# The Unintended Consequences of Biomedical Advances: Socioeconomic Gradients in Health Behaviors Among Pregnant Women

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**ABSTRACT**

Scholars in the social sciences and public health have long observed that people with more money, knowledge, power, and prestige live longer and healthier lives. These socially advantaged people are better able to avoid newly identified health risks when biomedical information emerges, and they consistently make decisions that lead to longer and healthier lives. Over time this process results in a socioeconomic gradient in health—the unintended consequences of biomedical advances. In part, this explains why inequalities in health persist, but research has not examined the process by which these inequalities are reproduced. I combine an emerging approach that focuses on the importance of new health information and disease preventability with the bedrock of literature that describes the influence of social relationships on medical decision-making. To examine the influence of new health information and social relationships, I focus on an empirical example: women who are pregnant for the first time and must navigate a plethora of new health information. Based on preliminary data, I find an educational gradient in health knowledge levels, as well as the influence of social relationships on prenatal health behaviors. This example not only advances our knowledge about the processes that contribute to inequalities in health, it also provides insight into decisions about behaviors that lead to unequal health among women and infants.

## INTRODUCTION

Examining inequalities is a classic sociological aim and, recently, scholars in medical sociology and public health have turned their attention to the processes that reproduce inequalities in health (Link and Phelan 1995; Lutfey and Freese 2005; Glied and Lleras-Muney 2008; Chang and Lauderdale 2009). These scholars contend that broader social and economic inequalities contribute to unequal rates of disease and mortality: people with more money, power, prestige and knowledge live longer and healthier lives (Link and Phelan 1995). These inequalities persist, in part, because people in more socially advantageous positions are better able to avoid newly identified health risks when medical research advances (Link et al. 1998). At the crux of this idea is the notion that over time, as health knowledge emerges and people learn *new* health information, those in more favorable social positions will continuously adopt advantageous health behaviors (Link et al. 1998; Glied and Lleras-Muney 2008; Chang and Lauderdale 2009). Over time this results in socioeconomic gradients in health—*the unintended consequences of biomedical advances*. Although this explains why social inequalities in health are reproduced, much less is known about the process by which these inequalities are generated.

One possibility is that social relationships play an integral role, providing individuals with new health information and influencing their decision-making about various health behaviors. This conjecture builds upon a bedrock of sociological and public health research, which emphasizes the importance of social ties for both health (Durkheim [1897] 1979; Syme and Berkman 1976; House, Landis and Umberson 1988) and medical decision-making (Pescosolido 1992), as well as more recent research, which indicates that individuals' social contacts influence their health behaviors (Marsden and Friedkin 1994; Meara 2001; Kohler,

Behrman and Watkins 2001; Behrman, Kohler and Watkins 2002; Christakis and Fowler 2007; 2008).

The idea that social relationships influence health behaviors, and the reproduction of health inequalities, is hardly new. The contribution of my research is that I combine this literature with an emerging approach in medical sociology and demography (Chang and Lauderdale 2009; Glied and Lleras-Muney 2008) that focuses on the importance of new health information in reproducing health inequalities, and I delineate specific mechanisms by which social ties influence health behaviors. To evaluate this explanation, I focus on women who are pregnant for the first time—an ideal empirical example because (1) they must navigate a plethora of new health information, newly acquired pregnancy information and emerging biomedical pregnancy information; and (2) their behaviors have a direct and measureable effect on birth outcomes and infant health. Understanding this example will not only advance our knowledge about the processes that contribute to inequalities in health, it will provide insight into decisions about health behaviors that lead to unequal health among women and infants.

The purpose of this paper is to build a conceptual model that explains how education, health knowledge, and social networks interact to affect health behaviors in such a way that reproduces social inequalities in health. Although I do not seek to test this model in a definitive way, I do take steps to explore its main implications using a specific empirical example. Using data gathered through surveys and in-depth, semi-structured interviews I examine the influence of socioeconomic status and social network processes on health behaviors. In the sections that follow I (1) describe the emerging literature that focuses on the evolution of health inequalities; (2) delineate the role that social relationships may play in reproducing health inequalities; (3)

explain my empirical example; and (4) interpret my results within the context of my conceptual model.

## BACKGROUND

### The Fundamental Cause Theory: Why Are Social Inequalities in Health Reproduced?

For over a century, scholars in public health, medicine, sociology, and elsewhere have observed social inequalities in health (Villerme 1840; Virchow 1848; Chapin 1924; Coombs 1941; Antonovsky 1967; Kitagawa and Hauser 1973; Robert and House 2003). Recent research suggests that these inequalities have remained remarkably persistent over the past century, at least in the United States (Warren and Hernandez 2007). Research that uses a variety of socioeconomic measures—including education, income, and social class—demonstrates an inverse relationship between socioeconomic status and health (Pamuk 1985; Duleep 1989; Preston and Elo 1995; Duncan 1996; Crimmins and Saito 2001; Lauderdale 2001; Lynch 2003). The persistent inverse relationship has reinvigorated debates about why there is a socioeconomic gradient in health (Mosley and Chen 1984; Brunner 1993; House et al. 1990; House et al. 1994; Link and Phelan 1995; Phelan et al. 2004), and an emerging literature is beginning to focus on the process by which social inequalities in health are reproduced (Link et al. 1998; Berkman et al. 2000; Lutfey and Freese 2005; Glied and Lleras-Muney 2008; Chang and Lauderdale 2009).

Among theories that have sought to explain persistent inequalities in health, one of the most widely cited is the fundamental cause theory, which posits that persistent health inequalities are a result of unequal access to social resources, such as money, knowledge, power, and prestige (Link and Phelan 1995). The theory harkens back to Durkheim's (1897) early proposition that social conditions have important implications for individuals' health and well-being. Individuals

with better social relationships, higher social status, and more power are consistently able to avoid health hazards, and are therefore able to live longer and healthier lives. These social conditions represent a fundamental cause of health inequalities because they correspond to access to resources that affect a broad range of health outcomes.

The fundamental cause theory requires three conditions: (1) disease preventability, (2) socioeconomic inequality, and (3) change in diseases and risks over time. Health inequality literature is replete with evidence of the association between disease preventability and SES differentials in mortality. As biomedical knowledge advanced the ability to treat and prevent chronic diseases those with a higher SES were better situated to avoid health risks and delay mortality (House et al.1990; 1994). For instance, there is a larger gradient for cancers that have a higher survival rate, compared to cancers that are not preventable (Kogevinas and Porta 1997).

Social inequality is the second necessary condition for the fundamental cause theory. Conditional upon disease preventability, social inequalities perpetuate health inequalities. Socially advantaged individuals possess the power and means to act upon medical knowledge about health hazards. This power, prestige, knowledge, and money has been referred to as human and nonhuman capital (Fuchs 1986; Grossman 1975), which "accrue[s] to members of higher SES strata [and] may repeatedly enable them to avoid health hazards more readily or to mobilize health-protective factors" (House et al. 1990:406). Thus, conditional upon disease preventability, socially advantaged individuals, will be able to avoid deleterious health effects.

