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Predicting influenza vaccination coverage by pregnancy intent in women of childbearing age.

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Predicting influenza vaccination coverage by pregnancy intent in women of childbearing age.

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2012

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ABSTRACT

Predicting influenza vaccination coverage by pregnancy intent in women of childbearing age.

By Sophie Smith

Influenza illness can result in severe complications, particularly in the high risk population of pregnant women. Maintaining high vaccination rates in women of childbearing age is one way to prevent severe outcomes as a result of influenza infection. The purpose of this investigation is to assess whether there is an association between pregnancy intent in women of childbearing age and receipt of the influenza vaccine. Data were taken from the Behavioral Risk Factor Surveillance System (BRFSS) from 2011 and included all women of childbearing age that answered the optional Preconception Health and Family Planning module of the questionnaire. The exposure was pregnancy intent, indicated by women that were considering pregnancy within 2 years, after 2 years, or not at all, and the outcome was the receipt of the influenza vaccine. Using multivariate logistic regression there was no overall significant association between considering pregnancy after 2 years (aOR: 0.94; 95%CI: 0.74, 1.20), or considering pregnancy within 2 years (aOR: 0.95; 95% CI: 0.71, 1.27) and vaccination status. Stratification by race showed a significant interaction among women of Asian, Native Hawaiian and other Pacific Islanders, American Indian, Alaskan Natives, Multiracial, and other non-specified races for both those considering pregnancy after 2 years, and women considering pregnancy within 2 years compared to not at all, with adjusted odds ratios of 0.14 (95% CI: 0.05, 0.40) and 0.39 (95%CI: 0.15, 0.99), respectively. Overall there was no significant association between pregnancy intent and vaccination status, but upon stratifying by race, there was significance among specific populations, and women of those populations considering pregnancy within 2 years or after 2 years were less likely to receive the influenza vaccine. This indicates that pregnancy intent in those populations is a significant predictor of influenza vaccination for this study population.

Cover page

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B.S., Auburn University, 2012

Thesis Committee Chair: Kevin M. Sullivan, PhD, MPH, MHA

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CHAPTER I: BACKGROUND AND LITERATURE REVIEW

Influenza illness can result in severe complications, especially in certain higher risk populations where more severe morbidity can lead to hospitalizations and poor health outcomes(1). Influenza pandemics have occurred in 1889-90, 1918-19, 1957, 1968, and 2009. Gary R. Noble detailed the history of influenza in his chapter on the epidemiology and clinical aspects of disease, and provides a detailed clinical and epidemiological perspective (2). Influenza is the result of a reaction between the influenza virus, environmental conditions, and the host. Influenza is divided into three types: A, B, and C, of which A and B cause epidemics of respiratory illness in humans (3). The virus contains eight different RNA segments two of which encode surface proteins that are used to type and categorize the viruses, hemagglutinin (HA) and neuraminidase (NA). To date there are 17 different HA subtypes and 10 different NA subtypes (4). The majority of influenza subtypes widely circulate in avian hosts, while only 3 HA subtypes and 2 NA subtypes widely circulate in humans (3). There are two different mechanisms through which influenza viruses can change: antigenic drift, and antigenic shift. Antigenic drift is a slower continuous process of genetic mutation in the RNA genome of the virus that arises largely from point mutations during viral replication (5).Antigenic shift, which only occurs in A viruses, happens infrequently and can arise through reassortment or adaptation (3). Reassortment is the product of a subtype that is normally not infective in humans exchanging genetic material with a subtype that does infect humans, resulting in a new subtype to which the population has almost no immunity (2, 6). Adaptation occurs when a non-human subtype, such as an avian strain, infects a human directly and causes human illness (3). This can also occur through an intermediate, where an avian influenza strain infects another mammal, such as a pig, adapts to mammalian hosts, and then infects a human. Major antigenic shifts have been the cause of pandemics of influenza, which occur when there is no widespread population immunity, and the virus is capable of efficient and sustained infection (5). Of particular interest is excess mortality and morbidity

during epidemic and pandemic situations in certain high risk groups. These high risk groups consist of people who are more likely to have adverse consequences from an influenza infection and include the elderly, those with chronic diseases including, but not limited to, heart or lung disease, and pregnant women(1, 2)

One study pertaining to groups at higher risk of adverse outcomes from influenza infections, authored by Eickoff et al, focused on the excess mortality due to pneumonia and influenza from 1957 to 1958, a pandemic influenza season (1). They obtained mortality data from the National Office of Vital Statistics to calculate excess deaths. Weekly reports of deaths due to pneumonia and influenza received from 108 major US cities, mortality data from September 1957 through 1960 for specific causes of death, and a ten percent sampling of death certificates taken by the National Office of Vital Statistics were compiled in order to define the mortality rates for the years in question. The expected number of deaths were calculated by a linear projection of mortality in similar months from 1953 to 1959 (excluding epidemic periods in 1957, 58, and 60). By comparing the expected number of deaths to the number of deaths that occurred during influenza epidemic outbreaks, the authors found that there were approximately 86,000 deaths in excess of what was expected. They then examined the excess deaths to determine high risk characterizations and identify associations between certain chronic and high risk conditions and influenza mortality. They found an association between increased influenza-associated mortality and age $\geq$ 65 years, certain chronic diseases, pregnancy, asthma, and other respiratory diseases other than influenza and pneumonia. Asthma and respiratory diseases other than influenza or pneumonia were more prominent associations, and milder associations were seen in chronic illnesses, including diabetes, rheumatic heart diseases, cirrhosis of the liver, tuberculosis, and chronic nephritis. The association between influenza-associated deaths and pregnancy was highly significant. While the authors identified potential high risk conditions, definitive causation cannot be determined from an observational study such as this. In order to make valid inferences about

associations in pregnant women, studies of associations with influenza in women of childbearing age must be done.

Influenza A infections during pregnancy have been studied more widely than influenza B or C. These adverse outcomes shown to be associated with influenza A include increased hospitalization, preterm labor and birth, pneumonia, adult respiratory distress syndrome, and cardiopulmonary disease complications (7, 8).

In order to further understand the increased risk influenza causes in pregnant women, Neuzil et al (8) performed both a nested case-control study, and a retrospective cohort study of women enrolled in the Tennessee Medicaid program during 17 influenza seasons from 1974 to 1993. Overall study outcomes were hospitalizations for pneumonia and influenza, and hospitalizations for a broader range of acute cardiopulmonary conditions and heart failure or myocarditis. Women eligible were aged 15 to 44, of African-American or white ethnicity, and enrolled in the Tennessee Medicaid program for at least 180 days. The case control study was performed to evaluate the relative risk of influenza associated with each stage of pregnancy compared to non-pregnant and postpartum women, and identify other risk factors for serious influenza-related morbidity. Hospitalized cases included 4,369 women of childbearing age that were enrolled in the program, and 21,845 non-hospitalized population controls were chosen at random from all women that met eligibility criteria and were alive on the index day of the case (first day of hospital admission due to one of the defined study outcomes). White ethnicity, residence in a non-urban area, the blind/disabled enrollment category, and increasing age were associated with increased risk of hospitalization. Controlling for demographic factors, the estimated relative risk of hospital admission for study outcomes increased with increasing pregnancy duration, with an odds ratios ranging from 1.44 (95% Confidence interval (CI) 0.97-2.15) during weeks 14-20 to 4.67 (95% CI: 3.42-6.39) during weeks 37-42. Women in their third trimester are approximately four times more likely to be hospitalized for influenza related complications than postpartum women.

The authors also performed a retrospective cohort study to estimate the rates of study events during influenza seasons and other times of the year in order to observe whether there is a significant difference in study event rates between influenza seasons and other times of year. The results showed that the incidence of acute pulmonary events were higher during the influenza season than during peri-influenza (any period from November through April with no influenza activity) or non-influenza seasons. Women in their third trimester were shown to have hospitalization rates of 21.74 per 10,000 during the influenza season compared to 11.26 during the peri-influenza, and 7.49 during the non-influenza season. This study is extremely robust, as they incorporated 17 influenza seasons, included a very large study population, and were able to utilize both cohort and case-control study designs. Neuzil et al confirms the hypothesis that pregnant women, especially during later stages of pregnancy are at high risk of hospitalization from respiratory illness due to influenza during the yearly epidemic influenza seasons.

Hartert et al performed a matched cohort study of pregnant women in the Tennessee Medicaid program from 1983 to 1993. The authors studied respiratory illness, perinatal morbidity, and maternal morbidity during the influenza season in order to determine additional factors that increase risk of adverse outcomes in pregnant women. The authors identified a number of predictors of respiratory hospitalization among Medicaid enrolled pregnant women including older maternal age (35-44 years), high risk conditions such as asthma, prior hospitalization, and later trimester(9).

In addition to the yearly seasonal epidemics, the high risk of influenza in pregnant women has shown to be exacerbated by pandemic influenza, to which most or all of the population typically does not have immunity(3). Following the 2009 influenza A H1N1 pandemic, Saleeby et al observed a number of maternal and fetal complications, and provided two detailed case descriptions showing the potential effects of influenza during pregnancy (7). In the two cases, adverse outcomes of influenza included cesarean sections, acute renal

failure, superimposed bacterial pneumonia, pulmonary embolus, and maternal death (7). Saleeby et al highlighted the potential for extreme complications from pandemic influenza, although it cannot be generalized to the population at large.

Shortly after the 2009 H1N1 pandemic began, the CDC implemented enhanced surveillance, and systematically collected detailed case information on pandemic H1N1 infection in pregnant women and the findings of subsequent studies gives credence to the alarm raised by Saleeby et al (10). Jamieson et al summarized the cases of laboratory confirmed 2009 H1N1infection in pregnant women reported from April 15th to May 18th, and the deaths associated with the virus from April 15th to June 16th. For this study, a confirmed case was defined as a laboratory confirmed pandemic H1N1 acute respiratory viral infection, and probable cases were defined as an acute febrile respiratory illness positive for influenza A and negative for seasonal H1 and H3 subtypes. Thirty-four women met the confirmed case definition; fifty percent were 18-29 years of age, 44% were Hispanic, 47% had one or more previous pregnancies, 26% were in their third trimester, 21% had a history of asthma, and only 9% had received the 2008-09 seasonal influenza vaccine. Of the 34 women, 11 were admitted to the hospital, an admission rate much higher than that for the general population (0·32 per 100,000 pregnant women compared to 0.076 per 100,000 population at risk). Of 45 deaths reported to the CDC from April 15th to June 16th, six (13%) occurred in pregnant women. All developed pneumonia and respiratory distress syndrome. Based on their findings, pregnant women appeared to be at greater risk of complications due to pandemic H1N1 infections. Their study had several limitations, including the reliance on state surveillance and reporting, which can vary depending on state and time of year, and can affect the quality of the data ascertained. In addition, this study took place during a pandemic when there was substantial stress on resources for reporting; thus, some cases may have been overlooked and all cases were likely not reported. It is unlikely this underreporting was differential for pregnant and non-pregnant populations, although it may have differed by disease severity.

According to a survey of obstetricians and gynecologists, done in 2004, pregnant women presenting with influenza symptoms are less likely to be tested for influenza than non-pregnant women(11). However, providers may also be more likely to admit pregnant than non-pregnant women.

The literature pertaining to risk to the fetus attributable to maternal influenza infection during pregnancy is contradictory. Several papers found that infants born to mothers that had influenza when pregnant (particularly 'Asian influenza', which caused the 1957 pandemic (2)) were at higher risk of having birth defects (12, 13). One study negated those findings, and concluded that no increased risk is added to the fetus of mothers who are ill during pregnancy, showing all non-significant results for associations with congenital defects (14) Another study found no evidence of transplacental transmission of influenza from mother to child (15). In the previously mentioned matched cohort study by Hartet et al, the authors also found no statistically significant associations between illness and pregnancy outcomes including birth weight, method of delivery, length of labor, preterm labor, fetal maturity, and fetal death (9). This study did not include women with miscarriages, women that died during pregnancy, or early neonatal deaths, which may cause an underestimation of perinatal and infant morbidity and mortality.

The Advisory Committee on Immunization Practices (ACIP) currently recommends that in light of the heightened risk of hospitalization, and because of the importance of immunization before the season starts, pregnant women, or women who are planning on, or could become pregnant, should routinely be vaccinated with inactivated vaccine, regardless of stage of pregnancy (16). Currently, immunization coverage of pregnant women in the United States is around 50% (17-19), far below the 2020 target of 80% (20). Exploration into the maternal factors that predicted influenza vaccination status revealed associations between vaccination and several maternal demographic characteristics including marital status, location of residence (urban versus rural locations), smoking during pregnancy, parity,

medical comorbidities, and maternal risk status due to the presence of underlying disease (diabetes, pulmonary disease, renal disease, asthma, heart disease, or anemia) (21). Single women, multiparous women, and women who smoked during their pregnancy are less likely to be vaccinated, and women in rural areas and women with comorbidities had higher vaccination rates (21).

The main reason many women cite for not getting vaccinated are concerns about the safety of the vaccination during pregnancy (22, 23). In a cross-sectional survey of postpartum women during the 2006 influenza season, 95% of the respondents correctly cited the infectious and contagious aspects of influenza, yet almost 90% of women incorrectly answered that pregnant women are not at any higher risk than non-pregnant women of complications due to influenza (23). Approximately 40% of the respondents knew the vaccine was recommended for expectant women during the influenza season, and 55% knew that the vaccine was safe to receive during pregnancy. Twenty-one percent of respondents believed that the vaccine, if taken during pregnancy, causes birth defects (23). In a study looking at predictors of influenza vaccine uptake, women that believed the influenza vaccine is safe for the fetus were approximately 21.6 times more likely to have received the vaccine (95% CI: 2.852-163.781) and women who were recommended by antenatal care provider to get the vaccine were approximately 15.6 times more likely to get the vaccine (95% CI: 6.055 – 40.09). Women were also more likely to have gotten the vaccine if they received the majority of their antenatal care at their general practitioner (OR: 4.854, 95% CI: 1.665-14.149), if they believed the vaccine protects the infant (OR: 3.803, 95% CI: 1.164-12.427), if they received the majority of antenatal care at their obstetrician (OR: 3.643, 95% CI: 1.316 – 10.080), if they have a chronic condition (OR: 3.485, 95% CI: 1.235-9.832), or if the vaccine was offered at the antenatal clinic (OR: 1.773, 95% CI:1.074-4.378) (24).

