*B*) = .949 ($p < .05$). Women who identified as Black were 81.8% less likely to smoke electronic cigarettes *Exp*(*B*) = .182 ($p < .05$), those who identified as Chinese were 72.1% less likely *Exp*(*B*) = 0.279 ($p < .05$). Women who were not married were 183% more likely to smoke electronic cigarettes *Exp*(*B*) = 2.839 ($p < .05$). Based upon these results, the null hypothesis is rejected, as there was statistically significant relationship between maternal language, electronic cigarette uses, and key social determinants including maternal race, maternal ethnicity, marital status, and income.

Research Question 2

A second multiple logistic regression analysis was conducted to investigate if there is an association between preventive services: accessing health care within the 12 months prior to pregnancy, receiving prenatal care in the first trimester, health insurance status during prenatal and postpartum period, and the use of electronic cigarettes in pregnant women. When evaluating the overall model compared to a null model, the Omnibus Chi-Square Test of model coefficients was statistically significant, $p < .001$, which indicates that the current model is a significant improvement of fit compared to a null model. The Hosmer and Lemeshow Test were revealed to be statistically significant 0.450 ($p > .05$), which indicated a good model of fit.

The model resulted the independent variables pre-pregnancy health care visit, health care visit with OB/GYN, number of prenatal care visits, prenatal care visits in the first trimester to not be statistically significant ($p > .05$). However, the model did find that certain types of insurance pregnant women had at the time of pregnancy were statistically significant especially those with private insurance ($p < .05$). The unstandardized $B = -.447$, $SE = .159$, Wald = 7.938, $p < .05$. The estimated odds ratio favored a negative relationship of nearly 36% decrease, $Exp(B) = .640$, 95% CI (.469, .873) for every unit increase use of electronic cigarettes. Additional statistically significant independent variables included women who had Champus/Tricare. The unstandardized $B = 1.231$ $SE = .486$, Wald = 6.422, $p < .05$. The estimated odds ratio favored a positive relationship of nearly 242% increase, $Exp(B) = .3.423$, 95% CI (1.322, 8.867) for every unit increase use of electronic cigarettes. Other Government forms of insurance was also found to be

statistically significant, the unstandardized $B = 1.175$, $SE = .390$, Wald = 9.104 ($p < .05$). The estimated odds ratio favored a positive relationship of nearly 223.9% increase, $Exp(B) = 3.239$, 95% CI (1.510, 6.951) for every unit increase use of electronic cigarettes. Women who received a postpartum checkup were found statistically significant, unstandardized $B = -.605$, $SE = .215$, Wald = 7.954 $p < .05$. The estimated odds ratio favored a negative relationship of nearly 45% decrease $Exp(B) = .546$, 95% CI (.359, .831) for every unit increase use of electronic cigarettes. For the evaluation of the statistical significance of specific variables in relation to use of electronic cigarettes, Table 9 can be referred to.

Table 9

Logistic Regression Model for Research Question 2

							95% CI for *Exp(B)*	
Variable	*B*	*SE*	Wald	*df*	Sig	*Exp(B)*	Lower	Upper
Medicaid			30.664	5				
Private insurance	-.447	.159	7.938	1	.005	.640	.469	.873
Self pay	-.319	1.026	.097	1	.756	.727	.097	5.431
Champus/Tricare	1.231	.486	6.422	1	.011	3.423	1.322	8.867
Other government	1.175	.390	9.104	1	.011	3.239	1.510	6.951
Other	.661	.609	1.178	1	.278	1.936	.587	6.381
Pre-pregancy health care visit	.384	.517	.552	1	.458	1.468	.533	4.039
Health care check up with OB/GYN	-.237	.156	3.073	1	.080	.761	.561	1.033
Postpartum check up	-.605	.215	7.954	1	.005	.546	.359	.831
Number of prenatal care visits 1st trimester grouped	-.001	.094	.000	1	.993	.999	.830	1.203
Prenatal care in first trimester	-.229	.176	1.699	1	.192	.795	.563	1.122
Constant	-2.984	.582	26.301	1	<.001	.051		

Note. Variable(s) entered on step 1: Method of payment, pre pregnancy health care visit, health care check up with my OB/GYN, postpartum checkup for self, number of prenatal care visits grouped, prenatal care in first trimester. CI = confidence interval.

Summary

This chapter presented the research questions, corresponding data analysis and the results of the research questions under investigation. From the CDC PRAMs data, I reported the results of the relationships between the outcome of interest, use of electronic cigarettes, and the possible predictor variables. Multiple logistic regression analyses were conducted to accurately assess these relationships and analyze the data. Adjusted odds ratios of all independent variables were reported. The level of association of the independent variables in relation to use of electronic cigarette use was reported. Relationships that were found to be statistically significant were determined at a significance level of 5%. These included maternal primary language non-English, specifically Spanish language, Hispanic ethnicity, maternal income, racial identification as Black or Chinese, marital status defined as not married, source of maternal insurance, and postpartum checkup.

Chapter 5 will be the interpretation of these findings, as well as further reflection into the limitations and strengths of the study. The chapter will also incorporate possible recommendations for future research. In addition, the concluding chapter will explain the implications of the findings within this study, and the impact on positive social change.

Chapter 5: Discussion, Conclusions and Recommendations

Introduction

The purpose of this study was to determine whether a woman's primary language and pregnancy health care factors (i.e., access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status) are associated with electronic cigarette use during pregnancy. Upon review of the literature, a woman's primary language and pregnancy health care factors were investigated. This study utilizes a national data set from the CDC PRAMs to provide a rich evaluation of maternal health primarily in New York State and New York City from the years 2016–2020. The United States has not seen an improvement in maternal health outcomes and maternal morbidity as should be expected for a high resource country (Wolfson et al., 2022).

A multiple logistic regression analysis was conducted for the first research question to determine whether there is an association between primary language spoken (English vs. non-English) and use of electronic cigarette in pregnancy. Women whose primary language was Spanish were nearly two thirds less likely to smoke electronic cigarettes compared to those who were primarily English speaking, which was statistically significant, B = -.974, SE = .394, Wald = 6.118 ($p < .05$). Based on these results, the null hypothesis was rejected, and the alternative hypothesis was accepted due to finding there was a statistically significant association between primary language spoken (English vs. non-English) and use of electronic cigarettes in pregnancy.

A second multiple logistic regression analysis was conducted to investigate whether there is an association between preventive service and the use of electronic cigarettes in pregnant women. Not all preventive services were found to be statistically significant, including independent variables of pre-pregnancy health care visit, health care visit with OB/GYN, number of prenatal care visits, and prenatal care visits in the first trimester. However, specific types of insurance did seem to be related to electronic cigarette use and reach statistical significance ($p < .05$). Statistically significant independent variables included private insurance, women who had Champus/Tricare and other government forms of insurance as well as postpartum visits ($p < .05$.) With statistically significant findings between the use of electronic cigarette use in pregnancy and the independent variables, the null hypothesis was rejected, and the alternative hypothesis was accepted.

Chapter 5 will focus on a discussion of the findings and interpretation of the data and the impact that these results may have on the body of research for a woman's primary language, pregnancy health care factors, and the use of electronic cigarettes during pregnancy. I will first interpret each individual research question and compare with the current body of peer-reviewed literature. Then I will compare the findings to the theoretical framework for this study, the SEM. Secondly, I will discuss the strengths and limitations of the study, offering recommendations for potential areas for further research, based upon the current body of research as outlined in the Chapter 2 literature review. Lastly, I will discuss the social change and potential impact that this study and

the findings have for practical implication and use and concluding remarks related to the overall study.

Interpretation of Findings for RQ1

The first research question explored the relationship between maternal language and use of electronic cigarettes in pregnancy. Key findings were that maternal language did significantly impact use of electronic cigarettes in pregnancy; however, the relationship was found to be an inverse relationship. Maternal language, especially for Spanish-speaking individuals was found to be negatively correlated with use of electronic cigarettes. In California a study was conducted to evaluate English speaking compared to non-English-speaking Hispanics and electronic cigarettes, evaluating awareness and ever use of electronic cigarettes (Wada et al., 2017). When comparing Native English speakers, to non-Native English, and non-English Hispanics, those who were native English speakers were found to have significantly higher awareness and ever use of electronic cigarettes compared to the other two populations (Wada et al., 2017).