The third requirement combines the first two and states that people in advantageous positions will "avoid risks and adopt protective strategies that enhance health and well-being no matter what the risk and protective factors happen to be at a given point in time " (Link and Phelan 2000:39). The favorable social conditions that accrue to those in higher social positions

have a ripple effect across a broad range of health outcomes, regardless of the type of disease. Link, Phelan and their colleagues (1995; 2000; 2002; Link et al. 1998, Phelan et al. 2004) further substantiate this claim by using the change in diseases and risk factors in the U.S. over the past century as an example. In spite of the epidemiologic transition from infectious to chronic diseases in developed nations, the inverse relationship between socioeconomic status and health has remained constant—or declined only modestly—in the United States over the past century (Warren and Hernandez 2007). People with higher SES had better morbidity and mortality rates prior to the epidemiologic transition and they continue to have better rates afterward. The overwhelming evidence indicates that when these three conditions are met, health inequalities not only emerge, they are repeatedly observed (Villerme 1840; Virchow 1848; Chapin 1924; Coombs 1941; Antonovsky 1967; Kitagawa and Hauser 1973; Pamuk 1985; Duleep 1989; Preston and Elo 1995; Duncan 1996; Lauderdale 2001; Robert and House 2003; Lynch 2003).

**How Are Social Inequalities in Health Reproduced?**

The fundamental cause theory provides three conditions, which, upon being fulfilled, result in a persistent inverse association between socioeconomic status and health. In this paper, I build on an emerging literature (Link et al. 1998; Glied and Lleras-Muney 2008; Chang and Lauderdale 2009) that attempts to understand *how* social inequalities in health are reproduced. More specifically, I suggest that social relationships play a role by providing new health information and influencing health behaviors. I explore this possibility by focusing on the role of emerging biomedical knowledge.

At the crux of the fundamental cause theory is the notion that over time, *as health knowledge emerges and biomedical technology advances*, "those who command the most resources are best able to avoid the risks and take advantage of the protective factors, [which

results] in the emergence of an SES gradient in these factors" (Link et al. 1998:377). Although the theory descrsibes the role of health knowledge in reproducing inequalities, it does not describe the process in detail.

Familiar examples lend credence to the assumption that new health knowledge influences behavior changes. In the decades after the 1964 Surgeon General's report about the hazards of smoking, for instance, individuals with more education were more likely to quit and less likely to begin smoking (Kenkel 1991). Even after accounting for individual health knowledge, people with more education were still less likely to smoke than those with lower levels of education (Kenkel 1991), a result that is mirrored in later research on educational differences in maternal knowledge about smoking and actual behaviors during pregnancy (Meara 2001).

Lacking individual measures of health knowledge, another approach considers the emergence of social inequalities in health following exogenous shocks of health information, biomedical technology or abrupt changes in social norms. Indeed, with advances in cancer screening and treatment (Link et al. 1998; Glied and Lleras-Muney 2008), improvements in pharmaceutical drugs (Lichtenberg and Lleras-Muney 2005; Chang and Lauderdale 2009; Price and Simon 2009), technological innovation in infant care (Gortmaker and Wise 1997), and changes in the social stigma associated with cocaine use (Miech 2008), social inequalities in health behaviors and outcomes emerged. These findings indicate that individuals with higher socioeconomic status are more likely to adopt behaviors to avoid health hazards when new health information emerges.

Though promising, accounting for individual health knowledge does not explain the relationship between SES and health behaviors in its entirety (Kenkel 1991; Meara 2001). I contend that, in addition to health knowledge, social networks mediate the relationship between

socioeconomic status and health behaviors, and that they confound the relationship between health knowledge and health behaviors. In recent analysis, Cutler and Lleras-Muney (2010) found that knowledge about a health behavior and overall cognitive ability account for about thirty percent of the association between education and health behaviors. Aside from these factors, they found that social integration accounts for an additional ten percent of the association. Most pertinent for this research, social relationships provide social support, pressure behavior through relationships, and influence medical decision-making (Durkheim [1897] 1979; Syme and Berkman 1976; House, Landis and Umberson 1988, Pescosolido 1992, Marsden and Friedkin 1994; Meara 2001; Behrman, Kohler and Watkins 2002; Christakis and Fowler 2007; 2008).

**Hypotheses: Health Knowledge & Social Networks Influence Health Behaviors**

In order to understand how education, health knowledge and social networks interact to affect health behaviors in such a way that reproduces health inequalities, I put forth the following five hypotheses, and provide an ideal empirical example: women who are pregnant for the first time. These women provide a distinct opportunity to observe how *new* health information—newly acquired pregnancy information and emerging biomedical pregnancy information—influences health behaviors; the majority of women begin their pregnancy with low levels of knowledge about healthy pregnancy behaviors and they are presented with a plethora of new information about their pregnancy. A portion of women, in particular, those with higher levels of SES (Korenbrot, Steinberg, Bender and Newberry 2002), seek information about preconception health prior to becoming pregnant. I include women with both planned and unplanned pregnancies in order to capture a range of health knowledge levels. In Figure 1, I present a conceptual model of the way these factors interact—based, in part, on the conceptual model put

forth by Berkman et al. (2000)—which I use to delineate mechanisms that influence health behaviors. For this paper I show SES as education, but I include other measures of SES.

Hypothesis 1: *Women with higher levels of education will be more likely to engage in behaviors that will promote a healthy pregnancy (Education → Behavior in Figure 1).*

Hypothesis 2*: Women with higher levels of education will be more likely to translate new health information into healthy pregnancy behaviors (Education → Knowledge → Behavior in Figure 1).*

Hypothesis 3: *Women's social contacts serve as sources of new health information about pregnancy (Social Networks → Knowledge in Figure 1).*

Hypothesis 4: *Health information women receive from their social contacts affects their health behaviors during pregnancy through social learning (Social Network s → Knowledge → Behavior in Figure 1).*

Hypothesis 5: *Behaviors and opinions among members of a woman's social network will influence her health behaviors during pregnancy directly through social influence (Social Networks → Behavior in Figure 1).*

Hypothesis 5: *Social learning and social influence processes mediate the educational gradient in behaviors (Education → Social Networks → Behavior in Figure 1).*

[Figure 1 about here.]

My first two hypotheses replicate previous work from the health inequality literature and the final three examine the role of social networks. I first hypothesize that socioeconomic status (e.g., education) is associated with healthy behaviors during pregnancy. I then build on previous literature (Kenkel 1991; Meara 2001; Glied and Lleras-Muney 2008; Chang and Lauderdale 2009; Cutler and Lleras-Muney 2010) and hypothesize that health knowledge accounts for some of the association between SES and health behaviors.