Several studies spanning from 1998 until 2008 examined the safety of vaccination among pregnant women. Munoz et al. performed a retrospective cohort study using an electronic

database, and calculated rates of immunization and complications pregnant women receive in vaccine and control groups matched on age, month of delivery, and type of medical insurance(25). They found no significant differences in the rate of adverse conditions diagnosed between vaccination and delivery in women who were vaccinated and non-vaccinated controls. There were also no reported differences in the pregnancy outcomes and infant conditions between birth and 6 months of age in the vaccination group compared to non-vaccinated controls, and the authors concluded that influenza vaccine administered during pregnancy is safe in the study population (25). This was a relatively small study that was taken from records at a multispecialty clinic in Houston, Texas, and so the results may not be generalizable. However the results were repeated and the conclusions are similar to other studies in other locations. Moro et al. examined adverse events (AEs) in pregnant women from data in the Vaccine Adverse Events Reporting System, a passive surveillance system that is used for vaccine safety by the CDC and the FDA. Reports from 1990 through 2009 were analyzed, and 148 reports of AEs in pregnant women after receipt of trivalent inactivated vaccine, and 27 reports after receiving live attenuated influenza vaccine were found. Rates of spontaneous abortion, and of other adverse outcomes were found to be similar to the general population of pregnant women, and thus the rates of adverse effects show no association with receiving TIV in pregnant women (26). There was only one serious adverse outcome associated with LAIV, noted in a woman that received LAIV during the 12th week of her pregnancy, which ultimately ended in miscarriage. This study was very robust, as it covered 19 years of data for TIV, and 6 years of data for LAIV, and replicated findings in previous studies. The authors noted that while LAIV was not shown to increase the risk of adverse effects, it is not indicated for pregnant women, and only the trivalent inactivated vaccine is recommended.

In their population based retrospective cohort study on women that gave birth between November 2010 and March 2012 in Nova Scotia, Legge et al found that pregnant women that

were vaccinated for influenza were less likely to have preterm births or low birth weight infants than women that were unvaccinated (21). The authors conclude that contrary to the fear that the vaccine is unsafe, a true association exists between vaccination and improved neonatal outcomes.

Influenza vaccination coverage of pregnant women for the 2010-11 and 2011-12 seasons were approximately 49% and 47%, respectively (27, 28). Coverage rates for the general population of adults aged 18-49 during the 2010-11 and 2011-12 seasons were 30.5% and 28.6% respectively (29). While immunization rates for pregnant women are higher than the general population, adequate coverage to significantly reduce disease incidence needs to be much higher. In a case-control study of Kaiser Permanente health plan members of California and Oregon, vaccine effectiveness for preventing laboratory-confirmed influenza illness in pregnant women was studied. Cases were defined as pregnant women with acute respiratory illness that was confirmed as influenza by reverse transcriptase polymerase chain reaction (rRT-PCR). Influenza negative controls were defined as pregnant women with acute respiratory illness that tested negative for influenza. The secondary control group consisted of acute respiratory infection negative controls with no medical visit or self-reports of illness with fever and cough since the start of the influenza season through the start of illness for the first case. Two secondary controls were matched to the case by season, study site, and trimester of the case. Among influenza positive cases, 48% were vaccinated compared to 58% of influenza-negative controls, and 63% of matched acute respiratory infection negative controls. The results showed that in pregnant women the vaccine effectively reduced acute respiratory illness associated with lab-confirmed influenza by approximately one half, with adjusted vaccination effectiveness estimates using influenza-negative controls and acute-respiratory infection negative controls at 48% (95% CI: 16% - 68%) and 44% (95% CI: 5%-67%) respectively (30). The authors also noted that vaccination during the previous season modified the effect of vaccination and pregnancy. The authors observed an adjusted vaccine

efficacy of 51% to 76% comparing cases to influenza negative ARI-positive controls, and 48% to 76% in influenza negative ARI-negative controls. This protective effect was observed during two seasons through which the vaccine components did not change, especially if the vaccines were a good match for the strains in circulation. This study had a relatively small population size, of only 100 cases, 192 influenza-negative controls, and 200 ARI-negative controls resulting in extremely wide confidence intervals. The study also occurred during two seasons during which the vaccine components and circulating strains were all relatively similar, so the findings of vaccine effectiveness in pregnancy will likely differ based on predominant circulating strains and the degree of vaccine match.

While vaccination coverage is part of routine surveillance for the general population and for pregnant women, there is no information available specifically on women who are not yet pregnant, but are considering it. This paper aims to address this literature gap, and specifically addresses whether the odds of getting the influenza vaccine in the past 12 months are higher in women considering pregnancy within the next two years and women who are considering pregnancy after two years, compared to not at all.

CHAPTER II: MANUSCRIPT

Predicting influenza vaccination coverage by pregnancy intent in women of childbearing age.

By Sophie Smith

Influenza illness can result in severe complications, particularly in the high risk population of pregnant women. Maintaining high vaccination rates in women of childbearing age is one way to prevent severe outcomes as a result of influenza infection. The purpose of this investigation is to assess whether there is an association between pregnancy intent in women of childbearing age and receipt of the influenza vaccine. Data were taken from the Behavioral Risk Factor Surveillance System (BRFSS) from 2011 and included all women of childbearing age that answered the optional Preconception Health and Family Planning module of the questionnaire. The exposure was pregnancy intent, indicated by women that were considering pregnancy within 2 years, after 2 years, or not at all, and the outcome was the receipt of the influenza vaccine. Using multivariate logistic regression there was no overall significant association between considering pregnancy after 2 years (aOR: 0.94; 95%CI: 0.74, 1.20), or considering pregnancy within 2 years (aOR: 0.95; 95% CI: 0.71, 1.27) and vaccination status. Stratification by race showed a significant interaction among women of Asian, Native Hawaiian and other Pacific Islanders, American Indian, Alaskan Natives, Multiracial, and other non-specified races for both those considering pregnancy after 2 years, and women considering pregnancy within 2 years compared to not at all, with adjusted odds ratios of 0.14 (95% CI: 0.05, 0.40) and 0.39 (95%CI: 0.15, 0.99), respectively. Overall there was no significant association between pregnancy intent and vaccination status, but upon stratifying by race, there was significance among specific populations, and women of those populations considering pregnancy within 2 years or after 2 years were less likely to receive the influenza vaccine. This indicates that pregnancy intent in those populations is a significant predictor of influenza vaccination for this study population.

INTRODUCTION

Influenza illness can result in severe complications, especially in certain high risk populations where more severe morbidity can lead to hospitalizations and poor health outcomes (1). Pregnancy causes significant strain on respiratory functions, especially during the second and third trimesters, placing pregnant women at increased risk of complications from respiratory illness and influenza related hospitalizations(7, 8). Influenza infections during pregnancy have been associated with a spectrum of adverse maternal and neonatal outcome, including hospitalizations, cardiopulmonary events, and general increases in pregnancy complications (8, 15, 31, 32). In the 2010 – 2011 season, of all women aged 15-44 (childbearing age) that were hospitalized for influenza, 31.3% were pregnant, and during the 2011-2012 season, 34.8% of women of childbearing age hospitalized for influenza were pregnant (33).

Currently, the Advisory Committee on Immunization Practices (ACIP) recommends that in light of the heightened risk of hospitalization, and because of the importance of immunization before the season starts, pregnant women, or women who are planning on, or could become pregnant, should routinely be vaccinated (16). There is no evidence of harm to the fetus if the mother receives inactivated vaccine, and studies have shown that infants whose mothers were vaccinated were less likely to get laboratory confirmed influenza (27, 34). Despite the recommendations for vaccination in this population, coverage is still below the Healthy People 2020 goal of 80 percent (20).According to an internet panel survey conducted by the CDC in April 2011, vaccination coverage for pregnant women was approximately 49% of the 1,457 women surveyed for the 2010-2011 influenza season, and 43.2% of the 2,047 women surveyed in November of 2011 (35). Understanding factors associated with vaccine uptake in pregnant women and women who are considering pregnancy will allow for more targeted interventions to increase vaccination rates.

The Behavioral Risk Factor Surveillance System (BRFSS) questionnaire contains questions on pregnancy, pregnancy intent, and vaccine uptake. However, due to the nature of the

questions pertaining to these subjects, and the nature of the questionnaire itself, temporality of pregnancy and influenza vaccination cannot be established, and raises methodological and interpretive difficulties. Due to this discrepancy, this investigation focuses on pregnancy intent.

In order to better predict vaccine uptake in women who are considering pregnancy, we looked at cohort of women to ascertain whether there is an association between pregnancy intent and receipt of the influenza vaccine. Data from the 2011 Behavioral Risk Factor Surveillance System was used to assess whether there was an association between pregnancy intent, defined as desiring to have a child within 2 years, more than 2 years, or not at all, and having received the influenza vaccine within the last 12 months.

METHODS

Data

Data for this survey were obtained from the Behavioral Risk Factor Surveillance System (BRFSS) 2011 survey, a publically available telephone health survey that aggregates both cell phone and landline telephone interviews. Background, survey design, data collection and processing, and all information on the cell phone and landline datasets have been previous described (36).

Survey population

The dataset includes all non-pregnant women between ages 18 and 44 living in a state that included the optional Preconception Health and Family Planning module in the BRFSS questionnaire that answered the question on having a child now or sometime in the future (37). States that included this module were Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah.

Exposure, Outcome, and additional Variables Described

All survey questions that were answered by ‘refused’ or ‘don’t know’ were treated as missing information.

The primary exposure was pregnancy intent. The questionnaire asked "How do you feel about having a child now or sometime in the future?" (37). The survey population was split into three exposure groups: women that do not want to have a child, women that are considering having a child within the next two years, and women who are considering having a child after 2 years.

The primary outcome of interest was whether the subjects had received the influenza vaccine in the last 12 months. The question was worded "During the past 12 months, have you had either a seasonal flu shot or a seasonal flu vaccine that was sprayed in your nose?" (37).

In addition to considering pregnancy, demographic information for age, race and ethnicity, marital status, smoking status, employment status, number of children in household, general health, physical activity, BMI, insurance, heavy drinking, history of asthma, whether respondents live in a metropolitan area, education, and income, were also assessed in the analysis.

The respondents' ages were categorized into 18 to 24, 25 to 34, and 35 to 44 years of age. Race and Hispanic ethnicity were combined into a single variable. Marital status was condensed into a dichotomous yes/no variable based on current status. Smoking status combined questions asking whether respondents have smoked at least 100 cigarettes in their entire lifetime, and whether they smoke every day, some days, or not at all, into a four level smoking categorization (everyday, some days, former, non-smoker). Due to insufficient numbers in several categories for employment status, those that were employed for wages and self –employed were grouped together, and statuses for unable to work, retired, or out of work for any amount of time were also grouped together. Categories for physical activity were established using several questions pertaining to exercise type, duration, frequency, and age, resulting in a comprehensive four level variable. BMI was calculated using weight, and height, and grouped by underweight or normal weight, overweight, and obese. Categories of insurance were insured, underinsured, and uninsured, compiled from a combination of healthcare access, availability, and whether the individual had insurance or not. Due to small cell sizes, education was condensed into a four level

variable of less than or equal to some high school, high school graduate, some college or technical school, and college graduate.

Statistical Analysis

SAS version 9.3 was used to analyze the data. Due to the complexity of the survey design, bivariate associations were assessed using surveyfreq procedures. Significance was assessed using two sided Rao-Scott Chi square test. Multivariate logistic regression was done using surveylogistic procedures. Variables entered into logistic regression models for assessment included age, race and ethnicity, smoking status, insurance status, and education levels. Income was initially assessed for significance, however approximately 13% of the survey sample was missing a response for income. In order to determine whether there was any bias due to the amount of missing data, observations for survey sample where income was answered was assessed separately from observations where income was not answered (Appendix A, C). It was determined based on the results of this analysis that the associations were differential based on response to the income variable, and thus it was removed from the model in order to minimize the potential bias introduced to the survey.

Interaction and confounding were assessed for each of these variables, and prevalence odds ratios were calculated with the use of the multivariate logistic regression model. Prevalence odds ratios (POR) were used due to the survey design. The outcome of interest, vaccine receipt, does not meet the criteria for rare outcomes, and so the PORs tend to overestimate the true prevalence ratios. Model selection strategy is detailed in the supplemental information (Appendix B, E).

RESULTS

Of the survey respondents that answered the optional Preconception Health and Family Planning module, 7,964 women answered the question on considering pregnancy. Of these, 6,778 (85.1%) were not missing and thus included in the analysis. There were 1,520 women that were considering pregnancy in less than two years, 1,708 women that were considering pregnancy in greater than or equal to two years, and 3,550 women that were not considering pregnancy.

Demographic Characteristics

The survey population overall tended to be 25 to 34 years old, white (non-Hispanic), married, living in the center of a metropolitan area, with no children already living in the household. They were mostly employed for wages or self-employed, insured, with incomes greater than $50,000 per annum, and have completed some college or technical school education. The survey population was mostly under- or normal weight, in good or better health, non-heavy drinkers, non-smokers, and the majority never had asthma (Table 1).

Distributions among pregnancy intent categories

Pregnancy intent was significantly associated with age, current marital status, number of children in household, current smoking status, general health, physical activity, employment status, income, and education (all p-values <0.05) (Table 1).