Although the Californian study had been performed in both men and women, the findings of this current study, also shows that non-English-speaking Hispanic women were less likely to use electronic cigarettes during pregnancy. This may be an indication that media and marketing strategies of electronic cigarettes may not be as prevalent in Spanish or on Spanish broadcast streams, compared to advertisements in English and the importance of cultural buffering as a protective barrier against use of electronic cigarettes. As seen in Chapter 2, there is little knowledge regarding electronic cigarette use and maternal language; therefore, this study adds to the body of literature that

maternal language may be more important in determining the use of electronic cigarette use than previously thought.

The findings from this study also correlate with past studies and the understanding that there is greater use of electronic cigarettes in White individuals, compared to Black and Hispanic populations, which was a similar trend seen (Hartwell et a., 2017 & Spears et al., 2019).

In addition, much of the current body of literature evaluates perceptions of electronic cigarette use or effects of electronic cigarette use on neonatal outcomes; however, the literature does not evaluate how much the sociodemographic factors impact electronic cigarette use. Key sociodemographic variables that were found to be statistically significant were marital status and maternal race. Variables that were not statistically significant were years of education, and number of prior births, which was an interesting finding. Typically, the higher the level of education, the less likely one is to participate in high-risk behaviors such as electronic cigarettes (Assari et al., 2020). In this study, there was not a significant relationship between maternal years of education and use of electronic cigarettes, which differs from trends in general public.

It has been found in the past that women, who had a higher socioeconomic status or level of income were less likely to smoke traditional cigarettes in pregnancy (McHale et al., 2022); this study also shows these variables were statistically significant for electronic cigarettes. Although, the years of education and prior births were not significant, the role of language is significant with the use of electronic cigarettes. Therefore, a clinician's counsel during the prenatal period should take into consideration

a woman's primary language when informing them that electronic cigarettes are unsafe. The knowledge gained from this study, shows that there needs to be a better understanding of the role of language, social economic factors, and the influence that they may have on electronic cigarette use during pregnancy.

Interpretation of Findings for RQ2

The key findings for the second research question involved the variables that would show insight into if access to certain preventative services such as access to health care prior to pregnancy, during the pregnancy, and in the postpartum period influenced use of electronic cigarettes in pregnancy. There have been known sociodemographic disparities between tobacco use, ability to quit, less education and increased risk for disease states leading to increased morbidity and mortality, but how these disparities translate into electronic cigarette use, as well as in pregnancy is still left with limited research (Spears et al., 2019).

One key finding from this research question was the difference in predicted use of electronic cigarettes based upon type of health insurance patients had. There was an increase in electronic cigarette use seen in mothers who had specifically Tricare, or Champus insurance or other government insurances, compared to private insurance. It has been shown previously that mothers utilizing Medicaid programs have been linked to less utilization of prenatal care services in comparison to commercial or private insurance, which may play a role in prevalence of high-risk behaviors (Taylor et al., 2020). There is no other supporting literature regarding insurance use and maternal outcomes with electronic cigarettes as a potential risk modifier; however, this is one area

that can continue to be investigated. It was not show statistical significance whether or not maternal use of electronic cigarettes were linked to prenatal visits, but postpartum visits were found to have a significant relationship. A mother who attended a postpartum visit was found to be significantly less likely use electronic cigarettes.

Although there is very literature related to postpartum screening of electronic cigarettes, the Society for Maternal Fetal Medicine (SMFM), a collective body of specialists aiming to optimize care to high-risk pregnancies and reduce maternal risk and morbidity by defining standards of care and educating practitioners for at risk populations to reduce complications has found the importance to create postpartum care checklist for both normal and complicated pregnancy. The SMFM checklist for postpartum patients includes general screening of general questions to ask the patient to determine whether there are any additional services or specialists that the patient should be referred to (Morgan et al., 2022). The creation of these checklists or even the presence of physicians and health care practitioners to potentially add to these lists use of electronic cigarettes or follow-up lifestyle modifications may also aid to reduce the use of electronic cigarettes.

Interpretation of Findings in Relation to Theoretical Framework

When evaluating the reasoning behind use of electronic cigarettes, health behaviors, and the different interactions and relationships between the environment around an individual, the SEM is a widely accepted model (Han & Son, 2022). This study explored the relationship between electronic cigarette use and different social factors (i.e., marital status and health insurance status) that may also continue to influence or be

correlated. It has been found that interventions created with a multilevel approach should be the most effective in changing behavior (Sallis et al., 2015).

One study that evaluated the importance of social interactions upon different levels, found that the most common source for advertisement for electronic cigarette use apart from television marketing was through friends and family (Wada et al., 2017). This directly correlates with the first, second, and fifth level of the SEM model. The individual, the interpersonal, and the societal layers play a direct role in the use of electronic cigarettes. Although traditional tobacco commercials cannot be advertised on television or radio through the passing of the Public Health Cigarette Smoking Act of 1969 (CDC, 2020), it was found that the more exposure to advertisement of electronic cigarettes through media, the greater ever and current use of electronic cigarettes in the United Sates (Ali et al., 2021).

Another potential relationship that may be important to maternal use of electronic cigarettes in pregnancy is interpersonal relationships. The data derived from this study found that women who were unmarried were more likely to use electronic cigarettes than women who were married ($p < .001$). A similar finding was concluded in an English study also evaluating maternal use of electronic cigarettes and women who were not living with a partner were more likely to use electronic cigarettes in pregnancy (Opondo et al., 2021). This directly correlates with the second level of the SEM as seen in Figure 3. Within the tier of the SEM, the importance of interpersonal relationships with family, friends, and the relationships between those networks impacts decisions made by the individual. It is apparent from the current data that these relationships are potentially

strong enough to influence electronic cigarette use during pregnancy, which can lead to further understanding of trends in use of electronic cigarettes among women during pregnancy and reiterate the need to further investigate the different levels of the SEM and use of electronic cigarettes in pregnancy potentially in other regions or states or countries.

In a meta-analysis evaluating the fetal outcomes of electronic cigarettes and pregnancy, there was also emphasis on the role of government and the need to create regulatory policies minimize the poor maternal fetal outcomes such as low birth weight and the increased harm due to use of electronic cigarettes (Ren et al., 2022). Governmental regulation of electronic cigarettes can be on both the state and federal level. Current restrictions include sales tax, age eligibility to purchase, and laws that enforce prohibition to use within certain establishments such as restaurants or indoor use in public settings (Sindelar, 2020). This shows the importance of regulating the policies that influence the societal of the SEM, which would impact the individual future interpersonal relationships.

Limitations of the Study

Survey-based questionnaire data is subject to limitations on many different levels. One of the first limitations of survey-based questionnaire data is potential for bias. Two types of bias may have been present during this study, including response bias, and recall bias. The PRAMS data set as discussed in Chapter 3, women start to receive letters and questionnaires in the mail months several months after delivery, which can impact their ability to recall the timing or accuracy of their answers (Shulman et al., 2018). The second type of bias that may arise is response bias. When questions may result in a

negative connotation, or negative perception from others, responses may not be truthful due to fear of judgment or shame from those conducting the survey. Also, due to potential response bias being present, respondents may have omitted answer in their completion of the survey, which could also lead to bias with missing data present. As reiterated by Galbo et al. (2022), there is also potential for recall bias based on the terminology of the questions within the PRAMS data survey. For instance, in the survey, it is not as clear regarding electronic cigarette use for the during the pregnancy, since the two main questions asked pertain to 3 months prior to pregnancy, and 3 months after pregnancy (CDC, 2022).

The state of New York and New York City provided the geographical basis for this study. New York City alone is the largest city in the United States based on population size (U.S. Census Bureau, 2021). Geographically limiting this research study to New York and New York City, although the current study provided a great insight into the relationship of electronic cigarettes and maternal language during pregnancy, it is not the only region or city that should be evaluated. This is an example of external validity that may not be the same in other regions of the United States, or other countries around the world. There could be different trends in the data and the relationship between variables based upon region, state, or city based upon different languages or race/ethnicity and language population differences. A major limitation to this study was the record of only three different possible languages for the CDC PRAMS data set in conjunction to the United States as a whole. Limiting to Spanish, Chinese, and English language limited the potential relationship between additional languages and use of

electronic cigarette use in pregnancy in a more broad-spectrum population and application in other regions. Within New York City alone, in a census conducted in 2020, 64% of individuals spoke English, 19% spoke Spanish, 3% Chinese, but other languages above 1% included Russian, Indo-European, Italian, and French Creole (World Atlas, 2020). This breakdown of languages supports the PRAMS protocol for including Spanish and Chinese as the other languages of investigation within their methodology protocol supporting the internal validity for a study based in New York and New York City. According to the United States Census Bureau in 2021, there was a record of 21% of Americans who spoke a language other than English, equivalent to 69 million individuals (U.S. Census Bureau, 2021).