My third hypothesis posits that women will learn about pregnancy behaviors from their social contacts. Demographic models of diffusion—comprised of social learning and social influence—inform my conceptual model (Montgomery and Casterline 1996; Kohler, Behrman and Watkins 2001; Behrman, Kohler and Watkins 2002). Social learning occurs when an actor provides an individual with information that influences their subjective beliefs about a behavior

(Montgomery and Casterline 1996; Kohler, Behrman and Watkins 2001). For instance, a woman's highly educated sister might inform her that consuming omega-3 fatty acids will help with brain development of the fetus, which influences the woman to consume a fish oil supplement. Social influence arises when social contacts exert normative influences on behavior (Montgomery and Casterline 1996; Kohler, Behrman and Watkins 2001).

My final three hypothesis anticipate that social network processes of social learning and social influence will affect women's behavior. In my fourth hypothesis, I anticipate that women learn health information from their social contacts, which influences their health behaviors. Even so, I expect that women may imitate behaviors, or be influenced by opinions, even though they know nothing about the benefits of the behavior. Therefore, I also posit that women's behaviors are influenced by beliefs and opinions of those in their social network. Finally, in my sixth hypothesis, I predict that these social network processes will mediate the educational gradient in health behaviors.

## METHODS

### Research Design

My empirical example combines a quantitative component (Part A) and two qualitative components (Parts B and C), as shown in Figure 2. For Part A, I sequentially enrolled women from four health clinics in the Minneapolis/St. Paul area over the course of thirteen months (November 2009-November 2010). These clinics were chosen because they serve women from a diversity of socioeconomic backgrounds in the metropolitan area. To ensure confidentiality, I refer to these clinics as the Red, Orange, Yellow and Green Clinics. Women who are over the age of 18, pregnant for the first time (prima gravida), under 27 weeks pregnant, and who speak English are included—women still qualify for the study if they have had an elected or

spontaneous abortion (essential prima gravida). Women with planned and unplanned pregnancies are included to capture a range of health knowledge levels and health behaviors.

[Figure 2 about here.]

For Part A, women are asked to complete a 20-minute survey interview, the Health Information and Behaviors During Pregnancy Study (HIBPS) questionnaire. Three obstetricians and obstetrics residents reviewed the questionnaire prior to collecting data, and it was pre-tested on 30 women from the clinics. Each month the enrollment ranged from 10 to 32 women, yielding a final sample size of 225. The preferred mode of administration for the questionnaire was in-person, but participants were also given the option to complete it over the phone, which ensures the most reliable social network data and highest response rate.[1] All surveys were conducted by me or by a trained survey interviewer and respondents were given a $5 gift card. Approximately 60.9% of eligible prima gravida or essential prima gravida women who have been seen in the four clinics agreed to participate in the 20-minute survey interview, either in the clinic following their appointment or by phone at a later time.

The HIBPS questionnaire has five main aims: (1) it assesses women's socioeconomic background; (2) it tests their health knowledge; (2) it inquires about social contacts with whom they discussed their pregnancy; (3) it asks about their social contacts' socioeconomic status, attitudes, and behaviors related to health during pregnancy; and (4) it asks about their health behaviors.[2] The HIBPS questionnaire borrows questions from the Behavioral Risk Factor Surveillance System (CDC 2009), the Pregnancy Risk Assessment Monitoring System (PRAMS; Gilbert, Shulman, Fischer and Rogers 1999), the National Health Interview Survey (National Center for Health Statistics 2009), and the Kenya Diffusion and Ideational Change Project

[1] All survey interviews were recorded on paper and digital voice recorder to ensure accuracy. Among women who agree to participate 85% complete the survey in-person and 15% complete the survey by phone at a later time.
[2] The HIBPS questionnaire is available upon request.

female questionnaire (KDICP; Kohler, Behrman, and Watkins 2001). By using questions from nationally representative studies, which inquire about pregnancy status, I am able to situate my survey results within a state and national context.

For Part B, I stratified the monthly samples by education-level and randomly selected a subset of two women from each strata—six women total—each month to participate in in-depth semi-structured interviews during the end of their beginning of their third trimester. In all, I conducted in-depth interviews with forty women.[3] Women who participated in these interviews were given a $20 gift card. The final component, Part C, is comprised of in-depth interviews with health care providers, including the physicians, midwives, and nurses that provide care at the four clinics. These interviews allow me to portray a more complete illustration of the ways that these providers offer health information or influence women's behaviors during pregnancy.

**Measures**

*HIBPS Survey Interviews*

Socioeconomic Status. The health inequality literature represents a diverse spectrum of disciplines, with a variety of approaches to measuring socioeconomic status or position (Robert 1999; Braveman, Cubbin, Marchi, Egerter and Chavez 2001; Lynch, Kaplan 2000; Galobardes, Lynch and Davey Smith 2007). My research focuses on education as an indicator of socioeconomic status for theoretical and methodological reasons. A goal of my research is to understand how people react to new health information. Aside from the additional human capital bestowed upon those with more years of schooling, education helps people develop cognitive skills, it "develops the habits and skills of communication: reading, writing, inquiring,

[3] I also conducted in-depth interviews with a subset of women who participated in a group prenatal class but did not participate in the in-depth interviews.

discussing, looking things up, and figuring things out..." and through the process of learning it "builds the confidence and self-assurance needed to attempt to solve problems" (Mirowsky and Ross 2003: 26-7). Therefore, an individual's years of schooling are likely to enhance their ability to decipher, understand and react to novel health information to better their health (Rosenzweig 1995). From a methodological standpoint, educational attainment is an ideal measure of socioeconomic status for a number of reasons (Elo and Preston 1996; Hummer and Lariscy 2011): 1) in most instances, schooling ends in the beginning of adulthood and does not change; 2) it is a stable measure of socioeconomic status regardless of employment status; and, 3) it precedes, and often directly impacts, other measures of socioeconomic status such as income and occupation, thus reducing the impacts of endogeneity.

For these reasons, I focus on education as my measure of socioeconomic status. My measure of education level is based on a question from the 2009 National Health Interview Survey (NHIS), and is very similar to the 2009 Behavioral Risk Factor Surveillance System (BRFSS) question. I also inquire about the education-level of their significant other (if they are in a relationship) as well as all of the social contacts that women list in their social network using a simplified version of the original NHIS question. For my analysis, I coded education as three dummy measures: less than a bachelor's degree (i.e., less than a high school degree, high school degree, associate's degree or some college), Bachelor's degree, and graduate degree (master's degree, professional degree or doctoral degree). To account for variation in education-levels among those in their social network, I include a measure that represents the proportion of their social contacts who have completed a bachelor's degree.