Among the three pregnancy intent groups (considering pregnancy within 2 years, after 2 years, and not at all), respondents were similar in regards to location related to metropolitan area, whether they are heavy drinkers, their general health, asthma status, insurance and healthcare access, race and ethnicity, BMI, and education (Table 1). Women in the groups that didn't want children and that wanted children within the next two years had similar distributions of marriage, smoking status, and employment status (Table 1).

Women considering pregnancy within the next two years were more likely to be ages 25-34 years, have no children living in the household, and in the highest income bracket (>$50,000 per annum). They had the lowest percentage of homemakers at 12.07% compared to 16.79% and

16.69% in women who didn't want children and women who wanted children after two years, respectively.

Considering pregnancy after 2 years was associated with the youngest age group (18-24 years of age), being unmarried, having no children living in the household, and being highly active. This group also had the highest percentage of never smokers (77% compared to 65% and 66% in women who wanted no children and wanted children within two years, respectively), and employment status of being out of work, retired, or unable to work (29% compared to 5% and 11% in women who wanted no children and wanted children within two years, respectively) (Table 1).

Women not considering pregnancy were more likely to be age 35-44 years, inactive, have higher rates of former smokers (16% compared to 11% and 7%), live in the center city of a metropolitan area, and live in a household with 2 children. They also had the highest percentage of women that never attended school through attending some high school (16% compared to 134% of women considering pregnancy within the next 2 years, and 13% in women considering pregnancy after 2 years) (Table 1).

Distribution among Vaccinated and Unvaccinated

Vaccine receipt was significantly associated with current marital status, number of children in household, current smoking status, general health, insurance status, income, and education (p-values <0.05) (Table 2).

Prevalence of vaccination was not significantly different based on pregnancy intent, age, heavy drinking, BMI, physical activity, and employment status.

White women had highest vaccination prevalence (30%), and black women had lowest vaccination prevalence (23%). Married women had higher vaccination prevalence, as did women that live in suburban parts of metropolitan areas. Women living in households with no children had lower vaccination prevalence, and women living in households with 2 children had the highest prevalence (23% compared to 33%). Women that were currently smoking everyday had

low vaccination coverage (20%), and women that were former smokers had the highest vaccination coverage (31%). Women of good or better health had higher vaccination prevalence compared to women of fair or poor health, and women that formerly had asthma had higher vaccination prevalence compared to women that currently have or never had asthma. Uninsured women had the lowest vaccination coverage (17%), and women that were adequately insured had the highest coverage (31%). As income increased, vaccination prevalence also increased sequentially, with the lowest vaccination coverage in women with income <$15,000 at 18%, and the highest coverage in women with income >$50,000 at 33%. Similarly, as education increases vaccination prevalence increases from 17% to 34% (Table 2).

Logistic Regression

The crude prevalence odds ratio between wanting a child within 2 years and vaccination receipt was 0.95 (95% CI: 0.70, 1.30) and the crude prevalence odds ratio for wanting a child after 2 years and vaccination receipt was 0.86 (95% CI: 0.63, 1.19) (Table 3). After controlling for age, race, insurance, smoking status, number of children in household, and education, there was still no significant association between pregnancy intent and vaccination receipt. Women considering pregnancy after the next 2 years were 0.95 (95% CI: 0.70, 1.30) times more likely to have received the vaccine in the past year compared to women that were not considering pregnancy. Women considering pregnancy within the next 2 years were 0.94 (95% CI: 0.74, 1.20), times more likely to have received the vaccine in the past year compared to women that were not considering pregnancy.

After interaction and confounding assessment, the final multivariate model for pregnancy intent and vaccination coverage included age, race, insurance, smoking status, number of children in household, and education. Age, education, number of children in the house, and insurance status were all found to be confounders (Appendix part D, E). There was statistically significant interaction between race and pregnancy intent on vaccination status ($p < 0.05$). After stratifying on race, adjusted odds ratios showed statistically significant decreased odds of influenza vaccine

receipt in both women considering pregnancy within 2 years and considering pregnancy after 2 years for women of 'Other, Non-Hispanic' races, which includes Asian, Native Hawaiian, other Pacific Islanders, American Indian, Alaskan Natives, Multiracial, and other non-specified races. Among women classified as 'Other, Non-Hispanic' race, those considering pregnancy within 2 years were less likely to have gotten the vaccine than women not considering pregnancy (aOR: 0.39, 95% CI: 0.15, 0.99), and women considering pregnancy after 2 years were also less likely to have gotten the vaccine than women not considering pregnancy (aOR: 0.14, 95% CI: 0.05, 0.40) (Table 3).

Other significant predictors (p-values <0.05) of influenza vaccination coverage include age, insurance status, number of children in the household, and education. Women of ages 25-34 and 35-44 were significantly less likely to be vaccinated compared to women of ages 18-24. Women that were uninsured were significantly less likely to be vaccinated than fully insured (aOR: 0.5; 95% CI: 0.4, 0.7). Women with 2 or greater than 3 children already in the household were significantly more likely to be vaccinated than women with no children in the household (aOR: 1.9; 95% CI: 1.4, 2.5 and aOR: 1.5; 95% CI: 1.1, 2.1, respectively). Women with some college or technical school were more likely to be vaccinated (aOR: 1.7; 95% CI: 1.0, 2.6), and college graduates were also more likely to be vaccinated (aOR 2.1; 95% CI: 1.3, 3.3) than women with some high school or less (Table 4).

DISCUSSION

Overall, pregnancy intent is not associated with receipt of the influenza vaccine in this population. Women that are considering pregnancy, whether within or after 2 years, are no more likely to be immunized for influenza than those not considering pregnancy. However, upon stratification by race, there are several specific races and ethnicities that are significantly less likely to have received the vaccine. Women categorized as Asian, Native Hawaiian and other Pacific Islanders, American Indian, Alaskan Natives, Multiracial or other non-specified races

were significantly less likely to have received the vaccine than women of White, non-Hispanic race. This suggests that there are certain populations of women that may be considering pregnancy in the near future that are not being adequately covered by vaccination, and should be targeted more intentionally.

The strengths of this survey include the large population and the availability of a wide range of data for each respondent. First, this was a large survey population, which increases the power of the survey and indicates the results are not likely due to chance. Second, the BRFSS also encompasses a vast range of questions, and allows for the evaluation of many vaccination predictors. Many potential confounders were assessed and included in order to minimize confounding in the data. Factors that were potentially associated with both pregnancy intent and vaccination status were available, and were included in the analysis.

There are also several limitations. First, the BRFSS is a cross-sectional survey design, meaning temporality cannot be established. This greatly diminishes causality of the exposure on the outcome. However for this survey, it is unlikely that a woman would begin considering pregnancy because she received an influenza vaccination. In addition to being a cross-sectional survey, the BRFSS is self-reported, and because of this, all information provided may be subject to misclassification bias. It has been shown that self-reported influenza vaccination status is both a sensitive and specific indicator of true vaccination status in a population based registry in Wisconsin (38). However, it is unknown whether that is generalizable to other populations, and Wisconsin is not represented in this survey population. Thus self-reporting could result in the misclassification of vaccination status.

The BRFSS is also a telephone survey, and because of this there may be some selection bias due to phone type and ownership. There may be a certain type of person that uses landlines or cell phones which could reflect on the characteristics of those people. For the 2011 BRFSS, both landline and cell phone data was aggregated together (39), which helps include people that

preferentially use one type of phone over the other, however there is likely still some residual selection bias.

Next, 13% of respondents were missing data for the income variable and introduced some selection bias resulting from its inclusion in the initial analysis. Upon further investigation, there were significant differences in the distribution of education based on whether income was missing or present, which affected the effect measure of education level on vaccination status in the multivariate logistic regression model. However, this limitation was mitigated largely by removing income from the model. Income was shown to be significantly associated with vaccination status and pregnancy intent individually, which presents some analytic challenges. Associations between pregnancy intent, income, and vaccination status should be evaluated further. Lastly, while there was some interaction between certain races and pregnancy intent on vaccination status, the races of interest were largely underrepresented in the population, and for analyzing purposes had to be grouped together. Further investigation into race, pregnancy intent, and influenza vaccination status needs to be done with higher proportions of these race ethnicities in order to confirm the findings of this survey.

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Table 1. Selected demographic characteristics of women not considering pregnancy, considering prior to 2 years, and considering after 2 years*; BRFSS 2011**

Demographic Characteristic	Total	**Considering Pregnancy < 2 Years** (n = 1,520) Percent (95% CI)	**Considering Pregnancy > 2 Years** (n = 1,708) Percent (95% CI)	**Not Considering Pregnancy** (n = 3550) Percent (95% CI)
Influenza Vaccine (Frequency missing = 17				
No Vaccination	4662	73.1 (68.0, 78.2)	73.3 (69.4, 77.2)	72.1 (69.3, 74.9)
Vaccination	2099	26.9 (21.8, 32.0)	26.7 (22.8, 30.6)	27.9 (25.1, 30.7)
Age (Frequency missing = 0)**				
18-24	1102	23.9 (18.1, 29.7)	61.0 (56.7, 65.3)	10.0 (7.5, 12.5)
25-34	2624	56.8 (51.4, 62.2)	32.6 (28.5, 36.8)	35.2 (32.1, 38.3)
35-44	3052	19.4 (16.2, 22.5)	6.4 (4.5, 8.2)	54.9 (51.6, 58.1)
Race/Ethnicity; (Frequency missing = 52)				
White only, non-Hispanic	4112	59.0 (53.4, 64.7)	56.3 (51.8, 60.8)	58.4 (55.1, 61.7)
Black only, non-Hispanic	1612	16.5 (12.5, 20.5)	17.4 (14.3, 20.6)	20.0 (17.5, 22.6)
Other race, non-Hispanic	386	5.0 (3.3, 6.8)	7.6 (5.1, 10.1)	5.0 (3.7, 6.3)
Hispanic	616	19.5 (13.5, 25.4)	18.7 (14.5, 22.8)	16.6 (13.7, 19.5)
Metropolitan Status Code; (Frequency missing = 1147)				
Center city of an MSA	1932	47.2 (41.3, 53.2)	45.9 (40.8, 51.1)	41.3 (38.0, 44.6)
Inside county containing center city	819	19.3 (15.1, 23.4)	20.0 (15.6, 24.3)	21.6 (18.4, 24.8)
Inside suburban county of MSA	828	16.7 (13.5, 19.9)	15.7 (12.6, 18.8)	18.5 (16.1, 20.9)
Not in an MSA	2052	16.8 (13.7, 19.9)	18.4 (15.7, 21.2)	18.6 (16.8, 20.5)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 1. Continued

Demographic Characteristic	Total	**Considering Pregnancy < 2 Years** (n = 1,520) Percent (95% CI)	**Considering Pregnancy > 2 Years** (n = 1,708) Percent (95% CI)	**Not Considering Pregnancy** (n = 3550) Percent (95% CI)
Number Children in the Household (Frequency Missing = 19)**				
0	1956	36.2 (31.2, 41.2)	42.2 (37.7, 46.7)	22.9 (20.3, 25.6)
1	1722	30.5 (25.7, 35.2)	28.9 (24.7, 33.0)	20.2 (17.5, 23.0)
2	1732	15.9 (12.7, 19.1)	16.2 (13.1, 19.2)	30.3 (27.4, 33.2)
≥3	1349	17.5 (12.1, 22.8)	12.8 (9.9, 15.7)	26.6 (23.8, 29.4)
Heavy Drinkers?; (Frequency missing = 81)				
0 (no)	6433	96.4 (94.7, 98.1)	96.2 (94.8, 97.6)	96.1 (94.9, 97.3)
1 (yes)	264	3.6 (2.0, 5.3)	3.8 (2.4, 5.2)	3.9 (2.7, 5.1)
Smoking Status; (Frequency missing = 19)**				
Never Smoked (0)	4677	66.5 (61.8, 71.2)	76.6 (72.7, 80.4)	64.7 (61.7, 67.8)
Former smoker (1)	829	10.9 (8.2, 13.5)	7.4 (5.3, 9.6)	13.1, (11.2, 15.0)
Current smoker, every day (2)	893	16.2 (12.6, 19.8)	10.5 (7.4, 13.7)	16.0 (13.4, 18.6)
Current smoker, some days (3)	360	6.4 (3.7, 9.1)	5.5 (3.6, 7.3)	6.2 (4.7, 7.8)
General Health (Frequency missing = 20)**				
Good or Better Health	5966	87.2 (83.5, 90.9)	91.4 (88.9, 93.8)	85.8 (83.5, 88.2)
Fair of Poor Health	792	12.8 (9.1, 16.5)	8.6 (6.2, 11.1)	14.2 (11.8, 16.5)
BMI (Frequency missing = 559)				
Underweight and Normal Weight (12.0 ≤ bmi < 25.00)	2599	44.9 (39.3, 50.5)	49.7 (45.1, 54.4)	44.5 (41.1, 47.8)
Overweight (25.00 ≤ bmi <30.00)	1644	30.0 (24.0, 35.9)	22.9 (18.9, 26.8)	26.4 (23.5, 29.2)
Obese (30.00 ≤ bmi)	1976	25.1 (20.6, 29.7)	27.4 (23.1, 31.7)	29.2 (26.2, 32.1)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 1. Continued