Recommendations

Recommendations for further research summarized in this chapter are based on the use of the social ecological design in this study. This study used the CDC PRAMS data set for the region of New York and New York City only. Other potential social determinants of health should be further evaluated across the United States to determine whether maternal language influences the use of electronic cigarettes in pregnancy. Studying either state by state, or even regions within the country, may reveal other trends in maternal language, sociodemographic, and maternal health care factors, and their impact on electronic cigarette use would be beneficial for public health officials and health care practitioners.

Another area that could be expanded upon and further studied would be to determine whether there are other languages that may have a different relationship or

outcome, such as Farsi, Urdu, Swedish, Dutch, German, Creole, French, Italian, Japanese, Korean, and others, to better determine within the New York region whether these different languages are associated with any disparities in relation to electronic cigarette use in pregnancy. In a German study that was recently conducted, the researchers evaluated the perceived barriers and attitudes of a population of women using German language forums to discuss electronic cigarette use in pregnancy (Schilling et al., 2021). It was found that close to 31% of individual women found that there may be a benefit in consumption of electronic cigarettes to help reduce use of traditional tobacco cigarettes (Schilling et al., 2021). Understanding if there exist these other language barriers during pregnancy to accurate information on risks, accurate counseling on smoking cessation in pregnancy, or ability to converse clearly regarding use of electronic cigarettes is important for maternal health within the United States.

The CDC PRAMS data set questionnaire is occasionally revised, and there are additional supplemental questions added based upon current health trends, trends in social behaviors etc., in relation to topics that are of importance or elicit concern amongst the public health communities. Although the addition of the electronic cigarette supplemental in 2015 was a great addition to the base questions, perhaps adding more direct questions related to electronic cigarette use could further the knowledge gained. For instance, additional questions expanding upon perceived risks or benefits could add more information to those at risk for continued use or at-risk populations. Also evaluating further in the questionnaire health care discussions on electronic cigarettes in native tongue may further show whether a barrier exists.

In addition to better understanding the relationship between ethnicity, race, language and use of electronic cigarette, an additional variable that could be of interest would be birth country. It was found by Wada et al. (2017), that individuals who were foreign born, as well as non-English speaking, were found to have much lower levels of electronic cigarette use. This could be important to better understanding marketing strategies and how language and ethnicity may continue to serve as social barriers in understanding distinct patterns of use of electronic cigarettes among individuals.

Implications

Maternal child health has been a standard measure of a country's health for many years and understanding potential risk behaviors, barriers to understanding the negative impacts of toxic habits, and importance to reduce disparities to improve health outcomes is important to public health officials and health care practitioners. This study evaluated a potential relationship between socioeconomic, and racial disparities within a very populated region, amplifying the need for more research that may influence policy reform.

Implications for Social Change

The focus of this study was to determine the relationship between maternal language, electronic cigarettes and use in pregnancy. The study emphasizes the need to understand the potential social factors and sociodemographic variables that may influence or impact the relationship between electronic cigarette use and maternal use in pregnancy. The findings of this study shed light on the different dynamics that may influence electronic cigarette use such as maternal language, access to health services

(health insurance), and common demographics (economics, education, marital status, and age). The findings highlighted a surprising potential protective effect of maternal language possibly related to cultural ideals and norms within the second level of the SEM model, the interpersonal relationships. However, cultural norms have the potential to be influenced by advertisement, length of stay in United States and country of origin and the relationship between acculturation and electronic cigarette use. In this study, Spanish-speaking women and women of Hispanic ethnicity were found to be less likely to utilize electronic cigarettes, however further investigating the potential protective factor is important. In a study conducted by Wang et al. (2019), the greater proficiency of English increased the use of electronic cigarettes in population of adult immigrants within the United States. Understanding how to educate these individuals, screen, and provide education or literature on the dangers of electronic cigarettes, may counter advertisements or age-related trends and false perceptions. The data from this study may highlight a key trend in data that may show a need to create an impact on social media campaigns or increase advertisements educating individuals of the dangers such as the Truth Initiative® that aims to influence culture and create healthier lifestyles.

Use of the PRAMS questionnaire in other states, with the addition of the tobacco and electronic cigarette screen may be beneficial to get current trends on use in all PRAMS participating states as a baseline. Also adding additional questions to the PRAMS Phase 8 questionnaire may add additional insight, such where did you first learn about electronic cigarettes, or exposure to media/news outlets that may have influenced use? Drawing these additional insights can help further understand the relationships

between electronic cigarette use, maternal health, and the many levels of the SEM, to help better create targets for public health campaigns, informational handouts, and better equip health care professionals with materials to educate their patients.

Conclusions

In this study, I explored the relationship between maternal language and the use of electronic cigarettes and other social determinants for women in New York, and New York City spanning from 2016-2021. Using the CDC PRAMs data set, the maternal languages evaluated were Spanish and Chinese in comparison to native English-speaking women performing a retrospective logistic regression analysis. The social determinants evaluated in addition to maternal language included access to health care 12 months prior to pregnancy, access to prenatal care within the first trimester, and health insurance status in conjunction with sociodemographics. The findings of the study refuted the null hypothesis, and maternal language was found to have a statistically significant relationship with electronic cigarette use. These findings helped to highlight the importance to further investigate the role of sociodemographics and social determinants of health, and their relationships between toxic behaviors, especially electronic cigarette use and influence on maternal health behaviors.

The importance of improving health outcomes, reducing disparities, understanding at risk populations and the impact different societal levels may have on outcomes is at the foundation of public health. Although this study only evaluated one region in the United States, it calls for further research to be conducted in other parts of the United States especially in urban areas where tobacco use may be more prevalent.

This study also shows the importance and need for better screening protocols for at risk populations for by health care professionals, public health practitioners, and policy makers across the United States as well as other countries. Reducing health care disparities and expanding access to preventative services is crucial to improving population health, and this study emphasizes the gap in literature on the subject matter and the need for further research to follow suit.

References

Adams, E. K., & Johnston, E. M. (2016). Insuring women in the United States before, during and after pregnancies. *American Journal of Public Health, 106*(4), 585-586. https://doi.org/10.2105/AJPH.2016.303132

Alcala, H. E., Albert, S. L., & Ortega, A. N. (2016). E-cigarette use and disparities by race, citizenship status and language among adolescents. *Journal of Addictive Behaviors*, *57*, 30-34. https://doi.org/10.1016/j.addbeh.2016.01.014

Ali, F., Dave, D. M., Colman, G. J., Wang, X., Saffer, H., Marynak, K. L., Dench, D., & Grossman, M. (2021). Association of e-cigarette advertising with e-cigarette and cigarette use among US adults. *Addiction (Abingdon, England), 116*(5), 1212–1223. https://doi.org/10.1111/add.15281

American College of Obstetrics and Gynecology. (2020). Tobacco and nicotine cessation in pregnancy, ACOG Committee Opinion NO 807. *Obstetrics and Gynecology*, *135*(5), e221-e229. https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2020/05/tobacco-and-nicotine-cessation-during-pregnancy

American Academy of Pediatrics and American College of Obstetricians and Gynecologists. (2017). *Guidelines for perinatal care* (8th ed.).