Health Knowledge and Health Behaviors. Based on recommendations from the American College of Obstetricians and Gynecologists (ACOG), the U.S. Preventive Services Task Force

(USPSTF) as well as obstetricians at the clinics, the HIBPS questionnaire includes measures of a variety of behaviors, in this paper I focus on three behaviors: H1N1 influenza vaccinations, vitamin D supplement consumption and omega-3 fatty acid consumption.[4] Importantly, as preventability is a key component of the fundamental cause theory—SES gradients in health outcomes emerge when diseases are preventable—each of these represent behaviors where women have some agency in deciding how to behave.

The Centers for Disease Control and Prevention, the American Medical Association and American Congress of Obstetricians and Gynecologists all uniformly recommended that pregnant women receive both the seasonal and the H1N1 influenza vaccine during the 2009-2010 and the 2010-2011 flu seasons (ACOG 2010). Recommendations to consume vitamin D and omega-3 fatty acids have been slower to emerge. Aside from aiding bone development, recent evidence and emerging literature indicates that vitamin D reduces the odds of pre-term birth, preeclampsia and gestational diabetes, and omega-3 fatty acids help with brain development of the fetus (Ruxton, Reed, Simpson, and Millington 2004; Hollis and Wagner 2006; van der Meer, Nasra, Boeke, Lips, Middlekoop, Verhoeven and Wuister 2006; Hollick 2007). I coded each of these three behaviors as a dichotomous measure, which represents the behavior (supplement consumption or H1N1 vaccination; coded 1) or lack of the behavior (coded 0).

To inquire about vaccinations I use a question from the 2009 NHIS which asks: "During the past 12 months, have you had a flu shot?" I include a second question about the H1N1

[4] The questionnaire includes the following behaviors: (1) preconception preparations (i.e., pre-pregnancy health care appointment); (2) substance use (i.e., alcohol and smoking); (3) diet (i.e., fruit and vegetable consumption); (4) exercise (i.e., light and moderate); (5) immunizations (i.e., seasonal influenza and the H1N1 vaccine), and (6) supplementary vitamin intake (i.e., folic acid, vitamin D and omega-3 fatty acid). These behaviors are associated with a lower risk of infections during pregnancy, low birth weight, miscarriages, fetal alcohol syndrome, neural tube defects, gestational diabetes and macrosomia (very large infants) (Zhang, Solomon, Manson and Hu 2006; Hollander, Paarlberg and Huisjes 2007; Wolff, Witcop, Miller, and Syed 2009).

influenza vaccine: "Have you had the H1N1 or "swine" flu shot? This shot protects against the H1N1 or "swine" flu." I adapt a question about prenatal vitamin consumption from PRAMS to measure vitamin D consumption: "During the past month, have you taken a vitamin D supplement? Do not count your prenatal vitamin." Similarly, I adapt this question to measure omega-3 fatty acid consumption: "During the past month, have you taken any fish oil or flaxseed supplements?" To measure health knowledge of the benefits of omega-3 fatty acid, I adapt a survey question from PRAMS, which was originally intended to assess women's knowledge about the benefits of folic acid: "Some health experts recommend consuming omega-3 fatty acids during pregnancy for which of the following reasons?" Response options include the following: to help with brain development (correct); to help prevent a premature delivery; and, to help women sleep well. Women were asked whether each response option was correct and I used their responses to create an index ranging from 0 (low) to 3 (high). To measure vitamin D knowledge I include a similar question with an open-ended response option because of the wider range of health benefits of vitamin D consumption during pregnancy. If women provided an answer that correctly identified one benefit of vitamin D supplements based on a recent review of the literature (Hollick 2007) (i.e., bone development or calcium absorption (n=44), immunity (n=2), cancer prevention (n=2), or a deficiency due to lack of sunshine (n=20)), I coded their knowledge level as 1 out of 0.

My final three hypotheses posit that women's social contacts play an important role, and I use a modified social network name generator (Marsden 1990). Women are first asked to list everyone they talk to about their pregnancy, whether they are female, if they have had a baby in the past ten years or are currently pregnant—to identify pregnant peers—and how long they have known the person. For every social contact listed, they are asked how they are affiliated (e.g.,

friend or family member), the distance of the tie (stranger, acquaintance, friend, close friend), the frequency of contact (a little, some, a lot) and their education level.

Women are then asked whether they discussed H1N1 influenza vaccination with each of the social contacts that they listed.[5] For each of these behaviors I ask whether they discussed the topic (i.e., social learning) and whether the social contact agrees or disagrees with the behavior (i.e., social influence). I then ask whether *each* of their friends and family received the H1N1 or the seasonal flu vaccine (i.e., social influence). The social learning and social influence questions are adapted from the female questionnaire administered as part of the Kenya Diffusion and Ideational Change Project (KDICP) (Kohler, Behrman and Watkins 2001). The KDICP is a project that aims to examine the role of social networks in changing various attitudes related to family planning in Kenya.

Using the social network data, I constructed a measure to reflect the percent of people with whom women discuss the H1N1 vaccine as well as the percent of people in their social network who had received the H1N1 vaccine. Finally, I used the question, "[d]oes ____ agree or disagree with receiving the H1N1 vaccine during pregnancy?" to construct a measure of the percent of social contacts who women perceive as having a favorable opinion about H1N1 vaccination during pregnancy. There is one important caveat: Often women reported that they did not know about their social contact's opinions or behaviors, however, during the 2009-2010 season women were more aware of their social contact's opinions. For this paper, I excluded this missing data to avoid biasing my sample estimates downward.

*In-Depth Semi-Structured Interviews*

[5] Women were also asked about three additional behaviors: prenatal vitamin consumption, caffeine consumption and alcohol consumption.

During the in-depth interviews, I reviewed women's responses to the survey interview to record any changes and asked them to elaborate on their answers in more detail. For example, why did they choose to receive the H1N1 influenza vaccine but *not* the seasonal influenza vaccine, both of which are recommended for pregnant women? I pay particular attention to the social network questions, adding any new social contacts and asking about their behaviors, beliefs and attitudes. Each in-depth interview has been transcribed a short time after being conducted and themes that emerge have been content-coded using Atlas.ti version 6.

**Analysis**

I begin by estimating the likelihood of each health behavior using logistic regression. First, I estimate the effect of schooling on supplement consumption, and then account for individual knowledge about the benefits of supplement consumption. To account for educational differences in supplement consumption, I include measures of the woman's education-level. During the in-depth interviews, it also became apparent that women were consulting their partners prior to consuming a supplement, so I also include a measure of the highest educational degree of the couple.[6] Next, I estimate the effect of schooling on H1N1 vaccination. Again, I consider the woman's education level, but I also account for the proportion of their pregnancy network with a college degree. Finally, I incorporate measures of social learning and social influence to understand how these affect the association between education and H1N1 vaccination. To understand these processes in more detail, I stratified my sample of in-depth semi-structured interviews by education level (less than a bachelor's degree, bachelor's degree, graduate degree) and analyzed women's medical decision-making processes about supplement intake and H1N1 vaccination.