Demographic Characteristic	Total	**Considering Pregnancy < 2 Years** (n = 1,520) Percent (95% CI)	**Considering Pregnancy > 2 Years** (n = 1,708) Percent (95% CI)	**Not Considering Pregnancy** (n = 3550) Percent (95% CI)
Physical Activity categories (Frequency missing = 236)**				
Highly Active	1617	21.1 (17.2, 25.0)	29.2 (25.1, 33.3)	24.4 (21.6, 27.2)
Active	1529	22.2 (18.1, 26.3)	22.4 (18.8, 26.1)	22.3 (19.5, 25.1)
Insufficiently Active	1711	28.8 (23.9, 33.6)	26.5 (22.4, 30.5)	24.2 (21.5, 26.9)
Inactive	1685	27.9 (22.3, 33.6)	21.9 (18.2, 25.7)	29.2 (26.2, 32.2)
Asthma (Frequency missing = 34)				
Currently Have Asthma	641	9.5 (7.0, 12.1)	12.9 (9.3, 16.5)	8.8 (7.1, 10.5)
Formerly had Asthma	280	4.0 (2.6, 5.5)	3.9 (2.4, 5.3)	3.4 (2.5, 4.3)
Never had Asthma	5823	86.5 (83.5, 89.4)	83.3 (79.5, 87.0)	87.8 (85.9, 89.6)
Employment status; (Frequency missing = 22)**				
Employed for wages or Self Employed	4026	57.6 (52.4, 62.9)	48.5 (44.0, 53.0)	58.5 (55.3, 61.7)
Homemaker	1052	12.1 (8.9, 15.3)	16.7 (13.0, 20.4)	16.8 (14.4, 19.2)
Student	1061	19.6 (15.7, 23.6)	6.3 (4.5, 8.1)	19.2 (16.5, 21.9)
Out of work from at least <1 year, or retired/unable to work	617	10.7 (6.8, 14.5)	28.5 (24.4, 32.7)	5.5 (4.1, 6.9)
Insurance - Healthcare Access; (Frequency missing = 42)				
Insured	4596	63.2 (58.1, 68.2)	68.1 (64.0, 72.2)	64.5 (61.3, 67.7)
Underinsured	768	11.7 (8.8, 14.5)	8.9 (6.5, 11.3)	11.2 (9.3, 13.1)
Uninsured	1372	25.2 (20.5, 29.9)	23.0 (19.2, 26.8)	24.3 (21.3, 27.3)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 1. Continued

Demographic Characteristic	Total	**Considering Pregnancy < 2 Years** (n = 1,520) Percent (95% CI)	**Considering Pregnancy > 2 Years** (n = 1,708) Percent (95% CI)	**Not Considering Pregnancy** (n = 3550) Percent (95% CI)
Income (Frequency missing = 865)**				
Income < $15,000	859	11.6 (7.9, 15.4)	16.9 (12.5, 21.3)	13.0 (10.9, 15.1)
$15,000 ≤ Income <$25,000	1177	16.9 (13.1, 20.6)	23.7 (19.3, 28.1)	22.8 (19.9, 25.8)
$25,000 ≤ Income < $35,000	719	16.1 (9.9, 22.3)	8.1 (5.9, 10.4)	14.5 (11.8, 17.1)
$35,000 ≤ Income < $50,000	860	13.7 (10.4, 17.0)	19.0 (14.8, 23.1)	11.0 (8.9, 13.2)
Income > $50,000	2298	41.7 (36.3, 47.2)	32.3 (27.4, 37.2)	38.7 (35.6, 41.7)
Education (Frequency Missing = 6)**				
Never attended School, Elementary, or Some High School	560	13.9 (9.5, 18.3)	13.3 (9.7, 17.0)	16.1 (13.0, 19.2)
High school graduate	1755	20.6 (16.8, 24.5)	29.1 (25.1, 33.1)	27.2 (24.4, 30.0)
Some College or Technical school	2031	34.3 (28.7, 40.0)	36.6 (32.2, 41.0)	31.9 (29.0, 34.9)
College graduate	2426	31.1 (26.9, 35.4)	21.0 (17.7, 24.4)	24.8 (22.4, 27.2)
Married; (Frequency missing = 0)**				
No	3515	49.0 (43.7, 54.4)	83.0 (80.1, 85.9)	50.7 (47.5, 54.0)
Yes	3263	51.0 (45.6, 56.3)	17.0 (14.2, 20.0)	49.2 (46.1, 52.5)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 2. Prevalence of vaccination status by demographic characteristics*; BRFSS 2011**

Demographic Characteristic	Total	Vaccinated Percent (95% CI)	Unvaccinated Percent (95% CI)
Considering Pregnancy (Frequency missing = 17)			
Not considering pregnancy	3542	27.9 (25.1, 30.7)	72.1 (69.3, 74.9)
Considering Pregnancy <2 Years	1514	26.9 (21.8, 32.0)	73.1 (68.1, 78.2)
Considering Pregnancy ≥2 Years	1705	26.7 (22.8, 30.6)	73.3 (69.4, 77.2)
Age (Frequency missing = 17)			
18-24	1095	28.2 (23.2, 33.3)	71.8 (66.7, 76.8)
25-34	2619	25.5 (22.6, 28.3)	74.5 (71.7, 77.4)
35-44	3047	28.6 (25.7, 31.5)	71.4 (68.5, 74.3)
Race/Ethnicity; (Frequency missing = 69)			
White only, non-Hispanic	4099	30.0 (27.5, 32.6)	70.0 (67.4, 72.5)
Black only, non-Hispanic	1610	22.7 (18.0, 27.3)	77.3 (72.7, 82.0)
Other race, non-Hispanic	384	25.2 (17.9, 32.5)	74.8 (67.5, 82.1)
Hispanic	616	24.1 (16.8, 31.3)	75.9 (68.7, 83.2)
Married; (Frequency missing = 17)***			
No	3504	25.7 (22.6, 28.7)	74.3 (71.3, 77.4)
Yes	3257	30.0 (27.1, 32.6)	70.1 (67.4, 72.9)
Metropolitan Status Code; (Frequency missing = 1161)			
Center city of an MSA	1924	28.3 (24.0, 32.5)	71.7 (67.5, 76.0)
Inside county containing center city	819	22.8 (18.0, 27.5)	77.2 (72.5, 82.0)
Inside suburban county of MSA	828	31.2 (25.9, 36.5)	68.8 (63.5, 74.1)
Not in an MSA	2046	25.5 (22.1, 29.0)	74.5 (71.0, 77.9)
Number Children in the Household (Frequency Missing = 34)***			
0	1954	23.1 (19.8, 26.5)	76.9 (73.5, 80.2)
1	1715	26.9 (22.7, 31.1)	73.1 (68.9, 77.3)
2	1728	32.9 (29.6, 38.2)	66.1 (61.8, 70.4)
≥3	1347	26.5 (20.7, 32.3)	73.5 (67.7, 79.3)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 2. Continued

Demographic Characteristic	Total	Vaccinated Percent (95% CI)	Unvaccinated Percent (95% CI)
Heavy Drinkers?; (Frequency missing = 98)			
No	6416	27.3 (25.1, 29.5)	72.7 (70.5, 74.9)
Yes	264	24.3 (15.0, 33.5)	75.7 (66.5, 85.0)
Smoking Status; (Frequency missing = 34)***			
Never Smoked	4666	28.1 (25.4, 30.8)	71.9 (69.2, 74.6)
Former smoker	827	31.3 (25.7, 36.8)	68.7 (63.2, 74.3)
Current smoker, every day	892	19.8 (15.1, 24.5)	80.2 (75.5, 84.9)
Current smoker, some days	359	27.8 (19.1, 36.5)	72.2 (63.5, 80.9)
General Health (Frequency missing = 37)***			
Fair of Poor Health	791	20.6 (15.3, 25.9)	79.4 (74.1, 84.7)
Good or Better Health	5950	28.1 (25.8, 30.4)	71.9 (69.6, 74.2)
BMI (Frequency missing = 572)			
Underweight/Normal Weight (12.0 ≤ bmi < 25.00)	2589	27.3 (24.2, 30.4)	72.7 (69.6, 75.8)
Overweight (25.00 ≤ bmi <30.00)	1641	30.5 (35.2, 35.7)	69.5 (64.3, 74.7)
Obese (30.00 ≤ bmi)	1876	26.9 (22.9, 30.9)	73.1 (69.1, 77.1)
Physical Activity categories (Frequency missing = 251)			
Highly Active	1611	27.0 (23.0, 31.0)	73.0 (69.0, 77.0)
Active	1526	28.2 (23.9, 32.5)	71.8 (67.5, 76.1)
Insufficiently Active	1709	29.6 (25.4, 22.9)	70.4 (66.1, 74.6)
Inactive	1681	24.8 (18.9, 29.7)	75.2 (70.3, 80.1)
Asthma (Frequency missing = 51)			
Currently Have Asthma	637	27.1 (21.0, 33.1)	72.9 (66.9, 79.0)
Formerly had Asthma	280	33.1 (24.2, 42.1)	66.9 (57.9, 75.8)
Never had Asthma	5810	27.1 (24.7, 29.4)	72.9 (70.6, 75.3)
Employment status; (Frequency missing = 37)			
Employed for wages/Self Employed	4022	28.9 (26.0, 31.8)	71.1 (68.2, 74.0)
Homemaker	1048	24.7 (19.3, 30.0)	75.3 (70.0, 80.7)
Student	1057	24.7 (19.9, 29.5)	75.3 (70.5, 80.1)
Out of work from at least <1 year, or retired/unable to work	614	26.6 (20.5, 32.8)	73.4 (67.2, 79.5)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 2. Continued

Demographic Characteristic	Total	Vaccinated Percent (95% CI)	Unvaccinated Percent (95% CI)
Insurance - Healthcare Access; (Frequency missing = 59)***			
Insured	4583	31.1 (28.3, 33.9)	68.9 (66.1, 71.7)
Underinsured	768	27.3 (21.4, 33.2)	72.7 (66.8, 78.6)
Uninsured	1368	17.0 (13.2, 20.8)	83.0 (79.2, 86.8)
Income (Frequency missing = 874)***			
Income < $15,000	855	17.8 (13.1, 22.5)	82.2 (77.5, 86.9)
$15,000 ≤ Income <$25,000	1175	19.8 (15.6, 23.9)	80.2 (76.0, 84.4)
$25,000 ≤ Income < $35,000	719	28.0 (18.7, 37.3)	72.0 (62.7, 81.3)
$35,000 ≤ Income < $50,000	860	30.9 (24.6, 37.3)	69.1 (62.7, 75.4)
Income > $50,000	2295	32.6 (29.1, 36.0)	67.4 (64.0, 70.9)
Education (Frequency Missing =21)***			
Some High School or Less	558	17.3 (11.7, 22.9)	82.7 (77.1, 88.3)
High school graduate	1749	24.7 (20.9, 28.5)	75.3 (71.5, 79.1)
Some College or Technical school	2027	28.6 (24.4, 32.9)	71.4 (67.1, 75.6)
College graduate	2423	34.0 (30.6, 37.4)	66.0 (62.6, 69.4)

* not all variables add up to total sample size due to refused/unknown

**Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

***Rao-Scott Chi Square, P-value < 0.05

Table 3. Crude odds ratio from logistic regression of pregnancy intent on receipt of influenza vaccine, adjusted odds ratio, and adjusted odds ratio stratified by Race/Ethnicity; BRFSS 2011*

	Pregnancy Intent		
	After 2 years	**Within 2 years**	**Not at all**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**
Crude OR[A]	0.86 (0.63, 1.19)	0.95 (0.70, 1.30)	1.0 (Ref)
Adjusted OR[B]	0.94 (0.74, 1.20)	0.95 (0.71, 1.27)	1.0 (Ref)
Race[C]			
Hispanic	1.16 (0.53, 2.51)	1.08 (0.39, 3.01)	1.0 (Ref)
Other, Non-Hispanic	0.14 (0.05, 0.40)**	0.39 (0.15, 0.99)**	1.0 (Ref)
Black	1.02 (0.53, 1.94)	1.10 (0.57, 2.13)	1.0 (Ref)
White	0.89 (0.61, 1.28)	0.96 (0.70, 1.32)	1.0 (Ref)

A. Crude OR comparing pregnancy intent and vaccination status

B. Adjusted multivariate logistic Regression controlling for age, race, insurance, smoking status, number of children in household, and education; no interaction

C. Multivariate logistic regression of pregnancy intent on vaccination recipet stratified by race, adjusting for age, insurance, smoking status, number of children in household, and education

* Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

** P-value <0.05

Table 4. Other predictors of Vaccination coverage; BRFSS 2011.*

Variable	OR (95% CI)	p-value
Age		
18-24	REF	
25-34	0.7 (0.5, 1.0)	0.033
35-44	0.7 (0.5, 1.0)	0.0397
Race		
White only, non-Hispanic	REF	
Black only, non-Hispanic	0.7 (0.4, 1.0)	0.0641
Other race, non-Hispanic	1.7 (0.9, 3.0)	0.08
Hispanic	0.7 (0.4, 1.2)	0.2573
Insurance		
Insured	REF	
Underinsured	0.9 (0.7, 1.3)	0.6705
Uninsured	0.5 (0.4, 0.7)	<0.0001
Number of children		
0	REF	
1	1.3 (0.9, 1.7)	0.1075
2	1.9 (1.4, 2.5)	<0.0001
≥3	1.5 (1.1, 2.1)	0.0216
Smoking Status		
Never Smoked	REF	
Former Smoker	1.2 (0.9, 1.6)	0.3152
Current Smoker, every day	0.8 (0.5, 1.1)	0.1521
Current Smoker, some days	1.1 (0.7, 1.7)	0.6557
Education		
Some High school or less	REF	
High School Graduate	1.4 (0.9, 2.2)	0.1645
Some College or Technical School	1.7 (1.0, 2.6)	0.0304
College graduate	2.1 (1.3, 3.3)	0.0013

*Nine states including: Arizona, South Carolina, Tennessee, Florida, Indiana, Mississippi, Montana, Virginia, and Utah

Chapter III: summary, public health implications, possible future directions

Pregnancy intent does not significantly predict vaccination for the combined population. However, it does significantly predict vaccination status for women that are of Asian, Native Hawaiian, other Pacific Islanders, American Indian, Alaskan Natives, Multiracial, and other non-specified races for the population of this survey. Women of these ethnicities that are considering pregnancy are less likely to be vaccinated than women that are not considering pregnancy. Women of white-non-Hispanic, black-non-Hispanic, and Hispanic races are just as likely to be vaccinated whether considering pregnancy or not.