American Immigration Council. (2020). *Immigrant women and girls in the United States- A portrait of demographic diversity.* https://www.americanimmigrationcouncil.org/research/immigrant-women-and-girls-united-states

Anekwe, L. (2020). Ethnic disparities in maternal care. *The BMJ, 368*, m442.

https://doi.org/10.1136/bmj.m442

Assari, S., Mistry, R., & Bazargan, M. (2020). Race, Educational Attainment, and E-Cigarette Use. *Journal of Medical Research and Innovation*, 4(1). https://doi.org/10.32892/jmri.185

Ashford, K., Wiggins, A., Butler, K., Ickes, M., Rayens, M. K., & Hahn, E. (2016). E-cigarette use and perceived harm among women of childbearing age who reported tobacco use during the past year. *Nursing Research*, *65*(5), 404-414. https://doi.org/10.1097/nnr.0000000000000176

Ayers, B. L., Hawley, N. L., Purvis, R. S., Moore, S. J., & McElfish, P. A. (2018). Providers' perspectives on barriers experienced in maternal health care among Marshallese women. *Women and Birth, 31*, e294-e301. https://doi.org/10.1016/j.wombi.2017.10.006

Ayers, B. L., Purvis, R. S., Bing, W. I., Rubon-Chutaro, J., Hawley, N. L., Dalefield, R., Adams, I. K., & McElfish, P. A. (2018). Structural and socio-cultural barriers to prenatal care in a US Marshallese community. *Maternal and Child Health Journal*, *22*, 1067-1076. https://doi.org/10.1007/s10995-018-2490-5

Azagba, S., Manzione, L., Shan, L., & King, J. (2020). Trends in smoking during pregnancy by socioeconomic characteristics in the United States, 2010-2017. *BMC Pregnancy and Childbirth, 20*(52), 1-7. https://doi.org/10.1186/s12884-020-2748-y

Benowitz, N. L., & Fraiman, J. B. (2017). Cardiovascular effects of electronic cigarettes. *Nature Reviews Cardiology, 14*(8), 447-456.

https://doi.org/10.1038/nrcardio.2017.36

Bowker, K., Campbell, K. A., Coleman, T., Lewis, S., Naughton, F., & Cooper, S. (2016). Understanding pregnant smoker's adherence to nicotine replacement therapy during a quit attempt: a qualitative study. *Nicotine and Tobacco Research, 18*(5), 906-912. https://doi.org/10.1093/ntr/ntv205

Bowker, K., Ussher, M., Cooper, S., Orton, S., Coleman, T., & Campbell, K. A. (2020). Addressing and overcoming barriers to e-cigarettes use for smoking cessation in pregnancy: a qualitative study. *International Journal of Environmental Research and Public Health, 17*(3), 1-13. https://doi.org/10.3390/ijerph17134823

Bronfenbrenner, U. (1992). Ecological systems theory. In R. Vasta (Ed.), *Six theories of child development: Revised formulations and current issues* (187-249). Jessica Kingsley Publishers.

Brown, V. (2015). Using the social ecological model to inform community needs assessments. *Journal of Family and Consumer Sciences, 107*(1), 45-51.

Brown, Q.L., Hasin, D. S., Keyes, K. M., Fink, D. S., Ravenell, O., & Martins, S. S. (2016). Health insurance, alcohol, and tobacco use among pregnant and non-pregnant women of reproductive age. *Drug and Alcohol Dependence, 166*, 116-124. https://doi.org/10.1016/j.drugalcdep.2016.07.001

Calder, R., Grant, E., Bauld, L., McNeill, A., Robinson, D., & Brose, L.S. (2021). Vaping in pregnancy: a systematic review. *Tobacco Research*, 23(9), 1415-1458. https://doi.org/10.1093/ntr/ntab017

Centering Healthcare Institute. (2020). *CenteringPregnancy*.

https://www.centeringhealthcare.org/what-we-do/centering-pregnancy

Centers for Disease Control and Prevention. (2007). *The social-ecological model: a framework for prevention*. U.S. Department of Health and Human Services. https://www.cdc.gov/violenceprevention/overview/social-ecologicalmodel.html

Centers for Disease Control and Prevention. (2015). *Models and frameworks for the practice of community engagement*. U.S. Department of Health and Human Services. https://www.atsdr.cdc.gov/communityengagement/pce_models.html

Centers for Disease Control and Prevention. (2018). *PRAMS model surveillance protocol, 2005 CATI version*. Unpublished. U.S. Department of Health and Human Services. https://www.cdc.gov/prams/methodology.htm

Centers for Disease Control and Prevention. (2020). *Behavioral Risk Factor Surveillance System*. U.S. Department of Health and Human Services. https://www.cdc.gov/brfss/index.html

Centers for Disease Control and Prevention. (2022). *Smoking and Tobacco Use: About electronic cigarettes (E-cigarettes)*. U.S. Department of Health and Human Services. https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html

Centers for Disease Control and Prevention. (2022). *PRAMS*. U.S. Department of Health and Human Services. https://www.cdc.gov/prams/index.htm

Cerrai, S., Potente, R., Gorini, G., Gallus, S., & Molinaro, S. (2020). What is the face of new nicotine users? 2012-2018 e-cigarettes and tobacco use among young students in Italy. *International Journal of Drug Policy, 86*, 2-8.

https://doi.org/10.1016/j.drugpo.2020.102941

Chen, J., Bullen, C., & Dirks, K. (2017). A comparative health risk assessment of electronic cigarettes and conventional cigarettes. *International Journal of Environmental Research and Public Health, 14*(382), 1-10. https://doi.org/10.3390/ijerph14040382

Chiang, S. C, Abroms, L. C, Cleary, S. D, Pant, I., Doherty, L., & Krishnan, N. (2019). E-cigarettes and smoking cessation: a prospective study of a national sample of pregnant smokers. *BMC Public Health, 19*(964), 1-7. https://doi.org/10.1186/s12889-019-7299-7

Cooper, M., & Pesko, M.F. (2017). The effect of e-cigarette indoor vaping restrictions on adult prenatal smoking and birthing outcomes. *Journal of Health Economics, 56*, 178-190. https://doi.org/10.1016/j.jhealeco.2017.10.002

Coreil, J. (Ed.). (2010). *Social and Behavioral Foundations of Public Health* (2nd Ed). Sage Publications Inc.

Crear-Perry, J., Correa-de-Araujo, R., Lewis Johnson, T., McLemore, M. R., Neilson, E., & Wallace, M. (2021). Social and structural determinants of health inequities in maternal health. *Journal of Women's Health, 30*(2), 230-235. https://doi.org/10.1089/jwh.2020.882

Crowson, M. (2021). *Identifying collinearity among predictors in OLS and logistic regression using SPSS.* [PowerPoint Slides]. GoogleDrive. https://drive.google.com/file/d/1WKTeUZVchUE-3Glhbo5Io3sIgLdWlYqj/view

Cullen, K. A., Ambrose, B. K., Gentzke, A. S., Apelberg, B. J., Jamal, A., & King, B. A.

(2018). Notes from the field: use of electronic cigarettes and any tobacco product among middle and high school students- United States, 2011-2018. *CDC Morbidity and Mortality Weekly Report (MMWR), 67*(45), 1276-1277. https://www.cdc.gov/mmwr/volumes/67/wr/mm6745a5.htm?s_cid=mm6745a5_w

Dagklis, T., Tsakiridis, I., Mamopoulos, A., Dardavessis, T., & Athanasiadis, A. (2020). Modifiable risk factors for spontaneous preterm birth in nulliparous women: a prospective study. *Journal of Perinatal Medicine, 48*(2), 96-101. https://doi.org/10.1515/jpm-2019-0362

Dai, H., Ramos, A. K., Faseru, B., Hill, J. L., & Sussman, S. Y. (2021). Racial disparities of E-cigarettes Use Among US Youths: 2014-2019. *American Journal of Public Health*, *111*, 2050-2058. https://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2021.306448

D'Angelo, D. V., O'Neil, M. A., Williams, L., Ahluwalia, I. B., Harrison, L. L., Floyd, R. L., & Grigorescu, V. (2015). Patterns of health insurance coverage around the time of pregnancy among women with live-born infants- Pregnancy Risk Assessment Monitoring System, 29 States, 2009.*MMWR Surveillance Summaries, 64*(4), 1-19. https://www.cdc.gov/mmwr/preview/mmwrhtml/ss6404a1.htm

Daw, J. R., & Sommers, B. D. (2019). The Affordable Care Act and access to care for reproductive-aged and pregnant women in the United States, 2010-2016. *American Journal of Public Health Policy, 109*(4), 565-571. https://doi.org/10.2105/ajph.2018.304928

Dillman, D. A. (1999). Mail and Internet surveys; the tailored design method. New York;

John Wiley and Sons.