[6] Sixteen women did not report that they had a partner and these participants are excluded from this analysis to compare the results across models.

## RESULTS

Three novel health topics comprise the outcomes of interest for this paper: omega-3 fatty acid consumption, vitamin D consumption and H1N1 vaccination. These health behaviors are somewhat novel to the staff at the Red, Orange, Yellow and Green Clinics. Moreover, the spread of information about these behaviors, as well as the health care providers' recommendations for pregnant women, differed.

Women often learn about omega-3 fatty acids supplements, available in the form of fish oil or plant-based supplements, during their initial intake visit at the clinic, outside of their prenatal visit, from pregnancy web sites, books and magazines. It is not a main topic discussed during their initial prenatal visit, but women are encouraged to consume omega-3 fatty acids because they benefit the brain development of their fetus as well as their own cardiovascular and neurological health. Recommending vitamin D supplement consumption is a new practice, primarily within the two clinics with the most study participants (Orange and Red): One of the Orange Clinic midwives learned about the benefits of vitamin D from a physician and friend in early 2009, and in the early winter of 2009 the clinic began testing all pregnant women's vitamin D levels during their initial visit. The practice soon diffused throughout the Red Clinic as well because many of the providers rotate through both clinics. Both clinics now aim to raise women's vitamin D levels above the standard levels (minimum 25-35 ng/ML), and have created a target range of 50-80 ng/ML. The nurses, midwives and obstetricians provide a consistent message about the importance of vitamin D consumption, and women are informed that living at a higher latitude (Minnesota) affords less opportunity for vitamin D absorption from the sun.

In contrast to supplement knowledge levels, all women who participated in the study were aware of the H1N1 influenza pandemic prior to their prenatal visit. The H1N1 virus

emerged in Mexico in the spring of 2010 and garnered significant media attention over the course of the year (MMWR 2009). Clinicians identified pregnant women to be particularly vulnerable to the H1N1 virus (MMWR 2010), and placed them on the priority list to receive the vaccine. When it became available in November 2009, the clinics reached out, by phone or mail, to their pregnant patients first. Pregnant women were strongly encouraged to receive the H1N1 influenza vaccine, and were assured that its safety level is equivalent to the annual influenza vaccine.

*Descriptive Statistics*

Approximately 32% of women consume an omega-3 fatty acid supplement, and approximately 41% consume a vitamin D supplement, as described in Table 1. H1N1 vaccination rates were higher, with 53% of women opting to be vaccinated. These differences are not surprising, given the strong recommendations for pregnant women and media coverage of the H1N1 influenza pandemic. About 42% of women chose all of the correct answers on the omega-3 fatty acid knowledge test, and the mean knowledge test score was 1.9 out of 3. Among a smaller sample of women, 50% correctly identified a health benefit of consuming vitamin D.[7]

[Table 1 about here.]

HIBPS participants are more highly educated than the average prima gravida or essential prima gravida woman: Among participating HIBPS women, 40% completed a master's, professional or doctoral degree, and only 22% did not complete college. Using a pooled sample of women from the 2005-2009 National Health Interview Surveys, I isolated a subset of women over the age of 18 who reported being pregnant and had no other children in their household, as a

[7] The vitamin D knowledge question was added to the survey at the start of month five, in March 2010, because it is such a novel health topic (n = 127).

proxy for prima gravida or essential prima gravida pregnancy status (n = 1,202). On average, 68% of NHIS participants had not completed college, and only 14% had completed a graduate or professional degree. The age distribution was more similar between the HIBPS and NHIS samples, though, with means of 29.98 and 28.50 years, respectively.

With regard to the social network measures, women reported discussing H1N1 vaccination with approximately 34% of their social contacts. If women knew their social contacts' vaccination status, they estimated that approximately 29% had been vaccinated to prevent H1N1 infection. If they knew their social contacts' opinions, on average women reported that 82% agreed with H1N1 vaccination during pregnancy.

*Supplement Intake*

Are women who have completed more schooling more likely to consume a supplement (hypothesis 1)? In Tables 2 and 3, I show the results of the logistic regression analysis. For omega-3 fatty acid, women with more schooling were more likely to consume a supplement: Women who completed a degree beyond college were two times as likely to take a fish oil or flaxseed supplement as those who did not complete college. The association between supplement intake and education was even stronger when considering the highest educational degree between the couple: If a woman or her partner completed a graduate degree the woman was more than five and a half times as likely to consume an omega-3 fatty acid supplement, compared to those without a college degree.

[Table 2 about here.]

Does individual knowledge about the benefits of the supplement account for the association between education and supplement intake (hypothesis 2)? Women's knowledge about the benefits of fish oil or flaxseed supplements was significantly associated with

supplement consumption. Accounting for women's knowledge attenuated the association between their own education-level and supplement intake, but it did not account for association between the highest educational degree between the couple and supplement intake. Women often attend their prenatal appointments with their partners, and, as I show below, their decision to consume a supplement is often a joint decision.[8] Moreover, supplement intake is a repeated behavior, and women mentioned that their partners often reminded them to consume the supplement.

I estimate identical models to understand the association between education, women's knowledge levels, and women's vitamin D consumption. One caveat, due to the fact that vitamin D consumption was so new to the clinics, I added the vitamin D knowledge question to the HIBPS questionnaire during at the beginning of month five, which resulted in a smaller overall sample for this analysis. Unlike the previous results, women's education-level was not associated with her consumption of a vitamin D supplement, nor was it was associated with the highest educational degree between the couple. Individual knowledge about the benefits of the vitamin D supplement was not associated with vitamin D supplement intake either.

[Table 3 about here.]

To further explore these relationships, I stratified my in-depth interviews by education level and selected quotes to represent women with varying levels of education.[9] In the first example, I show an excerpt from an in-depth interview with Danielle, who has completed 12$^{th}$ grade. She scored 0 out of 3 on the knowledge test, and she chose not to take the omega-3 fatty acid supplement because she was fearful that it would harm her baby.

[8] In all, 92.7% of women reported that they had a partner during the survey interview, which, most often, took place during their first trimester. In the entire sample, only ten women did not report their significant other's education-level, and these women were excluded from the analysis in Tables 2 and 3.
[9] All names have been changed to protect participants' identities.

EH: So, what do you know about [omega-3 fatty acid supplements]?
Danielle: Um…I just know that it helps the baby out. And it helps me. I have them at home; I don't really take them. I'm going to…I'm scared it's going to hurt the baby but like I know that…they told me that I should start taking them…but I just worry! (laughs) **I worry that the baby's going to get harmed or something by something that's in a pill.** Even though it's probably made for that exact reason, so…to take while you're pregnant.