Hypotheses can be generated based on these results that women of these races and ethnicities may benefit from more directed targeting for vaccination, and targeted vaccine safety messages, emphasizing focus on those considering pregnancy at any point in the near future. Maintaining high vaccination rates among women of childbearing age will ensure that women will be immunized if and when they do become pregnant, and this survey has shown specific populations that may benefit from more active immunization strategies.

However, in order to further specify this relationship, future research is needed. To procure a full understanding of the relationship between pregnancy intent and vaccination status among the races that were most significantly affected, future studies should focus on specificity of pregnancy intent and vaccine receipt in context of race and ethnicity.

Appendices

Appendix A: Assessment of selection bias due to income inclusion

The assessment of selection bias due to income inclusion was necessary due to the large number of missing data from the respondents based on inclusion of income. The distribution of exposure and outcome variables was assessed based on whether respondents had answered the income questions. The results showed a differential distribution of the variables, indicating significant selection bias by including income in the final multivariate model. The results showed that there was a differential distribution of vaccine coverage by pregnancy intent in those that did not answer the income question (See appendix part B for analysis output).

Appendix B: Model Selection Strategy and output

Model selection proceeded through the systematic evaluation of single predictor variables for the exposure and outcome. First, variables were looked at individually in association between the exposure and outcome. All variables significant with a p-value <0.05 were then entered into a multiple logistic regression novel, with interaction terms for all predictors. The interaction terms were eliminated by standard backwards elimination at a significance of 0.05. Once all non-significant interaction terms were eliminated, confounding assessment was done. Variables were removed one at a time, and odds ratios for the full and reduced models were compared. Those predictors that caused the odds ratios to vary by more than 10% from the full model were determined to be confounders, and kept in the model. Age, education level, insurance status, number of children in the household and smoke were assessed for confounding, and all were confounders except smoke. However, removing smoke did not improve precision for all odds ratios, and was thus kept in the model.

Appendix C: SAS output for selection bias due to income inclusion

Respondents that answered income:

Data Summary	
Number of Strata	347
Number of Clusters	4563
Number of Observations	5913
Sum of Weights	7387669.41

Table of flu1 by fp2										
flu1	**fp2**	**Frequency**	**Weighted Frequency**	**Std Dev of Wgt Freq**	**Percent**	**Std Err of Percent**	**95% Confidence Limits for Percent**		**Row Percent**	**Std Err of Row Percent**
0	**0**	2179	2376523	87753	32.1992	1.2108	29.8253	34.5731	44.0398	1.5767
	1	899	1250024	79567	16.9364	1.0469	14.8840	18.9888	23.1644	1.3818
	2	962	1769766	109785	23.9783	1.3194	21.3916	26.5650	32.7958	1.6658
	Total	4040	5396313	128404	73.1139	1.1922	70.7766	75.4513	100.000	
1	**0**	1023	870889	47651	11.7996	0.6776	10.4712	13.1280	43.8873	2.4306
	1	446	482451	62049	6.5367	0.8155	4.9378	8.1355	24.3125	2.5990
	2	395	631038	61375	8.5498	0.8100	6.9618	10.1379	31.8003	2.5188
	Total	1864	1984379	93585	26.8861	1.1922	24.5487	29.2234	100.000	
Total	**0**	3202	3247413	91039	43.9988	1.3232	41.4046	46.5930		
	1	1345	1732475	97513	23.4731	1.2263	21.0688	25.8774		

Table of flu1 by fp2										
flu1	fp2	Frequency	Weighted Frequency	Std Dev of Wgt Freq	Percent	Std Err of Percent	95% Confidence Limits for Percent		Row Percent	Std Err of Row Percent
	2	1357	2400804	121624	32.5282	1.3932	29.7968	35.2596		
	Total	5904	7380692	125446	100.000					
Frequency Missing = 9										

Table of flu1 by fp2			
flu1	fp2	95% Confidence Limits for Row Percent	
0	0	40.9485	47.1310
	1	20.4554	25.8734
	2	29.5301	36.0616
	Total		
1	0	39.1220	48.6525
	1	19.2170	29.4079
	2	26.8622	36.7384

Data Summary	
Number of Strata	347
Number of Clusters	4563

Data Summary	
Number of Observations	5913
Sum of Weights	7387669.41

Table of fp2 by flu1										
fp2	**flu1**	**Frequency**	**Weighted Frequency**	**Std Dev of Wgt Freq**	**Percent**	**Std Err of Percent**	**95% Confidence Limits for Percent**		**Row Percent**	**Std Err of Row Percent**
0	**0**	2179	2376523	87753	32.1992	1.2108	29.8253	34.5731	73.1821	1.4112
	1	1023	870889	47651	11.7996	0.6776	10.4712	13.1280	26.8179	1.4112
	Total	3202	3247413	91039	43.9988	1.3232	41.4046	46.5930	100.000	
1	**0**	899	1250024	79567	16.9364	1.0469	14.8840	18.9888	72.1525	2.9603
	1	446	482451	62049	6.5367	0.8155	4.9378	8.1355	27.8475	2.9603
	Total	1345	1732475	97513	23.4731	1.2263	21.0688	25.8774	100.000	
2	**0**	962	1769766	109785	23.9783	1.3194	21.3916	26.5650	73.7156	2.3111
	1	395	631038	61375	8.5498	0.8100	6.9618	10.1379	26.2844	2.3111
	Total	1357	2400804	121624	32.5282	1.3932	29.7968	35.2596	100.000	
Total	**0**	4040	5396313	128404	73.1139	1.1922	70.7766	75.4513		
	1	1864	1984379	93585	26.8861	1.1922	24.5487	29.2234		
	Total	5904	7380692	125446	100.000					
Frequency Missing = 9										

Table of fp2 by flu1			
fp2	flu1	95% Confidence Limits for Row Percent	
0	0	70.4153	75.9488
	1	24.0512	29.5847
	Total		
1	0	66.3487	77.9563
	1	22.0437	33.6513
	Total		
2	0	69.1845	78.2466
	1	21.7534	30.8155
Frequency Missing = 9			

Respondents that did not answer income:

Data Summary	
Number of Strata	215
Number of Clusters	663
Number of Observations	865
Sum of Weights	1528509.75

Table of flu1 by fp2										
flu1	**fp2**	**Frequency**	**Weighted Frequency**	**Std Dev of Wgt Freq**	**Percent**	**Std Err of Percent**	**95% Confidence Limits for Percent**		**Row Percent**	**Std Err of Row Percent**
0	**0**	243	323522	30932	21.2712	1.9837	17.3726	25.1698	29.7347	2.7156
	1	125	186633	24713	12.2709	1.6162	9.0944	15.4473	17.1533	2.2117
	2	254	577873	49702	37.9945	2.9436	32.2092	43.7797	53.1120	3.1322
	Total	622	1088028	54139	71.5366	2.8354	65.9641	77.1091	100.000	
1	**0**	97	161826	33544	10.6399	2.1620	6.3907	14.8890	37.3809	5.8813
	1	44	48541	8846	3.1915	0.5947	2.0226	4.3603	11.2126	2.2354
	2	94	222544	31997	14.6320	2.0752	10.5535	18.7106	51.4065	5.5704
	Total	235	432911	44710	28.4634	2.8354	22.8909	34.0359	100.000	
Total	**0**	340	485348	44196	31.9111	2.7519	26.5027	37.3195		
	1	169	235173	25781	15.4624	1.7067	12.1081	18.8167		

Table of flu1 by fp2										
flu1	fp2	Frequency	Weighted Frequency	Std Dev of Wgt Freq	Percent	Std Err of Percent	95% Confidence Limits for Percent		Row Percent	Std Err of Row Percent
	2	348	800418	51011	52.6265	2.8338	47.0571	58.1960		
	Total	857	1520939	44574	100.000					
Frequency Missing = 8										

Table of flu1 by fp2			
flu1	fp2	95% Confidence Limits for Row Percent	
0	0	24.3977	35.0718
	1	12.8066	21.5000
	2	46.9562	59.2678
	Total		
1	0	25.8221	48.9397
	1	6.8193	15.6059
	2	40.4588	62.3542
Frequency Missing = 8			

Data Summary	
Number of Strata	215
Number of Clusters	663
Number of Observations	865
Sum of Weights	1528509.75

Table of fp2 by flu1

fp2	flu1	Frequency	Weighted Frequency	Std Dev of Wgt Freq	Percent	Std Err of Percent	95% Confidence Limits for Percent		Row Percent	Std Err of Row Percent
0	**0**	243	323522	30932	21.2712	1.9837	17.3726	25.1698	66.6578	5.1917
	1	97	161826	33544	10.6399	2.1620	6.3907	14.8890	33.3422	5.1917
	Total	340	485348	44196	31.9111	2.7519	26.5027	37.3195	100.000	
1	**0**	125	186633	24713	12.2709	1.6162	9.0944	15.4473	79.3596	3.7861
	1	44	48541	8846	3.1915	0.5947	2.0226	4.3603	20.6404	3.7861
	Total	169	235173	25781	15.4624	1.7067	12.1081	18.8167	100.000	
2	**0**	254	577873	49702	37.9945	2.9436	32.2092	43.7797	72.1965	3.7556
	1	94	222544	31997	14.6320	2.0752	10.5535	18.7106	27.8035	3.7556
	Total	348	800418	51011	52.6265	2.8338	47.0571	58.1960	100.000	
Total	**0**	622	1088028	54139	71.5366	2.8354	65.9641	77.1091		
	1	235	432911	44710	28.4634	2.8354	22.8909	34.0359		

Table of fp2 by flu1										
fp2	**flu1**	**Frequency**	**Weighted Frequency**	**Std Dev of Wgt Freq**	**Percent**	**Std Err of Percent**	**95% Confidence Limits for Percent**		**Row Percent**	**Std Err of Row Percent**
	Total	857	1520939	44574	100.000					
Frequency Missing = 8										

Table of fp2 by flu1			
fp2	**flu1**	**95% Confidence Limits for Row Percent**	
0	**0**	56.4542	76.8613
	1	23.1387	43.5458
	Total		
1	**0**	71.9186	86.8007
	1	13.1993	28.0814
	Total		
2	**0**	64.8154	79.5776
	1	20.4224	35.1846
Frequency Missing = 8			

Respondents that answered income:

Model Information		
Data Set	WORK.INCANS	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	347	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	4556	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	5913

Number of Observations Used	5904
Sum of Weights Read	7387669
Sum of Weights Used	7380692

Response Profile			
Ordered Value	flu1	Total Frequency	Total Weight
1	0	4040	5396313.1
2	1	1864	1984378.7

Probability modeled is flu1=1.

Note 9 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information			
Class	Value	Design Variables	
fp2	0	0	0
	1	1	0

Class Level Information			
Class	Value	Design Variables	
	2	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	8592935.1	8591678.6
SC	8592941.8	8591698.6
-2 Log L	8592933.1	8591672.6

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1260.4948	2	<.0001

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Score	1264.3862	2	<.0001
Wald	0.1745	2	0.9165

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	2	0.1745	0.9165

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept		1	-1.0039	0.0719	194.8454	<.0001
fp2	**1**	1	0.0518	0.1644	0.0995	0.7525
fp2	**2**	1	-0.0274	0.1396	0.0384	0.8446

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
fp2 1 vs 0	1.053	0.763	1.454

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
fp2 2 vs 0	0.973	0.740	1.279

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	31.7	**Somers' D**	0.033
Percent Discordant	28.4	**Gamma**	0.055
Percent Tied	40.0	**Tau-a**	0.014
Pairs	7530560	**c**	0.517

Respondents that did not answer income:

Model Information		
Data Set	WORK.INCMISS	
Response Variable	flu1	
Number of Response Levels	2	

Model Information		
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	215	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	657	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	865
Number of Observations Used	857
Sum of Weights Read	1528510
Sum of Weights Used	1520939

Response Profile			
Ordered Value	**flu1**	**Total Frequency**	**Total Weight**
1	0	622	1088028.4
2	1	235	432911.1

Probability modeled is flu1=1.