Doherty, E. M., Kingsland, M., Wolfenden, L., Wiggers, J., Dray, J., Hollis, J., Elliot, E. J., Daly, J. B., Bailey, K. A., Attia, J., Hunter, M., Symonds, I., Tully, B., Tremain, D., & Hodder, R. K. (2019). Implementation strategies to improve preconception and antenatal care for tobacco smoking, alcohol consumption and weight management: a systemic review protocol. *Systematic Reviews, 8*(285), 1-8. https://doi.org/10.1186/s13643-019-1193-3

Dong, Y., & Peng, C.J. (2013). Principled missing data methods for researchers. *Spingerplus*. *2*, 222. https://doi.org/10.11186/2193-1801-2-222

Ebersole, J., Samburova, V., Son, Y., Cappelli, D., Demopoulos, C., Capurro, A., Pinto, A., Chrzan, B., Kinglsey K., Howard, K., Clark, N., Khlystov, A. (2020). Harmful chemicals emitted from electronic cigarettes and potential deleterious effects in the oral cavity. Tobacco Induced Diseases, 18,41. https://doi.org.10.18332/tid/116988

England, L. J.., Bunnell, R. E., Pechacek, T. F., Tong, V. T., & McAfee, T. A. (2015). Nicotine and the developing human: a neglected element in the electronic cigarette debate. *American Journal of Preventive Medicine, 49*(2), 286-293. https://doi.org/10.1016/j.amepre.2015.01.015

Fair, F., Raben, L., Watson, H., Vivilaki, V., van den Muijsenbergh, M., Soltani, H., & the ORAMMA team. (2020). Migrant women's experiences of pregnancy, childbirth and maternity care in European countries: a systematic review. *PLoS ONE, 15*(2), 1-26. https://doi.org/10.1371/journal.pone.0228378

Fallin, A., Miller, A., Assef, S., & Ashford, K. (2016). Perceptions of electronic cigarettes among Medicaid eligible pregnant and postpartum women. *Journal of Obstetrics Gynecology and Neonatal Nursing, 45*(3), 320-325. https://doi.org/10.1016/j.jogn.2016.02.009

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149-1160. https://doi.org/10.3758/BRM.41.4.1149

Flynn, A. C., Pryke, E., Wadhera, M., Poston, L., & White, S. L. (2021). A preconception intervention targeted at women with modifiable risk factors before pregnancy to improve outcomes; protocol for the Get Ready! Feasibility trial. *Pilot and Feasibility Studies*, 7(86). https://doi.org/10.1186/s40814-021-00824-0

Frieden, T. R. (2010). A framework for public health action: The Health Impact Pyramid. *American Journal of Public Health, 100*(4), 590-595. https://doi.org/10.2105/AJPH.2009.185652

Fryer, K., Lewis, G., Munoz, C., & Stuebe, A. M. (2021). Identifying Barriers and facilitators to prenatal care for Spanish-Speaking women. *North Carolina Medical Journal, 82*(1), 7-13. https://doi.org/10.18043/ncm.82.1.7

Global Center for Good Governance in Tobacco Control. (2020). E-cigarette ban and regulation: global status as of February 2020. https://ggtc.world/2020/02/24/e-cigarette-ban-regulation-global-status-as-of-february-2020/

Golden, S. D., & Earp, J. L. (2012). Social ecological approaches to individuals and their contexts: Twenty years of “health education & behavior” health promotion

interventions. *Health Education and Behavior, 39*(3), 364-374. https://doi.org/10.1177/1090198111418634

Golden, S. D., Mcleroy, K. R., Green, L.W., Earp, J. L., & Lieberman, L. D., (2015**).** Upending the social ecological model to guide health promotion efforts toward policy and environmental change. *Health Education & Behavior, 42*(Suppl 1), 8s-14s. https://doi.org/10.1177.1090198115575098

Gould, G. S., Havard, A., Lim, L. L., the PSANZ Smoking in Pregnancy Expert Group, & Kumar, R. (2020). Exposure to tobacco, environmental tobacco smoke and nicotine in pregnancy: A pragmatic overview of reviews of maternal and child outcomes, effectiveness of interventions and barriers and facilitators to quitting. *International Journal of Environmental Research and Public Health, 17*(2034), 2-34. https://doi.org/10.3390/ijerph17062034

Gravely, S., Driezen, P., Ouimet, J., Quah, A. C. K., Cummings, K. M., Thompson, M. E., Boudreau, C., Hammond, D., McNeill, A., Borland, R., Thrasher, J. F., Edwards, R., Omar, M., Hitchman, S. C., Yong, H., Barrientos-Gutierrez, T., Willemsen, M. C., Bianco, E., Boada, M., … Fong, G. T. (2019). Prevalence of awareness, ever-use and current use of nicotine vaping products (NVPs) among adult current smokers and ex-smokers in 14 countries with differing regulations on sales and marketing of NVPs: cross-sectional findings from the ITC project. *Addiction, 114*, 1060-1073. https://doi.org/10.1111/add.14558

Gravely, S., Driezen, P., Thrasher, J. F., Cummings, K. M., Ouimet, J., McNeill, A., Meng, G., Lindblom, E. N., Loewen, R., O'Connor, R. J., Thompson, M. E.,

Hitchman, S. C., Hammond, D., Heckman, B. W., Borland, R., Yong, H., Elton-Marshall, T., Bansal-Travers, M., Gartner, C., & Fong, G. T. (2018). Discussions between health professionals and smokers about nicotine vaping products: results from the 2016 ITC Four Country Smoking and Vaping Survey. *Addiction, 114* (Suppl. 1), 71-85. https://doi.org/10.1111/add.14527

Green, L.W., Richard, L., & Potvin, L. (1996). Ecological foundations of health promotion. *American Journal of Health Promotion, 10*(4), 270-281. https://doi.org/10.4278/0890-1171-10.4.270

Green, T. L., Bodas, M. V., Jones, H. A., Masho, S. W., & Hagiwara, N. (2018). Disparities in self-reported prenatal counseling: does immigrant status matter? *Journal of Community Health, 43*, 864-873. https://doi.org/10.1007/s10900-018-0495-z

Giovino, G. A., Villanti, A. C., Mowery, P. D., Sevilimedu, V., Niaura, R. S., Vallone, D. M., & Abrams, D. B. (2015). Differential trends in cigarette smoking in the USA: Is menthol slowing progress? *Tobacco Control, 24*, 28-37. https://doi.org/10.1136/tobaccocontrol-2013-051159

Hartwell, G., Thomas, S., Egan, M., Gilmore, A., & Petticrew, M. (2017). E-cigarettes and equity: a systematic review of differences in awareness and use between sociodemographic groups. *Tobacco control*, *26*(e2), e85–e91. https://doi.org/10.1136/tobaccocontrol-2016-053222

Han, G., & Son, H. (2022). A systematic review of socio-ecological factors influencing current e-cigarette use among adolescents and young adults. *Addictive Behaviors*,

135, 107425. https://doi.org/10.1016/j.addbeh.2022.107425

Hansen, A. R., Akomolafe, T. O., McGalliard, Z., Belle-Isle, L., & Zhang, J. (2018). Striving to meet Healthy People 2020 objectives: Trend analysis of maternal smoking. *Public Health Reports, 133*(6), 644-649. https://doi.org/10.1177.0033354918793120

Hawkins, S. S., Wylie, B. J., & Hacker, M. R. (2020). Use of ENDS and cigarettes during pregnancy. *American Journal of Preventive Medicine, 58*(1), 122-128. http//doi.org/ 10.1016/j.amepre.2019.08.031

Heetkamp, K. M., Peters, I. A., Bertens, L. C. M., & Knapen, M. F. C. M. (2020). An unwanted pregnancy and language proficiency level are associated with first antenatal visit after the first trimester: Results from prospective cohort study. *Midwifery, 89*(102784), 1-6. https://doi.org/10.1016/j.midw.2020.102784

Higginbottom, G., Safipour, J., Yohani, S., O'Brien, B., Mumtaz, Z., & Paton, P. (2015). An ethnographic study of communication challenges in maternity care for immigrant women in rural Alberta. *Midwifery, 31*(2), 297-304. https://doi.org/10.1016/j.midw.2014.09.009

Holdt Somer, S. J., Sinkey, R. G., & Bryant, A. S. (2017). Epidemiology of racial/ethnic disparities in severe maternal morbidity and mortality. *Seminars in Perinatology, 41*(5), 258-265. https://doi.org/10.1053/j.semperi.2017.04.001

Homan, G. F., deLacey, S., & Tremellen, K. (2018). Promoting healthy lifestyle in fertility clinics; an Australian perspective. *Human Reproduction Open*. eCollection,1-7. https://doi.org/10.1093/hropen/hox028

Hooker, S. A., Punjabi, A., Justesen, K., Boyle, L., & Sherman, M. D. (2018). Encouraging health behavior change: eight evidence-based strategies. *Family Practice Management, 25*(2), 31-36. https://pubmed.ncbi.nlm.nih.gov/29537244/

Huerta, T. R., Walker, D. M., Mullen, D., Johnson, T. J., & Ford, E. W. (2017). Trends in e-cigarette awareness and perceived harmfulness in the U.S. *American Journal of Preventive Medicine, 52*(3), 339-346. https://doi.org/10.1016/j.amepre.2016.10.017