For the second example, I selected an excerpt from an interview with Julie, a college graduate who reported taking omega-3 fatty acids and scored 1 out of 3 on the knowledge test. She clearly takes the supplement because they aid fetal development, and she educates her husband about their health benefit as well.

EH: And then how about omega-3 fatty acids? Fish oil, flax seed…
Julie: Yeah, I take the Expecta. I can actually look at it, it says DHA on it.
EH: Did you talk about [taking Expecta] with your husband again, or any of your other friends?
Julie**: I told him that they recommended that I take it and he said, "Why," and I said because it helps with brain and eye development and he said, "Okay." And off to Target we went!** (laughs)

Clearly, Julie understands the health benefits and it leads her to purchase and consume the supplement. This example also demonstrates that couples discuss prenatal behaviors together—Julie discussed the omega-3 fatty acid supplement with her husband prior to purchasing it.

Do women learn health information from their social contacts (social learning; hypothesis 4)? Even more, are they influenced by the information they learn from their social contacts (social influence; hypothesis 5)? Using the in-depth interview data, I was able to delve into the social processes of social learning and/or social influence that affect women's decisions to consume a supplement. For instance, Isabel, who has a Ph.D. in biology, mentions her mother when discussing the health benefits of consuming omega-3 fatty acids:

EH: Right, right. So what about omega-3 fatty acids? Have you ever heard of those? Can you tell me what you know about them?
Isabel: They're supposed to be good fat. Lower, does it lower your cholesterol? And like for baby, baby-wise it will help with the brain development and stuff like that. **My mom always said, "Eat more fish! It'll make you smart!"** And then I've been taking that for a while. Just for the baby's sake.

The information that Isabel learned from her mother when she was growing up influenced her behaviors later. In an example of social influence, Vanessa mentions that her decision to

consume an omega-3 fatty acid supplement was influenced by the intake nurse during her initial prenatal visit:

> EH: How about the omega-3, the DHA, why are you taking that supplement?
> Vanessa: Just for brain development of the children…I think [the intake nurse] even said something like, **"Yeah, all the doctors here who have babies have been taking it."** Kind of like, "Yeah, we really think that's a good idea."

In this example, the nurse specifically created a pregnancy peer group of physicians to influence her behavior through social influence.

*H1N1 Vaccination*

If women have completed more schooling are they more likely to be vaccinated against H1N1 (hypothesis 1)? In Table 4, I show the results of the logistic regression analysis of education, social network processes and vaccination. As with the omega-3 fatty acid supplement intake, women's education-level was positively associated with H1N1 vaccination: If they completed college, they were over two times as likely to receive the vaccine as those with less than a college degree, and if they completed a graduate degree they were almost three times as likely have been vaccinated. In a similar model (not shown), the highest educational degree between the couple was also associated with women's vaccination. I chose not to include the highest educational degree in the final models because I did not want to conflate the effect of a partner's influence with the social network measures included in models 2-5. Using data about their social network, I did not find that the proportion of college-educated people in their network was associated with H1N1 vaccination.[10]

[Table 4 about here.]

Do women act upon the health information that they learn from their social networks (hypothesis 4)? Are they influenced by the behaviors of those in their social network (hypothesis

[10] I did not test women's knowledge about the benefits of H1N1 vaccination because virtually all women knew that it prevents infection with the H1N1 influenza.

5)? In models 2-5 (Table 4), I include the measures of social network processes (social learning and social influence). Each of the social network measures was significantly associated with H1N1 vaccination, when considered in individually or in conjunction with the education measures.[11] The percent of social contacts who agree with H1N1 vaccination during pregnancy, a measure of social influence, emerged as the strongest predictor of women's H1N1 vaccination (see model 4). Once again, it is important to note that if women did not know their social contacts' opinions or behaviors their social contact was not included in the overall mean value. However, given my hypothesis, women's *perceptions* of their friends, family, or provider's opinions are of primary importance.

During the in-depth interviews, it became apparent that the social learning and social influence processes often occurred in concert, as shown in conversations with Carrie, Megan and Vanessa:

> EH: Right. I want to hear a little bit more about your [H1N1 decision-making] process. What happened?
> Carrie: I guess just education a little bit more…Hearing [health care providers'] personal and professional opinions. What they've done for their families as someone who is very clear of medicine in that field. So I think that was the main thing. There was definitely some influence by my mother. She researches everything to death and also is one of a science background and I trust her opinion and was given lots of material via her, too, to kind of look over and stuff. **So just research and study I guess. Education is what brought me to that decision.**

Carrie asked her health care providers for more information and she received information from her mother. Specifically, she asked about her health care providers' own behaviors, and she mentioned the importance of her mother's opinion. Megan and Vanessa emphasize the importance of other peoples' behaviors:

> Megan: Well, **[the doctor] had encouraged me in the appointment** before but tshen I wanted to think about it and then the next appointment my husband came with me and I ended up getting it.
> EH: So what happened between [the two prenatal visits]?
> Megan:…**I had talked to other friends who had friends who were pregnant and they all got it so I just kind of felt a little bit better.**
> EH: So when you said that you felt a little safer, what specifically made you feel safer about it?

[11] These models are not included in Table 4, but are available upon request.

Megan**: I just read more articles about how pregnant women had been getting the flu shot for a long time and the H1N1 is basically the same thing as that**.

Megan's decision to receive the H1N1 vaccine was swayed by more information about the vaccine safety and more information about other pregnant women's behavior.

In an attempt to understand how social learning and social influence affect the association between educational attainment and vaccination (hypothesis 6), I estimated model 5 in Table 4. Although women were more likely to be vaccinated if a higher percent of their social contacts received the vaccine, this did not lessen the educational gradient in H1N1 vaccination. I observed a similar result when I accounted for the percent of social contacts with whom they discussed the H1N1 vaccine. However, when I accounted for the percent of each woman's social contacts who approve of H1N1 vaccination during pregnancy, only women with a graduate degree were significantly more likely to have received the vaccine. In conjunction, the measure of social influence ("does ___ agree or disagree with receiving the H1N1 vaccine during pregnancy?") was most strongly associated with women's vaccination. Yet, even after accounting for all of the social network processes, an educational gradient in vaccination remained: Women with a graduate or professional degree were about three and a half times as likely to receive the vaccine compared to those with less than a college degree.

## DISCUSSION

Disentangling the effect of education and social network processes on prenatal behaviors is a complex task. The aim of this paper has been to build a conceptual framework to understand how these factors influence the ways that women decide to behave when pregnant. By melding the results from in-depth semi-structured interviews as well as survey interviews, I have presented an explanation for the emergence of inequalities in two new health behaviors during pregnancy: omega-3 fatty acid supplement intake and H1N1 vaccination. As with other health inequality

research (Lauderdale 2001; Lynch 2003; Phelan et al. 2004), I found educational gradients in supplement intake and H1N1 vaccination rates among prima gravida or essential prima gravida pregnant women. I also found an educational gradient in health knowledge. However, accounting for differences in health knowledge only attenuated the education-behavior gradient for supplement intake somewhat—a result consistent with prior work in health economics (Kenkel 1991; Meara 2001; Cutler and Lleras-Muney 2010).