Note : 8 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information			
Class	**Value**	**Design Variables**	
fp2	**0**	0	0
	1	1	0
	2	0	1

Model Convergence Status

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	1816845.9	1803641.3
SC	1816850.6	1803655.6
-2 Log L	1816843.9	1803635.3

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	13208.5826	2	<.0001
Score	12913.3889	2	<.0001
Wald	3.8942	2	0.1427

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	2	3.8942	0.1427

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept		1	-0.6927	0.2339	8.7737	0.0031
fp2	**1**	1	-0.6535	0.3333	3.8439	0.0499
fp2	**2**	1	-0.2615	0.2845	0.8448	0.3580

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
fp2 1 vs 0	0.520	0.271	1.000
fp2 2 vs 0	0.770	0.441	1.345

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	33.2	**Somers' D**	0.026

Association of Predicted Probabilities and Observed Responses			
Percent Discordant	30.6	**Gamma**	0.041
Percent Tied	36.2	**Tau-a**	0.010
Pairs	146170	**c**	0.513

Appendix D: SAS code for dataset and multiple logistic regression

```
*************************************************************;
*  Sophie Smith - Thesis Dataset from BRFSS 2011 survey      *;
*  Starting Date: 12/16/2013                                 *;
*                                                            *;
*  BRFSS data pulled from online website - public access     *;
*                  data available                            *;
*  Using SAS programs saved under 'Thesis Data' program      *;
*  data pulled into SAS, and formatted into SAS dataset      *;
*  from ACS formatted dataset. All files for this can be     *;
*  found at:                                                 *;
*        http://www.cdc.gov/brfss/annual_data/annual_2012.html*;
*                                                            *;
*************************************************************;
LIBNAME sophie '\\cdc.gov\private\L327\wvf7\Documents to email\Class
Work\Thesis\V_P_BRFSS\SAS';

*extraction of states including preconception/family planning module from landline and cellular
telephone questionnaire (llcp observation count = 25351);
data llcp;
        set sophie.landcell (where =(_state in (4, 45, 47)));
        _finalwt = _llcpwt;
        drop _llcpwt;
run;

*extraction of states including preconception/family planning module from landline only:
common module (land observation count = 58161);
data land;
        set sophie.landonly (where = (_state in (4, 12, 18, 28, 29, 45, 47, 51)));
        _finalwt = _landwt;
        drop _landwt;
run;

*need to get the correct weights for the sample sizes from each of the versions that Utah used:;
proc freq data=sophie.landv2;
        where FPCHLDF2 ne . and _state = 49;
        tables _state;
run;

proc freq data =sophie.landv3;
        where FPCHLDF2 ne . and _state = 49;
        tables _state;
run;


*extraction of states including preconception/family planning module from landline only:
multiple modules, versions 2 and 3.
        For these extractions, since Utah used two different versions of the landline (versions 2
and 3) the weights have to be multiplied accordingly so
        that the sample size is correct. Taking the sum of sample size frequencies just found (312
+ 343 = 655), and finding the proportions of the sample size
```

```
        each version is of the sum (version 2 = 312/655 = 0.4763 ~ .5) (version 3 = 343/655 =
0.5237 ~ 0.5), multiply the weights accordingly. Since the sample
        sizes of the two versions are roughly equivalent, a proportion of 1/2 is used, and the final
weights are calculated by multiplying the weights in each
        dataset by 1/2.;
        *(landv2 observation count = 2618);
data landv2;
        set sophie.landv2 (where =(_state=49));
        _finalwt = _lndwtv2*(1/2);
        drop _lndwtv2;
run;
        *(landv3 observation count = 2583);
data landv3;
        set sophie.landv3 (where =(_state=49));
        _finalwt = _lndwtv3*(1/2);
        drop _lndwtv3;
run;

*final thesis dataset as compiled from the datasets extracted from original BRFSS datasets (thesis
final observations count = 88713);
data THESIS;
        set llcp land landv2 landv3;
run;
data thesis;
set thesis;

*creation of variable to show adequate, under, and un-insured status*;
if HLTHPLN1 = 1 and MEDCOST = 2 then under = 1;
if HLTHPLN1 = 1 and MEDCOST = 1 then under = 2;
if HLTHPLN1 = 2 then under = 3;

if fpchldf2 = 1 then fp2 = 0;
else if fpchldf2 = 2 or fpchldf2 = 3 then fp2=1;
else if fpchldf2 = 4 or fpchldf2 = 5 then fp2 = 2;
else if fpchldf2 = 7 or fpchldf2 = 9 then fp2 = 3;

if fp2 = 3 then fp3 = .;
else if fp2 = 0 then fp3 = 2;
else if fp2 = 1 then fp3 = 1;
else if fp2 = 2 then fp3 = 0;

if marital = . then married = .;
else if marital=1 then married = 1;
else married = 0;


If   smoker3 =9 then smoke = .;
else if _smoker3 = 4 then smoke = 0;
else if _smoker3 = 3 then smoke = 1;
else if   smoker3 = 1 then smoke = 2;
else if _smoker3 = 2 then smoke = 3;
```

```
if   rfdrwm4 = 9 then hvdrnk = .;
else if   rfdrwm4 = 1 then hvdrnk = 0;
else if _rfdrwm4 = 2 then hvdrnk = 1;

if   pacat = 9 then physac = .;
else if _pacat = 1 then physac = 1;
else if _pacat = 2 then physac = 2;
else if   pacat = 3 then physac = 3;
else if _pacat = 4 then physac = 4;

if _incomg = 9 then inc = .;
else if   incomg = 1 then inc = 1;
else if   incomg = 2 then inc = 2;
else if _incomg = 3 then inc = 3;
else if   incomg = 4 then inc = 4;
else if _incomg = 5 then inc = 5;

if _asthms1 = 9 then asth = .;
else if   asthms1 = 1 then asth = 1;
else if   asthms1 = 2 then asth = 2;
else if _asthms1 = 3 then asth = 3;

if employ =. then emp = .;
else if employ = 9 then emp = . ;
else if employ = 1 then emp = 1;
else if employ = 2 then emp = 1;
else if employ = 3 then emp = 2;
else if employ = 4 then emp = 2;
else if employ = 7 then emp = 2;
else if employ = 8 then emp = 2;
else if employ = 5 then emp = 3;
else if employ = 6 then emp = 4;

if   rfhlth = 9 then hlth = .;
else if   rfhlth = 1 then hlth = 1;
else hlth = 0;

if   chldcnt = 9 then chld =.;
else if   chldcnt = 0 then chld = 0;
else if _chldcnt = 1 then chld = 1;
else if   chldcnt = 2 then chld = 2;
else if   chldcnt = 3 then chld = 3;
else if _chldcnt ge 4 then chld = 4;

if flushot5 = . then flu1 = .;
else if flushot5 = 1 then flu1 = 1;
else if flushot5 = 2 then flu1 = 0;
else flu1 = .;

if race2 = . then r2 = .;
```

```
else if race2 = 9 then r2 = .;
else if race2 = 1 then r2 = 1;
else if race2 = 2 then r2 = 2;
else if 3 le race2 le 7 then r2 = 3;
else if race2 = 8 then r2 = 4;

if _age_g = 4 or _age_g = 5 or _age_g = 6 then delete;

if 7 le genhlth le 9 then genhlth= .;

if educa = 9 then educa1 = .;
else if educa = 1 then educa1 = 1;
else if educa = 2 then educa1 = 1;
else if educa = 3 then educa1 = 1;
else if educa = 4 then educa1 = 2;
else if educa = 5 then educa1 = 3;
else if educa = 6 then educa1 = 4;

if _bmi5cat = ' ' then bmicat = .;
else if 1 le   bmi5cat le 2 then bmicat = 1;
else if   bmi5cat = 3 then bmicat = 2;
else if _bmi5cat = 4 then bmicat = 3;

run;

*dataset where exposure variable was answered, and all missing data removed;
data thesis2;
        set thesis;
        where fpchldf2 ne .;
run;

data thesis3;
        set thesis2;
        where fp2 ne 3;
run;

*proc surveyfreq to evaluate characteristics of exposure groups;

*age categories;
proc surveyfreq data=thesis3;
        cluster _PSU;
        strata _ststr;
        weight _finalwt;
        tables fp2*_age_g/chisq cl row;
run;

*ethnicity/race;
proc surveyfreq data=thesis3;
        cluster _PSU;
        strata _ststr;
        weight _finalwt;
```

```
        tables fp2*race2/chisq cl row;
run;

*marital status;
proc surveyfreq data = thesis3;
        cluster _PSU;
        strata _ststr;
        weight _finalwt;
        tables fp2*married/chisq cl row;
run;

*metropolitan status code;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*mscode/chisq cl row;
Run;

*how many children are already in the household?;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*chld/chisq cl row ;
Run;
*Alcohol consumption;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*hvdrnk/chisq cl row;
Run;

*smoking status;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*smoke/chisq cl row;
Run;

*employment status;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*emp/chisq cl row;
Run;

*general health – computed variable of adults with good/better health;
```

```
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*hlth/chisq cl row;
Run;

*created variable for healthcare access = adequately, under, or un- insured;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*under/chisq cl row ;
Run;

*have healthplan at all?;

Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*hp1/chisq cl row ;
Run;

*bmi in categories;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*_bmi5cat/chisq cl row;
Run;

*physical activity categories;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*physac/chisq cl row;
Run;

*calculated income categories;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*inc/chisq cl row;
Run;

*computed asthma categories;
Proc surveyfreq data=thesis3;
        Cluster _psu;
```

```
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*asth/chisq cl row;
Run;

*education;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*educa/chisq cl row;
Run;

*alternate insurance var;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*hp1/chisq cl row;
Run;

*place of flushot;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*fluplace/chisq cl row;
Run;

*flushot;
Proc surveyfreq data=thesis3;
        Cluster _psu;
        Strata _ststr;
        Weight _finalwt;
        Tables fp2*flu1/chisq cl row;
Run;


*************************************************************************;
*       MODEL SELECTION SECTION:
        *;
*           - Part 1: individual terms to find those that are significant*;
*           - Part 2: mutivariate model selection with interaction and   *;
*                 confounding
        *;
*************************************************************************;
*                                                 PART 1
        *;
*************************************************************************;
proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
```

```
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class _age_g (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') =  fp2 _age_g;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class r2 (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 r2 ;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 married;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class mscode (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 mscode;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class chld (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 chld;
run;

proc surveylogistic data = thesis3;
```

```
        class fp2 (ref = '0')/ param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 hvdrnk;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class smoke (ref = '0')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 smoke;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class emp (ref = '2')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fpm2 emp;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 hlth;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class under (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 under;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class bmicat (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 bmicat;
run;
```

```
proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class physac (ref = '4')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 physac;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class inc (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') =  fp2 inc;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class asth (ref = '3')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 asth;
run;

proc surveylogistic data = thesis3;
        class fp2 (ref = '0')/ param = ref;
        class educa1 (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') = fp2 educa1;
run;


*************************************************************************;
* The inc variable has a high amount of missing, ~13% of respondents    *;
* did not answer. In order to assess for selection bias due to this     *;
* large amount of missing data, a seperate multivariate analysis is     *;
* needed for those with an answer to the income variable and those      *;
* without one.                                                          *;
*************************************************************************;

*dataset including only observations with an answer for income;
data incans;
set thesis3;
where inc ne .;
run;
```

```
*dataset including only observations without an answer for income;
data incmiss;
set thesis3;
where inc = .;
run;

*multivariate regression for those with answer for income;
ods rtf file = '\\cdc.gov\private\L327\wvf7\Documents to email\Class Work\Thesis\model
selection outputs\income models.rtf' bodytitle startpage = no;
ods noproctitle;
proc surveylogistic data=incans;
        class fp2 (ref = '0')/ param = ref;
        class r2 (ref = '1')/param = ref;
        class _age_g (ref = '1')/param = ref;
        class under (ref = '1')/param = ref;
        class chld (ref = '1')/param = ref;
        class smoke (ref = '0')/param = ref;
        class educa1 (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') =          fp2 r2 _age_g smoke under chld educa1 fp2*r2;

        contrast 'fp2=2, r2=4' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 0 1/est=exp;
        contrast 'fp2=2, r2=3' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 1 0/est=exp;
        contrast 'fp2=2, r2=2' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 1 0 0/est=exp;
        contrast 'fp2=1, r2=1' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 0 0/est=exp;

        contrast 'fp2=1, r2=4' fp2 1 0 r2 0 0 0 fp2*r2 0 0 1 0 0 0/est=exp;
        contrast 'fp2=1, r2=3' fp2 1 0 r2 0 0 0 fp2*r2 0 1 0 0 0 0/est=exp;
        contrast 'fp2=1, r2=2' fp2 1 0 r2 0 0 0 fp2*r2 1 0 0 0 0 0/est=exp;
        contrast 'fp2=1, r2=1' fp2 1 0 r2 0 0 0 fp2*r2 0 0 0 0 0 0/est=exp;


run;

* mulivariate regression for those without an answer for income;
proc surveylogistic data=incmiss;
        class fp2 (ref = '0')/ param = ref;
        class r3 (ref = '1')/param = ref;
        class _age_g (ref = '1')/param = ref;
        class under (ref = '1')/param = ref;
        class chld (ref = '1')/param = ref;
        class smoke (ref = '0')/param = ref;
        class educa1 (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') =          fp2 r2 _age_g smoke under chld educa1 fp2*r2;

        contrast 'fp2=2, r2=4' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 0 1/est=exp;
```

```
        contrast 'fp2=2, r2=3' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 1 0/est=exp;
        contrast 'fp2=2, r2=2' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 1 0 0/est=exp;
        contrast 'fp2=1, r2=1' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 0 0/est=exp;

        contrast 'fp2=1, r2=4' fp2 1 0 r2 0 0 0 fp2*r2 0 0 1 0 0 0/est=exp;
        contrast 'fp2=1, r2=3' fp2 1 0 r2 0 0 0 fp2*r2 0 1 0 0 0 0/est=exp;
        contrast 'fp2=1, r2=2' fp2 1 0 r2 0 0 0 fp2*r2 1 0 0 0 0 0/est=exp;
        contrast 'fp2=1, r2=1' fp2 1 0 r2 0 0 0 fp2*r2 0 0 0 0 0 0/est=exp;


run;
ods rtf close;

*based on the results, inclusion of income variable causes selection bias, and thus will not be
included in the final multivariate regression model;

*************************************************************************;
*       MODEL SELECTION SECTION:
*;
*               - Part 1: individual terms to find those that are significant*;
*               - Part 2: mutivariate model selection with interaction and   *;
*                       confounding
*;
*************************************************************************;
*                               PART 2
*;
*************************************************************************;

*************************************************************************;
*Based off of part 1 of model selection, variables that are significant    *;
*and will be included are:                                                 *;
*       _age_g (even though not actually significant, age should be kept in),*; *  r2 (race), chld,
smoke, hlth, under, educa1.                                               *;
*************************************************************************;

ods rtf file = '\\cdc.gov\private\L327\wvf7\Documents to email\Class Work\Thesis\model
selection outputs\final model output.rtf' bodytitle startpage = no;
ods noproctitle;

proc surveylogistic data = thesis3;
        class fp2 (ref='0')/param=ref;
        class _age_g (ref = '1')/param = ref;
        class r2 (ref='1')/param=ref;
        class under (ref = '1')/param = ref;
        class chld (ref = '1')/param = ref;
        class smoke (ref = '0')/param = ref;
        class educa1 (ref = '1')/param = ref;
        stratum _ststr;
        cluster _psu;
        weight _finalwt;
        model flu1 (event = '1') =          fp2 _age_g r2 under smoke chld educa1 fp2*r2;
```

```
        contrast 'fp2=2, r2=4' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 0 1/est=exp;
        contrast 'fp2=2, r2=3' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 1 0/est=exp;
        contrast 'fp2=2, r2=2' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 1 0 0/est=exp;
        contrast 'fp2=1, r2=1' fp2 0 1 r2 0 0 0 fp2*r2 0 0 0 0 0 0/est=exp;

        contrast 'fp2=1, r2=4' fp2 1 0 r2 0 0 0 fp2*r2 0 0 1 0 0 0/est=exp;
        contrast 'fp2=1, r2=3' fp2 1 0 r2 0 0 0 fp2*r2 0 1 0 0 0 0/est=exp;
        contrast 'fp2=1, r2=2' fp2 1 0 r2 0 0 0 fp2*r2 1 0 0 0 0 0/est=exp;
        contrast 'fp2=1, r2=1' fp2 1 0 r2 0 0 0 fp2*r2 0 0 0 0 0 0/est=exp;

run;
ods rtf close;
```

Appendix E: Confounding assessment output

The SAS System

Model Information		
Data Set	WORK.THESIS3	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	353	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	5117	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	6778
Number of Observations Used	6634
Sum of Weights Read	8916179
Sum of Weights Used	8714751

Response Profile			
Ordered Value	**flu1**	**Total Frequency**	**Total Weight**
1	0	4580	6344532.6
2	1	2054	2370218.9

Probability modeled is flu1=1.