Huisman, M., Van Lenthe, F. J., Giskes, K., Kamphuis, C. B. M., Brug, J., & Mackenbach, J. P. (2012). Explaining socio-economic inequalities in daily smoking: a social-ecologic approach. *European Journal of Public Health, 22*(2), 238-243. https://doi.org/10.1093/eur-pub/ckr039

Jankowski, M., Minarowski, Ł., Mróz, R. M., Guziejko, K., Mojsak, D., Poznański, M., Zielonka, T. M., Rachel, M., Kornicki, K., Pepłowska, P., Bielewicz, K., Piotrowski, W., Ziobroń, A., Pękala-Wojciechowska, A., Zborowski, J., Shpakou, A., Skoczyński, S., Majek, P., Lawson, J., … Brożek, G. M. (2020). E-cigarette use among young adults in Poland: Prevalence and characteristics of e-cigarette users. *Advances in Medical Science*, *65*, 437-441. https://doi.org/10.1016/j.advms.2020.09.002

Kapaya, M., D'Angelo, D. V., Tong, V. T., England, L., Ruffo, N., Cox, S., Warner, L., Bombard, J., Guthrie, T., Lampkins, A., & King, B. A. (2019). Use of electronic vapor products before, during and after pregnancy among women with a recent live birth- Oklahoma and Texas, 2015. *CDC Morbidity and Mortality Weekly*

Report (MMWR), 69(8), 189-194. https://doi.org/10.15585/mmwr.mm6808a1

Kahr, M. K., Padgett, S., Shope, C. D., Griffin, E. N., Xie, S. S., Gonzales, P. J., Levison, J., Mastrobattista, J., Abramovici, A. R., Norhturp, T. E., Stotts, A. L., Aagaard, K. M., & Suter, M. A. (2015). A qualitative assessment of the perceived risks of electronic cigarette and hookah use in pregnancy. *BMC Public Health, 15*(1273), 1-8. https://doi.org/10.1186.s12889-015-2586-4

Kataoka, M. C., Carvalheira, A., Ferrari, A. P., Malta, M. B., de Barros Leite Carvalhaes, M. A., & Garcia de Lima Parada, C. M. (2018). Smoking during pregnancy and harm reduction in birth weight: a cross-sectional study. *BMC Pregnancy and Childbirth, 18*(67), 1-10. https://doi.org/10.1186/s12884-018-1694-4

Kaufman, A. R., Finney Rutten, L. J., Parascandola, M., Blake, K. D., & Augustson, E. M. (2015). Food and drug administration tobacco regulation and product judgements. *American Journal of Preventive Medicine, 48*(4), 445-451. https://doi.org/10.1016/j.amepre.2014.10.026

Kesimer, M. (2019). Another warning sign: High nicotine content in electronic cigarettes disrupts mucocilliary clearance, the essential defense mechanism of the lung. *American Journal of Respiratory and Critical Care Medicine*, *200*(9). https://doi.org/10.1164/rccm.201905-1080ED

Kim, S. (2020). Changes in multiple and different tobacco product use behaviors in women before and during pregnancy: An analysis of longitudinal population assessment of tobacco and health data. *American Journal of Preventive Medicine, 59*(4), 588-592. https://doi.org/ 10.1016/j.amepre.2020.05.006

Kiron, K., Fowler, A. J., Gundogan, B., & Agha, R.A. (2018). Peer review in scholarly publishing part A: Why do it? *International Journal of Surgery: Oncology, 3*(2), e56. https://doi.org/10.1097/IJ9.0000000000000056

Ko, J. Y., Tong, V. T., Haight, S. C., Terplan, M., Stark, L., Snead, C., & Schulkin, J. (2020). Obstetrician-gynecologists' practices and attitudes on substance use screening during pregnancy. *Journal of Perinatology, 40*(2), 422-432. https://doi.org/10.1038/s41372-019-0542-3

Krishnan-Sarin, S., Green, B. G., Kong, G., Cavallo, D. A., Jatlow, P., Gueorguiva, R., Buta, E., & O'Malley, S. S. (2017). Studying the interactive effects of menthol and nicotine among youth: an examination using e-cigarettes. *Drug and Alcohol Dependance, 180*, 193-199. https://doi.org/10.1016/j.drugalcdep.2017.07.044

Krug, E., Dahlberg, L., Mercy, J., Swi, A., & Lozano, R. (Eds.). (2002). Violence- a global public health problem. *World report on violence and health* (pp 1-56). Geneva, Switzerland: World Health Organization.

Kurti, A. N., Redner, R., Bunn, J. Y., Tang, K., Nighbor, T., Lopez, A. A., Keith, D. R., Villanti, A. C., Stanton, C. A., Gaalema, D. E., Doogan, N. J., Cepeda-Benito, A., Roberts, M. E., Phillips, J., Parker, M. A., Quisenberry, A. J., & Higgins, S. T. (2018). Examining the relationship between pregnancy and quitting use of tobacco products in a U.S. national sample of women of reproductive age. *Preventive Medicine, 117*, 52-60. https://doi.org/10.1016/j.ypmed.2018.08.019

Laerd Statitistics. (n.d.). *Binomial Logistic regression using SPSS. Statistics.* https://statistics.laerd.com/spss-tutorials/binomial-logistic-regression-using-spss-

statistics.php

Lam, C. N., Goldenson, N. I., Burner, E., & Unger, J. B. (2016). Cultural buffering as a protective factor against electronic cigarette use among Hispanic emergency department patients. *Journal of Addiction and Behavior, 63*, 155-160. https://doi.org/19.106/j.addbeh.2016.07.020

Leal, M. do C., Esteves-Pereira, A. P., Viellas, E. F., Domingues, R. M. S. M., & Gama, S. G. N. da. (2020). Prenatal care in the Brazilian public health services. *Revista De Saúde Pública, 54*, 8. https://doi.org/10.11606/s1518-8787/2020054001458

Lin, S., Wang, L., Zhou, W., Kitsantas, P., Wen, X, & Xue, H. (2023). E-cigarette use during pregnancy and its association with adverse birth outcomes in the US. *Preventive Medicine*, *166*. https://doi.org/10.1016/j.ypmed.2022.107375

Liu, B., Du, Y., Wu, Y., Sun, Y., Santillan, M. K., Santillan, D. A., & Bao, W. (2021). Prevalence and Distribution of Electronic Cigarette Use Before and During Pregnancy Among Women in 38 States of the United States. *Nicotine & Tobacco*, *23*(9), 1459–1467. https://doi.org/10.1093/ntr/ntab041

Livingston, C. J., Freeman, R. J., Costales, V. C., Westhoff, J. L., Caplan, L. S., Sherin, K. M., & Niebuhr, D. W. (2019). Electronic nicotine delivery systems or E-cigarettes: American College of Preventive Medicine's practice statement. *American Journal of Preventive Medicine, 56*(1), 167-178. https://doi.org/10.1016/j.amepre.2018.09.010

March of Dimes. (2021). *Early prenatal care by race/ethnicity: New York City, 2016-2018 Average*.

https://www.marchofdimes.org/Peristats/ViewSubtopic.aspx?reg=3651000&top=5&stop=24&lev=1&slev=5&obj=1

Margerison, C. E., MacCallum, C. L., Chen, J., Zamani-Hank, Y., & Kaestner, R. (2020). Impacts of Medicaid expansion on health among women of reproductive age. *American Journal of Preventive Medicine, 58*(1), 1-11 https://doi.org/10.1016/j.amepre.2019.08.019

Margerison, C. E., Kaestner, R., Chen, J., & MacCallum-Bridges, C. (2021). Impacts of Medicaid expansion before conception on pre-pregnancy health, pregnancy health, and outcomes. *American Journal of Epidemiology, 190*(08), 1488-1498. https://doi.org/10.1093/aje/kwaa289

Marynak, K. L., Gammon, D. G., King, B. A., Loomis, B. R., Fulmer, E. B., Wang, T. W., & Rogers, T. (2017). National and state trends in sales of cigarettes and e-cigarettes, U.S., 2011-2015. *American Journal of Preventive Medicine, 53*(1), 96-101. https://doi.org/10.1016/j.amepre.2017.01.016

McCubbin, A., Fallin-Bennett, A., Barnett, J., & Ashford, K. (2017). Perceptions and use of electronic cigarettes in pregnancy. *Health Education Research, 32*(1), 22-32. https://doi.org/10.1093/her/cyw/059

McDaniel, J. T. (2018). Emergency room visits for chronic obstructive pulmonary disease in Illinois counties: An epidemiological study based on the Social Ecological Model. *Chronic Illness, 16*(1), 69-82. https://doi.org/10.1177/1742395318778102

McElfish, P. A., Moore, R., Woodring, D., Purvis, R. S., Maskarinec, G. G., Bing, W. I.,

Hudson, J., Kohler, P. O., & Goulden, P. (2016). Social ecology and diabetes self-management among Pacific Islanders in Arkansas. *Journal of Family Medicine and Disease Prevention, 2*(1), 2-16. https://doi.org/10.23937/2469-5793/1510026

McHale, P., Maudsley, G., Pennington, A., Schluter, D. K., Barr, B., Paranjothy, S., & Taylor-Robinson, D. (2022). Mediators of socioeconomic inequalities in preterm birth: a systematic review. *BMC Public Health, 22*, 1134. https://doi.org/10.1186/s12889-022-13438-9

McLeroy, K., Steckler, A., & Bibeau, D. (1988). The social ecology of health promotion interventions. *Health Education Quarterly,15*(4), 351-377. http://tamhsc.academia.edu/KennethMcleroy/Paper/81901/An_Ecological_Perspective_on_health_Promotion_Programs.