Aside from education and individual knowledge about the benefits of behaviors, my results indicate that women's decisions are also influenced by social network processes. Taken together, these findings suggest that women's decision-making is affected by a combination of social learning and social influence processes. Focusing solely on H1N1 vaccination, these social processes only partially accounted for educational differences in women's receipt of the vaccine. Social influence, measured as the attitudes and opinions about H1N1 vaccination during pregnancy held by those in their pregnancy network, emerged as the strongest predictor of their receipt of the vaccine. Indeed, the in-depth interviews reiterated the idea that women turned to their partners, friends and families when deciding whether or not to receive the vaccine or take a supplement. Even more, these discussions and decisions differed by education-level.

Given that my results differed depending on the type of novel health behavior, in additional analysis I will examine how these examples are qualitatively different. Although I was not able to access women's medical records to determine their actual vitamin D level (due to Health Insurance Portability and Accountability Act or HIPAA), I do have information about women's self-reported vitamin D levels. If women's vitamin D levels were not low, they may have been more influenced by their health care provider's recommendations.

In the process of interviewing providers (nurses, midwives, and physicians), I also learned that the clinics are more aggressive about recommending, even prescribing, vitamin D supplements. The primary clinic from which I derived my sample, the Orange Clinic, tests each woman who visits the clinic during their prenatal appointment, and conducts an additional test during later visits if her level is very low. In comparison, women are told about the benefits of omega-3 fatty acid supplement intake, and, occasionally, reminded during later prenatal visits but they are never prescribed the supplement. This more intensive outreach by health care providers to increase vitamin D intake may, inadvertently, prevent the emergence of an educational gradient in vitamin D intake. Additional research by Harper and colleagues, suggests that states that enforce stricter seat belt laws have smaller socioeconomic gradient in seat belt use compared to those that enforce more lenient laws (Harper, Strumpf, Davey Smith and Lynch 2008). Indeed, one factor that fosters or prevents the emergence of a gradient may be the role of the health care provider.

## CONCLUSION

I combine the bedrock of literature on social relationships and health and medical decision-making with an emerging approach in medical sociology and demography (Chang and Lauderdale 2009; Glied and Lleras-Muney 2008) that emphasizes the role of *new* health information and disease preventability in the reproduction of social inequalities in health—*the unintended consequences of biomedical advances*. Borrowing from these literatures, I then derive a conceptual framework to understand how education and social network processes affect decisions about health behaviors. My approach uses demographic models of the diffusion of health information and behavior to delineate specific mechanisms by which social ties influence

health behaviors (Kohler, Behrman and Watkins 2001).Together, my empirical example and my methodological and analytic approaches provide a unique illustration of the processes by which health inequalities are reproduced. Understanding this example will not only advance our knowledge about the processes that contribute to inequalities in health, it will also provide insight into decisions about health behaviors that lead to unequal health among women and infants.

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**Table 1. Education, Health Knowledge, Social Network and Health Behavior Measures**

| | n | Valid % | Mean | Standard Error |
|---|---|---|---|---|
| **Socioeconomic Status** | | | | |
| *Education* | | | | |
| High School Degree or less | 20 | 9.01 | | |
| Some College or Associate's Degree | 28 | 12.61 | | |
| Bachelor's Degree | 85 | 38.29 | | |
| Master's Degree | 54 | 24.32 | | |
| Professional Degree (MD, JD) | 13 | 5.86 | | |
| Doctoral Degree (PhD) | 22 | 9.91 | | |
| Total | 222 | | | |
| **Demographic** | | | | |
| *Age* | | | | |
| 18-24 | 36 | 16.07 | | |
| 25-29 | 67 | 29.91 | | |
| 30-34 | 84 | 37.5 | | |
| 35-39 | 25 | 11.16 | | |
| 40+ | 12 | 5.36 | | |
| Total | 224 | | 29.982 | 0.355 |
| **Omega-3 Fatty Acid (O3FA)** | | | | |
| *O3FA Knowledge Test Score* | | | | |
| 0 | 31 | 13.84 | | |
| 1 | 47 | 20.98 | | |
| 2 | 51 | 22.77 | | |
| 3 | 95 | 42.41 | | |
| Total | 224 | | 1.938 | 0.073 |
| *O3FA Supplement Consumption* | | | | |
| no | 152 | 68.16 | | |
| yes | 71 | 31.84 | | |
| Total | 223 | | 0.318 | 0.031 |
| **Vitamin D** | | | | |
| *Vitamin D Knowledge Test Score* | | | | |
| 0 | 64 | 50.39 | | |
| 1 | 63 | 49.61 | | |
| Total | 127 | | 0.496 | 0.045 |
| *Vitamin D Supplement Consumption* | | | | |
| no | 132 | 58.93 | | |
| yes | 92 | 41.07 | | |
| Total | 224 | | 0.411 | 0.033 |
| **H1N1 Vaccination** | | | | |
| *H1N1 Vaccination* | | | | |
| no | 104 | 46.85 | | |
| yes | 118 | 53.15 | | |
| Total | 222 | | 0.532 | 0.034 |
| **Social Network** | | | | |
| *Percent of Network Vaccinated Against H1N1* | 204 | | 28.676 | 2.526 |
| *Percent of Network With Whom Women Discussed H1N1* | 221 | | 33.970 | 2.289 |
| *Percent of Network Who Agree with H1N1 Vaccination During Pregnancy* | 186 | | 82.078 | 2.543 |

**Table 2. Logistic Regression Estimates of Education Level and Omega-3 Fatty Acid Supplement Consumption**

| | Model 1 | | | Model 2 | | | Model 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Exp(β) | β | S.E. | Exp(β) | β | S.E. | Exp(β) | β | S.E. |
| Education Level: HIBPS Participant | | | | | | | | | |
| Less than a Bachelor's Degree | *Reference group* | | | | | | | | |
| Bachelor's Degree | 1.368 | 0.314 | (0.435) | | -- | | | -- | |
| Graduate Degree (Master's, Professional or Doctoral) | 2.019 | 0.703 * | (0.426) | | -- | | | -- | |
| Education Level: Highest Educational Degree Between Couple | | | | | | | | | |
| Less than a Bachelor's Degree | | | | *Reference group* | | | *Reference group* | | |
| Bachelor's Degree | | | | 3.304 | 1.195 * | (0.670) | 2.588 | 0.951 | (0.684) |
| Graduate Degree (Master's, Professional or Doctoral) | | | | 5.681 | 1.737 *** | (0.640) | 4.266 | 1.451 ** | (0.657) |
| Omega-3 Fatty Acid Knowledge Level (0 = low; 3 = high) | | | | | | | 1.356 | 0.304 * | (0.157) |
| Constant | | -1.099 *** | (0.365) | | -2.079 *** | (0.612) | | -2.464 *** | (0.655) |
| Chi-Square | | 3.250 | | | 11.140 *** | | | 11.600 *** | |
| Log-Likelihood | | -132.725 | | | -128.780 | | | -126.838 | |
| *n* | | 208 | | | 208 | | | 208 | |