Note: 144 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information				
Class	**Value**	**Design Variables**		
fp2	**0**	0	0	

Class Level Information				
Class	**Value**	**Design Variables**		
	1	1	0	
	2	0	1	
_AGE_G	**1**	0	0	
	2	1	0	
	3	0	1	
r2	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
under	**1**	0	0	
	2	1	0	
	3	0	1	
chld	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
smoke	**0**	0	0	0
	1	1	0	0
	2	0	1	0

Class Level Information				
Class	Value	Design Variables		
	3	0	0	1
educa1	1	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	10200028	9748227.7
SC	10200034	9748397.7
-2 Log L	10200026	9748177.7

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	451847.891	24	<.0001
Score	424460.171	24	<.0001
Wald	103.5529	24	<.0001

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
fp2	2	0.3791	0.8273
_AGE_G	2	5.2908	0.0710
r2	3	8.6710	0.0340
under	2	17.2932	0.0002
smoke	3	4.2726	0.2335
chld	3	16.5299	0.0009
educa1	3	13.9478	0.0030
fp2*r2	6	13.1091	0.0413

Analysis of Maximum Likelihood Estimates							
Parameter			DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept			1	-1.1011	0.3119	12.4647	0.0004
fp2	1		1	-0.0252	0.1679	0.0225	0.8808

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	**2**		1	-0.1158	0.1926	0.3617	0.5476
_AGE_G	**2**		1	-0.4245	0.1905	4.9650	0.0259
_AGE_G	**3**		1	-0.4241	0.2010	4.4538	0.0348
r2	**2**		1	-0.3926	0.2157	3.3137	0.0687
r2	**3**		1	0.5424	0.3033	3.1982	0.0737
r2	**4**		1	-0.3396	0.2727	1.5510	0.2130
under	**2**		1	-0.0887	0.1718	0.2662	0.6059
under	**3**		1	-0.6659	0.1607	17.1732	<.0001
smoke	**1**		1	0.1518	0.1591	0.9108	0.3399
smoke	**2**		1	-0.2576	0.1818	2.0089	0.1564
smoke	**3**		1	0.0989	0.2257	0.1920	0.6612
chld	**2**		1	0.2446	0.1572	2.4225	0.1196
chld	**3**		1	0.6056	0.1499	16.3148	<.0001
chld	**4**		1	0.4301	0.1847	5.4231	0.0199
educa1	**2**		1	0.2881	0.2368	1.4802	0.2237
educa1	**3**		1	0.4774	0.2380	4.0239	0.0449
educa1	**4**		1	0.7268	0.2375	9.3611	0.0022
fp2*r2	**1**	**2**	1	0.1270	0.3639	0.1217	0.7272
fp2*r2	**1**	**3**	1	-0.9176	0.5026	3.3335	0.0679

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
fp2*r2	**1**	**4**	1	0.1459	0.5457	0.0714	0.7892
fp2*r2	**2**	**2**	1	0.1294	0.3511	0.1358	0.7125
fp2*r2	**2**	**3**	1	-1.8572	0.5623	10.9103	0.0010
fp2*r2	**2**	**4**	1	0.2775	0.4341	0.4087	0.5226

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
_AGE_G 2 vs 1	0.654	0.450	0.950
_AGE_G 3 vs 1	0.654	0.441	0.970
under 2 vs 1	0.915	0.653	1.282
under 3 vs 1	0.514	0.375	0.704
smoke 1 vs 0	1.164	0.852	1.590
smoke 2 vs 0	0.773	0.541	1.104
smoke 3 vs 0	1.104	0.709	1.718
chld 2 vs 1	1.277	0.939	1.738
chld 3 vs 1	1.832	1.366	2.458
chld 4 vs 1	1.537	1.070	2.208
educa1 2 vs 1	1.334	0.839	2.121

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
educa1 3 vs 1	1.612	1.011	2.570
educa1 4 vs 1	2.068	1.298	3.295

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	61.2	**Somers' D**	0.232
Percent Discordant	37.9	**Gamma**	0.235
Percent Tied	0.9	**Tau-a**	0.099
Pairs	9407320	**c**	0.616

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	1	0.1563	0.6926
fp2=2, r2=3 after 2 years, other NH	1	13.0748	0.0003
fp2=2, r2=2 after 2 years, black NH	1	0.0017	0.9672

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=1 after 2 years, white NH	1	0.3617	0.5476
fp2=1, r2=4 before 2 years, hispanic	1	0.0519	0.8198
fp2=1, r2=3 before 2 years, other NH	1	3.7987	0.0513
fp2=1, r2=2 before 2 years, black NH	1	0.0918	0.7619
fp2=1, r2=1 before 2 years, white NH	1	0.0225	0.8808

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	EXP	1	1.1755	0.4808	0.05	0.5273	2.6204	0.1563	0.6926
fp2=2, r2=3 after 2 years, other NH	EXP	1	0.1390	0.0759	0.05	0.0477	0.4051	13.0748	0.0003
fp2=2, r2=2 after 2 years, black NH	EXP	1	1.0136	0.3339	0.05	0.5315	1.9332	0.0017	0.9672
fp2=2, r2=1 after 2 years, white NH	EXP	1	0.8906	0.1715	0.05	0.6106	1.2991	0.3617	0.5476
fp2=1, r2=4 before 2 years, hispanic	EXP	1	1.1283	0.5978	0.05	0.3994	3.1875	0.0519	0.8198
fp2=1, r2=3 before 2 years, other NH	EXP	1	0.3895	0.1884	0.05	0.1509	1.0053	3.7987	0.0513

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=1, r2=2 before 2 years, black NH	EXP	1	1.1072	0.3720	0.05	0.5731	2.1388	0.0918	0.7619
fp2=1, r2=1 before 2 years, white NH	EXP	1	0.9751	0.1637	0.05	0.7017	1.3551	0.0225	0.8808

The SAS System

Model Information		
Data Set	WORK.THESIS3	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	354	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	5129	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	

Model Information		
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	6778
Number of Observations Used	6650
Sum of Weights Read	8916179
Sum of Weights Used	8728970

Response Profile			
Ordered Value	**flu1**	**Total Frequency**	**Total Weight**
1	0	4592	6356706.2
2	1	2058	2372263.6

Probability modeled is flu1=1.

Note : 128 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information				
Class	**Value**	**Design Variables**		
fp2	**0**	0	0	
	1	1	0	
	2	0	1	
_AGE_G	**1**	0	0	
	2	1	0	
	3	0	1	
r2	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
under	**1**	0	0	
	2	1	0	
	3	0	1	
chld	**1**	0	0	0

Class Level Information				
Class	**Value**	**Design Variables**		
	2	1	0	0
	3	0	1	0
	4	0	0	1
educa1	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	10213079	9776656.6
SC	10213085	9776806.3
-2 Log L	10213077	9776612.6

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	436464.028	21	<.0001
Score	410190.691	21	<.0001
Wald	97.6405	21	<.0001

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	2	0.3306	0.8476
_AGE_G	2	5.5909	0.0611
r2	3	8.6433	0.0344
under	2	17.8773	0.0001
chld	3	17.0312	0.0007
educa1	3	18.5371	0.0003
fp2*r2	6	13.1977	0.0400

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	-1.1722	0.3009	15.1748	<.0001
fp2	**1**		1	-0.0188	0.1676	0.0125	0.9109
fp2	**2**		1	-0.1068	0.1921	0.3091	0.5783
_AGE_G	**2**		1	-0.4266	0.1843	5.3554	0.0207
_AGE_G	**3**		1	-0.4151	0.1964	4.4691	0.0345
r2	**2**		1	-0.3785	0.2139	3.1319	0.0768
r2	**3**		1	0.5548	0.3038	3.3354	0.0678
r2	**4**		1	-0.3252	0.2650	1.5066	0.2197
under	**2**		1	-0.1076	0.1697	0.4023	0.5259
under	**3**		1	-0.6748	0.1598	17.8318	<.0001
chld	**2**		1	0.2512	0.1569	2.5620	0.1095
chld	**3**		1	0.6128	0.1501	16.6681	<.0001
chld	**4**		1	0.4470	0.1821	6.0276	0.0141
educa1	**2**		1	0.3219	0.2357	1.8653	0.1720
educa1	**3**		1	0.5309	0.2327	5.2056	0.0225
educa1	**4**		1	0.7942	0.2279	12.1424	0.0005
fp2*r2	**1**	**2**	1	0.1038	0.3635	0.0816	0.7752
fp2*r2	**1**	**3**	1	-0.9116	0.4983	3.3465	0.0674
fp2*r2	**1**	**4**	1	0.1443	0.5434	0.0705	0.7906

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
fp2*r2	**2**	**2**	1	0.1146	0.3513	0.1064	0.7443
fp2*r2	**2**	**3**	1	-1.8679	0.5633	10.9971	0.0009
fp2*r2	**2**	**4**	1	0.2983	0.4334	0.4736	0.4913

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
_AGE_G 2 vs 1	0.653	0.455	0.937
_AGE_G 3 vs 1	0.660	0.449	0.970
under 2 vs 1	0.898	0.644	1.252
under 3 vs 1	0.509	0.372	0.697
chld 2 vs 1	1.286	0.945	1.748
chld 3 vs 1	1.846	1.375	2.477
chld 4 vs 1	1.564	1.094	2.234
educa1 2 vs 1	1.380	0.869	2.190
educa1 3 vs 1	1.700	1.078	2.683
educa1 4 vs 1	2.213	1.415	3.458

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	60.8	**Somers' D**	0.226
Percent Discordant	38.2	**Gamma**	0.229
Percent Tied	1.1	**Tau-a**	0.097
Pairs	9450336	**c**	0.613

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	1	0.2199	0.6391
fp2=2, r2=3 after 2 years, other NH	1	13.0513	0.0003
fp2=2, r2=2 after 2 years, black NH	1	0.0006	0.9811
fp2=2, r2=1 after 2 years, white NH	1	0.3091	0.5783
fp2=1, r2=4 before 2 years, hispanic	1	0.0569	0.8115
fp2=1, r2=3 before 2 years, other NH	1	3.7653	0.0523
fp2=1, r2=2 before 2 years, black NH	1	0.0641	0.8001
fp2=1, r2=1 before 2 years, white NH	1	0.0125	0.9109

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	EXP	1	1.2110	0.4943	0.05	0.5441	2.6954	0.2199	0.6391
fp2=2, r2=3 after 2 years, other NH	EXP	1	0.1388	0.0759	0.05	0.0475	0.4052	13.0513	0.0003
fp2=2, r2=2 after 2 years, black NH	EXP	1	1.0078	0.3325	0.05	0.5279	1.9240	0.0006	0.9811
fp2=2, r2=1 after 2 years, white NH	EXP	1	0.8987	0.1727	0.05	0.6167	1.3097	0.3091	0.5783
fp2=1, r2=4 before 2 years, hispanic	EXP	1	1.1338	0.5968	0.05	0.4041	3.1810	0.0569	0.8115
fp2=1, r2=3 before 2 years, other NH	EXP	1	0.3944	0.1891	0.05	0.1541	1.0094	3.7653	0.0523
fp2=1, r2=2 before 2 years, black NH	EXP	1	1.0888	0.3657	0.05	0.5637	2.1029	0.0641	0.8001
fp2=1, r2=1 before 2 years, white NH	EXP	1	0.9814	0.1645	0.05	0.7066	1.3630	0.0125	0.9109

Model Information		
Data Set	WORK.THESIS3	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	353	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	5117	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	6778

Number of Observations Used	6634
Sum of Weights Read	8916179
Sum of Weights Used	8714751

Response Profile			
Ordered Value	flu1	Total Frequency	Total Weight
1	0	4580	6344532.6
2	1	2054	2370218.9

Probability modeled is flu1=1.