Mishra, A., Chaturvedi, P., Datta, S., Sinukumar, S., Joshi, P., & Garg, A. (2015). Harmful effects of nicotine. *Indian Journal of Medical and Paediatric Oncology, 36*(1), 24-31. https://doi.org/10.4103/0971-5851-151771

National Institutes of Health. (2021). *Vaping devices (Electronic cigarettes) drug facts*. https://www.drugabuse.gov/publications/drugfacts/vaping-devices-electronic-cigarettes

Nguyen, A. B., Henrie, J., Slavit, W. I., & Kaufman, A. R. (2018). Beliefs about FDA tobacco regulation, modifiability of cancer risk and tobacco product comparative harm perceptions: findings from the HINTS-FDA 2015. *Preventive Medicine, 110*, 1-8. https://doi.org/10.1016/j.ypmed.2018.01.011

Nichols, C. R. & Cohen, A. K. (2020). Preventing maternal mortality in the United

States: lessons from California and policy recommendations. *Journal of Public Health Policy, 42*, 127-144. https://doi.org/10.1057/s41271-020-00264-9

Northrup, T. F., Klawans, M. F., Villarreal, Y.R., Abramovici, A., Suter, M. A., Mastrobattista, J. M., Moreno, C. A., Aagard, K. M., & Stotts, A. L. (2017). Family physicians' perceived prevalence, safety, and screening for cigarettes, marijuana, and electronic-nicotine delivery systems (ENDS) use during pregnancy. *Journal of the American Board of Family Medicine, 30*, 743-757. https://doi.org/10.3122/jabfm.2017.06.170183

Obisesan, O. H., Osei, A. D., Uddin, I., Dzaye, O., Cainzos-Achirica, M., Mirbolouk, M., Orimoloye, O., Sharma, G., Al Rifai, M., Stokes, A., Bhatnagar, A., El Shahawy, O., Benjamin, E., DeFelippis, A., & Blaha, M. (2020). E-cigarette use patterns and high-risk behaviors in pregnancy: Behavioral Risk Factor Surveillance System, 2016-2018. *American Journal of Preventive Medicine, 59*(2), 187-195. https://doi.org/10.1016/j.amepre.2020.02.015

Office of Disease Prevention and Health Promotion. Healthy People 2020. (2020). *Maternal, Infant, and Child Health*. https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health

Office of Disease Prevention and Health Promotion. Healthy People 2030. (2020). *Social determinants of health*. https://health.gov/healthypeople/objectives-and-data/social-determinants-health

Office of Disease Prevention and Health Promotion. Healthy People 2030. (2020). *Increase successful quit attempts in pregnant women who smoke- TU-15*.

https://health.gov/healthypeople/objectives-and-data/browse-objectives/tobacco-use/increase-successful-quit-attempts-pregnant-women-who-smoke-tu-15

Owusu, D., Weaver, S. R., Yang, B., Ashley, D. L., & Popova, L. (2019). Trends in trust in the sources of health information on e-cigarettes among US adults, 2015-2017. *American Journal of Public Health, 109*(1), 145-147. https://doi.org/102.2105/ajph.2018.304754

Opondo C, Harrison S, Alderdice F, Carson C, & Quigley M A (2021) Electronic cigarette use (vaping) and patterns of tobacco cigarette smoking in pregnancy–evidence from a population-based maternity survey in England. *PLOS ONE, 16*(6): e0252817. https://doi.org/10.1371/journal.pone.0252817

Peters, I. A., Heetkamp, K. M., Ursem, N. T. C., Steegers, E. A. P., Denkatas, S., & Knapen, M. (2018). Ethnicity and language proficiency differences in the provision of and intention to use prenatal screening for Down's Syndrome and congenital anomalies. A prospective, non-selected, register-based study in the Netherlands. *Maternal Child Health Journal, 22*, 343-354. https://doi.org/10/1007/s10995-017-2364-2

Regan, A. K., Bombard, J. M., O'Hegarty, M. M., Smith, R. A., & Tong, V. T. (2021). Adverse Birth Outcomes Associated with Prepregnancy and Prenatal Electronic Cigarette Use. *Obstetrics and Gynecology, 138*(1), 85–94. https://doi.org/10.1097/AOG.0000000000004432

Reifsnider, E., Gallagher, M., & Forgione, B. (2005*).* Using ecological models in research on health disparities. *Journal of Professional Nursing, 21*(4), 216-222.

https://doi.org/10.1016/j.profnurs.2005.05.006

Ren, Z., Yao, Y., & Ma, J. (2022). Association of E-cigarette Use during Pregnancy with Adverse Birth Outcomes: A Meta-Analysis. *Proceedings of the 4th International Conference on Statistics: Theory and Applications*. Paper No. 147 https://doi.org/10.11159/icsta22.147

Robbins, C., Boulet, S. L., Morgan, I., D'Angelo, D. V., Zapata, L. B., Morrow, B., Sharma, A., & Kroelinger, C. D. (2018). Disparities in preconception health indicators- Behavioral Risk Factor Surveillance System, 2013-2015 and Pregnancy Risk Assessment Monitoring System, 2013-2014. *MMWR Surveillance Summary, 67*(No. SS-01), 1-16. https://doi.org/10.15585/mmwr.ss6701a1

Robbins, C., & Martocci, S. (2020). Timing of prenatal care initiation in the health resources and services administration health center program in 2017. *Annals of Internal Medicine, 173*(Suppl 11), s29-s36. https://doi.org/10.7326/m19-3248

Rollins, L. G., Sokol, N. A., McCallum, M., England, L., Matteson, K., Werner, E., & Stroud, L. R. (2020). Electronic cigarette use during preconception and/or pregnancy: Prevalence, characteristics, and concurrent mental health conditions. *Journal of Women's Health, 29*(6), 780-788. https://doi.org/10.1089/jwh.2019.8089

Romano, M., Cacciatore, A., Giordano, R., & La Rosa, B. (2010). Postpartum period: three distinct but continuous phases. *Journal of Prenatal Medicine, 4*(2), 22-25. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3279173/

Schilling, L., Schneider, S., Karlheim, C., Maul, H., Tallarek, M., & Spallek, J. (2019).

Perceived threats, benefits, and barriers of e-cigarette use during pregnancy: a qualitative analysis of risk perception within existing threads in online discussion forums. Midwifery, 79, 2-7. https://doi.org/10.1016/j.midw.2019.102533

Schilling, L., Spallek, J., Maul, H., & Schneider, S. (2021). Study on E-Cigarettes and Pregnancy (STEP)—Results of a Mixed Methods Study on Risk Perception of E-Cigarette Use During Pregnancy. *Geburtshilfe Und Frauenheilkunde*, *81*(2), 214–223. https://doi.org/10.1055/a-1308-2376

Shulman, H. B., D'Angelo, D. V., Harrison, L., Smith, R. A., & Warner, L. (2018). The Pregnancy Risk Assessment Monitoring Systems (PRAMS): Overview of design and methodology. *The American Journal of Public Health, 108*(10), 1305-1313. https://doi.org/10.2105/AJPH.2018.304563

Setia, M. S. (2016). Methodology series module 3: Cross sectional studies. *Indian Journal of Dermatology, 61*(3), 261-264. https://doi.org/10.4103/0019-5154.182410

Simplican, S. C., Leader, G., Kosciulek, J., & Leahy, M. (2015**).** Defining social inclusion of people with intellectual and developmental disabilities: An ecological model of social networks and community participation. *Research in Developmental Disabilities, 38*, 18-29. https://doi.org/10.1016/j.ridd.2014.10.008