*** = $p$ <0.01 ** =$p$ <0.05 * =$p$ <0.01

**Table 3. Logistic Regression Estimates of Education Level and Vitamin D Supplement Consumption**

| | Model 1 | | | Model 2 | | | Model 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Exp(β) | β | S.E. | Exp(β) | β | S.E. | Exp(β) | β | S.E. |
| Education Level: HIBPS Participant | | | | | | | | | |
| Less than a Bachelor's Degree | *Reference group* | | | | | | | | |
| Bachelor's Degree | 0.926 | -0.077 | (0.487) | | -- | | | -- | |
| Graduate Degree (Master's, Professional or Doctoral) | 1.350 | 0.300 | (0.476) | | -- | | | -- | |
| Education Level: Highest Educational Degree Between Couple | | | | | | | | | |
| Less than a Bachelor's Degree | | | | *Reference group* | | | *Reference group* | | |
| Bachelor's Degree | | -- | | 1.773 | 0.573 | (0.587) | 1.688 | 0.524 | (0.591) |
| Graduate Degree (Master's, Professional or Doctoral) | | -- | | 2.302 | 0.834 | (0.552) | 2.159 | 0.770 | (0.559) |
| Vitamin D Knowledge (0 = no knowledge; 1 = knowledgeable) | | | | | | | 1.317 | 0.275 | (0.367) |
| Constant | | -0.223 | (0.387) | | -0.773 | (0.494) | | -0.863 * | (0.510) |
| Chi-Square | | 0.950 | | | 2.450 | | | 3.020 | |
| Log-Likelihood | | -86.608 | | | -85.092 | | | -84.811 | |
| *n* | | 125 | | | 125 | | | 125 | |

*** = $p < 0.01$ ** = $p < 0.05$ * = $p < 0.10$

**Table 4. Logistic Regression Estimates of Education Level, Social Network Processes and H1N1**

| | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | | Model 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Exp(β) | β | S.E. | Exp(β) | β | S.E. | Exp(β) | β | S.E. | Exp(β) | β | S.E. | Exp(β) | β | S.E. |
| Education Level: HIBPS Participant | | | | | | | | | | | | | | | |
| Less than a Bachelor's Degree | *Reference group* | | | *Reference group* | | | *Reference group* | | | *Reference group* | | | *Reference group* | | |
| Bachelor's Degree | 2.290 | 0.828 * | (0.468) | 2.207 | 0.792 * | (0.457) | 2.304 | 0.834 * | (0.458) | 1.950 | 0.668 | (0.480) | 1.909 | 0.646 | (0.486) |
| Graduate Degree (Master's, Professional or Doctoral) | 2.814 | 1.034 ** | (0.469) | 2.614 | 0.961 ** | (0.460) | 3.187 | 1.159 ** | (0.467) | 3.112 | 1.135 ** | (0.494) | 3.411 | 1.227 ** | (0.506) |
| Education Level: HIBPS Participant's Social Network | | | | | | | | | | | | | | | |
| Percent with Bachelor's Degree | 0.956 | -0.045 | (0.395) | | | | | | | | | | | | |
| Social Network Measures: Percent of Network… | | | | | | | | | | | | | | | |
| ...Who Received H1N1 | | | | 1.010 | 0.010 ** | (0.005) | | | | | | | 1.062 | 0.060 | (0.052) |
| ...With Whom Women Discussed H1N1 | | | | | | | 1.010 | 0.010 ** | (0.005) | | | | 1.103 | 0.098 * | (0.055) |
| ...Who Agree with H1N1 Vaccination During Pregnancy | | | | | | | | | | 1.030 | 0.029 *** | (0.006) | 1.331 | 0.286 *** | (0.067) |
| Constant | | -0.324 | (0.431) | | -0.598 | (0.401) | | -0.809 * | (0.450) | | -2.812 *** | (0.688) | | -3.341 *** | (0.771) |
| Chi-Square | | 5.310 | | | 9.970 ** | | | 9.470 ** | | | 35.190 *** | | | 39.500 *** | |
| Log-Likelihood | | -111.757 | | | -109.427 | | | -109.679 | | | -96.818 | | | -94.661 | |
| *n* | | 170 | | | 170 | | | 107 | | | 170 | | | 170 | |

*** = $p < 0.01$ ** = $p < 0.05$ * = $p < 0.01$

## FIGURES

**Figure 1. Conceptual Model:** A diagram of the relationship between socioeconomic status – measured here as education level (E) – and health behaviors (B). Health inequality literature indicates that individuals with higher education levels are more likely to engage in health behaviors that reduce their chances of morbidity and mortality. Additional evidence supports the relationship between education level, health knowledge (K) and health behaviors – individuals with higher education levels are more likely to know more about health and act upon their health knowledge. My dissertation hypothesizes that the effect of health knowledge on health behaviors is confounded by an additional factor – social networks (N). The figure is not intended to represent all of the possible causal relationship between education, health behaviors, health knowledge, and social networks.

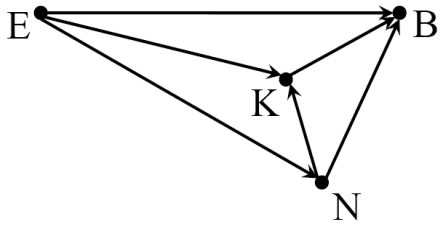


**Figure 2. Health Information and Behaviors During Pregnancy Study Design**: The Health Information and Behaviors During Pregnancy Study questionnaire (HIBPS) borrows questions from nationally-representative, cross-sectional data on pregnancy (i.e, PRAMS) and health behaviors (i.e, BRFSS and NHIS). Over the course of thirteen months I conducted over 225 fifteen minute survey interviews with pregnant women (Part A). This design allows me to situate the HIBPS survey within these larger quantitative surveys of health behaviors. To understand how social networks influence health behaviors, the HIBPS borrows questions about family planning from the Kenya Diffusion and Ideational Change Project and I conducted in-depth, semi-structured interviews with a stratified random sample selected from each monthly sample of women from the HIBPS study (Part B). In order to gain a more complete illustration of the information presented to women at the health clinics I also conducted in-depth, semi-structured interviews with obstetricians, midwives and nurses who provide care to women who are pregnant for the first time (Part C).