Siu, A. L. (2015). Behavioral and pharmacotherapy interventions for tobacco smoking cessation in adults, including pregnant women: U.S. Preventive Services Task Force recommendation statement. *Annals of Internal Medicine, 163*(8), 622-634. https://doi.org/10/7326/M15-2023

Spears, C. A., Jones, D. M., Weaver, S. R., Huang, J., Yang, B., Pechacek, T. F., & Eriksen, M. P. (2019). Sociodemographic Correlates of Electronic Nicotine Delivery Systems (ENDS) Use in the United States, 2016–2017. *American Journal of Public Health, 109*(9), 1224–1232. https://doi.org/10.2105/AJPH.2019.305158

Statista. (2020). *Number of refugees arriving in the United States in 2019, by gender*. https://www.statista.com/statistics/247062/number-of-refugees arriving-in-the-us-by-gender/

Statistic Solutions. (2022). *Assumptions of Logistic Regression*. https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/assumptions-of-logistic-regression/

Stephenson, J., Heslehurst, N., Hall, J., Schoenaker, D., Hutchinson, J., Cade, J., Poston, L., Barrett., Crozier, S., Kumaran, K., Yanjik, C., Barker, M., Baird, J., & Mishra, G. (2018). Before the beginning: nutrition and lifestyle in the preconception period and its importance for future health. *Lancet, 391*(10132), 1830-1841. https://doi.org/10.1016/S0140-6736(18)30311-8

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10*(4), 282-298. https://doi.org/10.4278/0890-1171-10.4.282

Stroud, L. R., Papandonatos, G. D., Borba, K., Kehoe, T., & Scott-Sheldon, L. (2019). Flavored electronic cigarette use, preferences, and perceptions in pregnant mothers: A correspondence analysis approach. *Addictive Behavior, 91*, 21-29.

https://doi.org/10.1016/j.addbeh.2018.10.043

Taylor, Y. J., Liu, T. L., & Howell, E. A. (2020). Insurance Differences in Preventive Care Use and Adverse Birth Outcomes Among Pregnant Women in a Medicaid Nonexpansion State: A Retrospective Cohort Study. *Journal of Women's Health, 29*(1), 29–37. https://doi.org/10.1089/jwh.2019.7658

Timmermans, Y. E. G., van de Kant, K. D. G., Krumeich, J. S. M., Zimmermann, L. J. I., Dompeling, E., Kramer, B. W., Maassen, L. L. J., Spaanderman, M. A. E., & Vreugdenhil, A. C. E. (2020). Socio-ecological determinants of lifestyle behavior of women with overweight or obesity before, during and after pregnancy: qualitative interview analysis in the Netherlands. *BMC Pregnancy and Childbirth, 105*, 1-11. https://doi.org/10.1186/s12884-020-2786-5

Toward Data Science. (2022). *Assumptions of Logistic Regression clearly explained*. https://towardsdatascience.com/assumptions-of-logistic-regression-clearly-explained-44d85a22b290

UCLA. (2016) Introduction to SAS. *UCLA: Statistical Consulting Group*. https://stats.idre.ucla.edu/other/mult-pkg/faq/general/faq-how-do-i-cite-web-pages-and-programs-from-the-ucla-statistical-consulting-group/

United Nations Children's Fund (UNICEF). (2018). *UNICEF 2017 Report on communication for development (C4D): Global progress and country level highlights across programme areas.* https://www.unicef.org/media/47781/file/UNICEF_2017_Report_on_Communication_for_Development_C4D.pdf

United States Census Bureau. (2021). *Language Other Than English Spoken at Home in United States*. https://www.census.gov/content/census/en/search-results.html?stateGeo=none&q=language%20spoken&searchtype=web

United States Food and Drug Administration. (2020). *Vaporizers, e-cigarettes and other electronic nicotine delivery systems (ENDS)*. https://www.fda.gov/tobacco-products/products-ingredients-components/vaporizers-e-cigarettes-and-other-electronic-nicotine-delivery-systems-ends

United States Food and Drug Administration (n.d.). FDA and NIH Study: *Population Assessment of Tobacco and Health*. https://www.fda.gov/tobacco-products/research/fda-and-nih-study-population-assessment-tobacco-and-health

United States Department of Health and Human Services. (2021). *Prenatal care.* https://www.womenshealth.gov/a-z-topics/prenatal-care

Wada, P., Lam, C. N., Burner, E., Terp, S., Menchine, M., & Arora, S. (2017). Exposure to and use of electronic cigarettes: does language matter? *Ethnicity and Disease, 27*(3), 217-221. https://doi.org/10.18865/ed.27.3.217

Wagner, N. J., Camerota, M., & Propper, C. (2017). Prevalence and perceptions of electronic cigarette use during pregnancy. *Maternal Child Health Journal, 21*, 1655-1661. https://doi.org/10.1007/s1-005-016-2257-9

Wang, Y., Laestadius, L., Stimpson, J. P., & Wilson, F. A. (2019). Association between e-cigarette use and acculturation among adult immigrants in the United States. *Substance Abuse: Research and Treatment, 13*, 1-7. https://doi.org/10.1177/1178221819855086

Wang, Y., Wilson, F. A., Larson, J., & Chen, L. (2016). The use of e-cigarettes among U.S immigrants: the 2014 National Health Interview Survey. *Public Health Reports, 131*, 605-613. https://doi.org/10.1177/00333549166662220

Wang, X., Lee, N. L., & Burstyn, I. (2020). Smoking and use of electronic cigarettes (vaping) in relation to preterm birth and small-for-gestational-age in a 2016 U.S. national sample. *Preventive Medicine, 134*, 3-8. https://doi.org/10.1016/j.ypmed.2020.106041

Whittington, J., Simmons, P., Phillips, A., Gammill, S., Cen, R., Magann, E., & Cardenas, V. (2018). The use of electronic cigarettes in pregnancy: A review of the literature. *Obstetrics and Gynecology Survey, 73*(9), 544-549. https://doi.org/10.1097/OGX.0000000000000595

Wigginton, B., Gartner, C., & Rowlands, I. (2017). Is it safe to vape? Analyzing online forums discussing E-cigarette use during pregnancy. *Women's Health Issue's, 27*(1), 93-99. https://doi.org/10.1016/j.whi.2016.09.008

Williams, O., & Swierad, E. M. (2019). A multisensory multilevel health education model for diverse communities. *International Journal of Environmental Research and Public Health, 16*(5), 872-889. https://doi.org/10.3390/ijerph16050872

Wolfson, C., Gemmill, A., & Strobino, D. M. (2022). Advanced Maternal Age and Its Association with Cardiovascular Disease in Later Life. *Women's Health Issues*, *32*(3), 219–225. https://doi.org/10.1016/j.whi.2021.12.007

Woolf, S. H., & Aron, L. (Ed.s). (2013). *U.S. Health in International Perspective: Shorter Lives, Poorer Health.* National Academies Press.

https://www.ncbi.nlm.nih.gov/books/NBK154478/

World Atlas. (2020). *How many languages are spoken in the New York area.* https://www.worldatlas.com/articles/how-many-languages-are-spoken-in-nyc.html#:~:text=Language%20in%20the%20Big%20Apple,of%20more%20than%20800%20languages.

World Health Organization. (1947). *Constitution*. https://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf

World Health Organization. (2020). *The ecological framework.* https://www.who.int/violenceprevention/approach/ecology/en/

Yang, B., Owusu, D., & Popova, L. (2020). Effects of a nicotine fact sheet on perceived risk of nicotine and e-cigarettes and intentions to seek information about and use e-cigarettes. *International Journal of Environmental Research and Public Health, 17*(131), 1-11. https://doi.org/10.3390/ijerph17010131

Yingst, J. M., Veldheer, S., Hammett, E., Hrabovsky, S., & Foulds, J. (2017). A method for classifying user-reported electronic cigarette liquid flavors. *Nicotine & Tobacco Research, 19*(11),1381-1385. https://doi.org/10.1093/ntr/ntw383

Yong, H. H., Borland, R., Balmford, J., McNeill, A., Hitchman, S., Driezen, P. Thompson, M. E., Fong, G. T., & Cummings, M. (2015). Trends in E-cigarette awareness, trial, and use under the different regulatory environments of Australia and the United Kingdom. *Nicotine and Tobacco Research, 17*(10), 1203-1211. https://doi.org/10.1093/ntr/ntu231