Note: 144 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information				
Class	Value	Design Variables		
fp2	0	0	0	
	1	1	0	

Class Level Information				
Class	**Value**	**Design Variables**		
	2	0	1	
r2	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
under	**1**	0	0	
	2	1	0	
	3	0	1	
chld	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
smoke	**0**	0	0	0
	1	1	0	0
	2	0	1	0
	3	0	0	1
educa1	**1**	0	0	0
	2	1	0	0
	3	0	1	0

Class Level Information				
Class	Value	Design Variables		
	4	0	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	10200028	9789197.5
SC	10200034	9789353.9
-2 Log L	10200026	9789151.5

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	410874.101	22	<.0001
Score	386973.718	22	<.0001
Wald	83.2432	22	<.0001

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	2	0.3008	0.8604
r2	3	8.3014	0.0402
under	2	16.0388	0.0003
smoke	3	3.9908	0.2625
chld	3	13.7647	0.0032
educa1	3	9.4159	0.0242
fp2*r2	6	13.0621	0.0421

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	-1.4104	0.2811	25.1802	<.0001
fp2	**1**		1	0.0263	0.1565	0.0282	0.8666
fp2	**2**		1	0.0885	0.1620	0.2986	0.5848
r2	**2**		1	-0.3770	0.2135	3.1184	0.0774
r2	**3**		1	0.5414	0.3018	3.2182	0.0728
r2	**4**		1	-0.3248	0.2742	1.4029	0.2362
under	**2**		1	-0.0958	0.1741	0.3025	0.5823

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
under	**3**		1	-0.6550	0.1640	15.9450	<.0001
smoke	**1**		1	0.0761	0.1569	0.2350	0.6278
smoke	**2**		1	-0.3068	0.1797	2.9145	0.0878
smoke	**3**		1	0.0827	0.2270	0.1329	0.7154
chld	**2**		1	0.2261	0.1564	2.0887	0.1484
chld	**3**		1	0.5483	0.1486	13.6106	0.0002
chld	**4**		1	0.3493	0.1805	3.7450	0.0530
educa1	**2**		1	0.3200	0.2372	1.8200	0.1773
educa1	**3**		1	0.4793	0.2404	3.9760	0.0462
educa1	**4**		1	0.6334	0.2330	7.3915	0.0066
fp2*r2	**1**	**2**	1	0.0811	0.3619	0.0503	0.8226
fp2*r2	**1**	**3**	1	-0.9211	0.4993	3.4031	0.0651
fp2*r2	**1**	**4**	1	0.1685	0.5811	0.0841	0.7718
fp2*r2	**2**	**2**	1	0.0728	0.3493	0.0435	0.8348
fp2*r2	**2**	**3**	1	-1.8646	0.5582	11.1593	0.0008
fp2*r2	**2**	**4**	1	0.2586	0.4330	0.3568	0.5503

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
under 2 vs 1	0.909	0.646	1.278
under 3 vs 1	0.519	0.377	0.716
smoke 1 vs 0	1.079	0.793	1.468
smoke 2 vs 0	0.736	0.517	1.046
smoke 3 vs 0	1.086	0.696	1.695
chld 2 vs 1	1.254	0.923	1.704
chld 3 vs 1	1.730	1.293	2.316
chld 4 vs 1	1.418	0.996	2.020
educa1 2 vs 1	1.377	0.865	2.192
educa1 3 vs 1	1.615	1.008	2.587
educa1 4 vs 1	1.884	1.193	2.974

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	61.6	**Somers' D**	0.243
Percent Discordant	37.3	**Gamma**	0.245
Percent Tied	1.0	**Tau-a**	0.104

Association of Predicted Probabilities and Observed Responses			
Pairs	9407320	**c**	0.621

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	1	0.7481	0.3871
fp2=2, r2=3 after 2 years, other NH	1	10.8862	0.0010
fp2=2, r2=2 after 2 years, black NH	1	0.2530	0.6150
fp2=2, r2=1 after 2 years, white NH	1	0.2986	0.5848
fp2=1, r2=4 before 2 years, hispanic	1	0.1159	0.7336
fp2=1, r2=3 before 2 years, other NH	1	3.4989	0.0614
fp2=1, r2=2 before 2 years, black NH	1	0.1057	0.7451
fp2=1, r2=1 before 2 years, white NH	1	0.0282	0.8666

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	EXP	1	1.4150	0.5680	0.05	0.6443	3.1077	0.7481	0.3871

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=3 after 2 years, other NH	EXP	1	0.1693	0.0911	0.05	0.0589	0.4862	10.8862	0.0010
fp2=2, r2=2 after 2 years, black NH	EXP	1	1.1751	0.3770	0.05	0.6266	2.2038	0.2530	0.6150
fp2=2, r2=1 after 2 years, white NH	EXP	1	1.0926	0.1770	0.05	0.7953	1.5009	0.2986	0.5848
fp2=1, r2=4 before 2 years, hispanic	EXP	1	1.2151	0.6955	0.05	0.3957	3.7310	0.1159	0.7336
fp2=1, r2=3 before 2 years, other NH	EXP	1	0.4087	0.1955	0.05	0.1600	1.0437	3.4989	0.0614
fp2=1, r2=2 before 2 years, black NH	EXP	1	1.1134	0.3679	0.05	0.5827	2.1275	0.1057	0.7451
fp2=1, r2=1 before 2 years, white NH	EXP	1	1.0266	0.1607	0.05	0.7555	1.3952	0.0282	0.8666

Model Information		
Data Set	WORK.THESIS3	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	353	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	5120	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	6778

Number of Observations Used	6637
Sum of Weights Read	8916179
Sum of Weights Used	8717112

Response Profile			
Ordered Value	flu1	Total Frequency	Total Weight
1	0	4583	6346893.4
2	1	2054	2370218.9

Probability modeled is flu1=1.

Note: 141 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information				
Class	Value	Design Variables		
fp2	0	0	0	
	1	1	0	

Class Level Information				
Class	**Value**	**Design Variables**		
	2	0	1	
_AGE_G	**1**	0	0	
	2	1	0	
	3	0	1	
r2	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
under	**1**	0	0	
	2	1	0	
	3	0	1	
chld	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
smoke	**0**	0	0	0
	1	1	0	0
	2	0	1	0
	3	0	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	10201526	9819290.5
SC	10201533	9819440.1
-2 Log L	10201524	9819246.5

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	382277.648	21	<.0001
Score	361378.131	21	<.0001
Wald	82.7233	21	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
fp2	2	0.3885	0.8235
_AGE_G	2	2.8382	0.2419
r2	3	11.9594	0.0075
under	2	20.9622	<.0001
smoke	3	8.2444	0.0412
chld	3	13.6573	0.0034
fp2*r2	6	13.7266	0.0328

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	-0.6461	0.2123	9.2638	0.0023
fp2	**1**		1	0.0199	0.1663	0.0143	0.9047
fp2	**2**		1	-0.0957	0.1918	0.2489	0.6179
_AGE_G	**2**		1	-0.3185	0.1908	2.7851	0.0951
_AGE_G	**3**		1	-0.2909	0.1984	2.1499	0.1426
r2	**2**		1	-0.4330	0.2104	4.2368	0.0396
r2	**3**		1	0.5763	0.2993	3.7076	0.0542
r2	**4**		1	-0.4745	0.2653	3.1994	0.0737
under	**2**		1	-0.1108	0.1704	0.4228	0.5156

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
under	**3**		1	-0.7354	0.1610	20.8670	<.0001
smoke	**1**		1	0.1146	0.1595	0.5156	0.4727
smoke	**2**		1	-0.4400	0.1735	6.4302	0.0112
smoke	**3**		1	-0.00057	0.2281	0.0000	0.9980
chld	**2**		1	0.1945	0.1559	1.5570	0.2121
chld	**3**		1	0.5485	0.1490	13.5426	0.0002
chld	**4**		1	0.3208	0.1807	3.1536	0.0758
fp2*r2	**1**	**2**	1	0.0872	0.3671	0.0565	0.8122
fp2*r2	**1**	**3**	1	-0.9382	0.5097	3.3882	0.0657
fp2*r2	**1**	**4**	1	0.2398	0.5650	0.1801	0.6713
fp2*r2	**2**	**2**	1	0.1486	0.3505	0.1798	0.6716
fp2*r2	**2**	**3**	1	-1.8354	0.5519	11.0595	0.0009
fp2*r2	**2**	**4**	1	0.3428	0.4304	0.6346	0.4257

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
_AGE_G 2 vs 1	0.727	0.500	1.057
_AGE_G 3 vs 1	0.748	0.507	1.103

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
under 2 vs 1	0.895	0.641	1.250
under 3 vs 1	0.479	0.350	0.657
smoke 1 vs 0	1.121	0.820	1.533
smoke 2 vs 0	0.644	0.458	0.905
smoke 3 vs 0	0.999	0.639	1.563
chld 2 vs 1	1.215	0.895	1.649
chld 3 vs 1	1.731	1.292	2.318
chld 4 vs 1	1.378	0.967	1.964

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	59.8	**Somers' D**	0.211
Percent Discordant	38.7	**Gamma**	0.214
Percent Tied	1.6	**Tau-a**	0.090
Pairs	9413482	**c**	0.605

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	1	0.3689	0.5436
fp2=2, r2=3 after 2 years, other NH	1	13.0727	0.0003
fp2=2, r2=2 after 2 years, black NH	1	0.0259	0.8722
fp2=2, r2=1 after 2 years, white NH	1	0.2489	0.6179
fp2=1, r2=4 before 2 years, hispanic	1	0.2223	0.6373
fp2=1, r2=3 before 2 years, other NH	1	3.5052	0.0612
fp2=1, r2=2 before 2 years, black NH	1	0.0998	0.7521
fp2=1, r2=1 before 2 years, white NH	1	0.0143	0.9047

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	EXP	1	1.2804	0.5210	0.05	0.5767	2.8425	0.3689	0.5436
fp2=2, r2=3 after 2 years, other NH	EXP	1	0.1450	0.0774	0.05	0.0509	0.4130	13.0727	0.0003
fp2=2, r2=2 after 2 years, black NH	EXP	1	1.0543	0.3468	0.05	0.5533	2.0089	0.0259	0.8722
fp2=2, r2=1 after 2 years, white NH	EXP	1	0.9088	0.1743	0.05	0.6240	1.3234	0.2489	0.6179

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=1, r2=4 before 2 years, hispanic	EXP	1	1.2965	0.7141	0.05	0.4405	3.8162	0.2223	0.6373
fp2=1, r2=3 before 2 years, other NH	EXP	1	0.3992	0.1958	0.05	0.1527	1.0440	3.5052	0.0612
fp2=1, r2=2 before 2 years, black NH	EXP	1	1.1131	0.3775	0.05	0.5726	2.1636	0.0998	0.7521
fp2=1, r2=1 before 2 years, white NH	EXP	1	1.0201	0.1697	0.05	0.7363	1.4133	0.0143	0.9047

Model Information		
Data Set	WORK.THESIS3	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	353	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	5127	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	6778

Number of Observations Used	6648
Sum of Weights Read	8916179
Sum of Weights Used	8734769

Response Profile			
Ordered Value	flu1	Total Frequency	Total Weight
1	0	4587	6347984.8
2	1	2061	2386784.5

Probability modeled is flu1=1.

Note: 130 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information				
Class	Value	Design Variables		
fp2	0	0	0	
	1	1	0	

Class Level Information				
Class	**Value**	**Design Variables**		
	2	0	1	
_AGE_G	**1**	0	0	
	2	1	0	
	3	0	1	
r2	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
under	**1**	0	0	
	2	1	0	
	3	0	1	
smoke	**0**	0	0	0
	1	1	0	0
	2	0	1	0
	3	0	0	1
educa1	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	10245286	9870842.9
SC	10245293	9870992.6
-2 Log L	10245284	9870798.9

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	374484.856	21	<.0001
Score	350484.593	21	<.0001
Wald	83.9643	21	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
fp2	2	1.1554	0.5612
_AGE_G	2	3.1398	0.2081
r2	3	10.6109	0.0140
under	2	17.2704	0.0002
smoke	3	4.7724	0.1892
educa1	3	11.1224	0.0111
fp2*r2	6	16.2205	0.0126

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	-0.7958	0.2951	7.2724	0.0070
fp2	**1**		1	-0.1006	0.1602	0.3946	0.5299
fp2	**2**		1	-0.2029	0.1918	1.1183	0.2903
_AGE_G	**2**		1	-0.3200	0.1840	3.0256	0.0820
_AGE_G	**3**		1	-0.3117	0.1970	2.5052	0.1135
r2	**2**		1	-0.3982	0.2106	3.5733	0.0587
r2	**3**		1	0.6363	0.2894	4.8351	0.0279
r2	**4**		1	-0.3001	0.2763	1.1796	0.2774
under	**2**		1	-0.0855	0.1747	0.2397	0.6244

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
under	**3**		1	-0.6601	0.1593	17.1621	<.0001
smoke	**1**		1	0.1356	0.1596	0.7216	0.3956
smoke	**2**		1	-0.2985	0.1805	2.7343	0.0982
smoke	**3**		1	0.0949	0.2292	0.1715	0.6788
educa1	**2**		1	0.2666	0.2320	1.3202	0.2505
educa1	**3**		1	0.4247	0.2318	3.3560	0.0670
educa1	**4**		1	0.6393	0.2295	7.7579	0.0053
fp2*r2	**1**	**2**	1	0.0637	0.3589	0.0315	0.8592
fp2*r2	**1**	**3**	1	-1.0597	0.4927	4.6259	0.0315
fp2*r2	**1**	**4**	1	0.1763	0.5809	0.0921	0.7615
fp2*r2	**2**	**2**	1	0.2547	0.3523	0.5227	0.4697
fp2*r2	**2**	**3**	1	-1.9577	0.5486	12.7356	0.0004
fp2*r2	**2**	**4**	1	0.2774	0.4404	0.3967	0.5288

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
_AGE_G 2 vs 1	0.726	0.506	1.041
_AGE_G 3 vs 1	0.732	0.498	1.077

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
under 2 vs 1	0.918	0.652	1.293
under 3 vs 1	0.517	0.378	0.706
smoke 1 vs 0	1.145	0.838	1.566
smoke 2 vs 0	0.742	0.521	1.057
smoke 3 vs 0	1.100	0.702	1.723
educa1 2 vs 1	1.305	0.828	2.057
educa1 3 vs 1	1.529	0.971	2.409
educa1 4 vs 1	1.895	1.209	2.972

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	61.0	**Somers' D**	0.236
Percent Discordant	37.4	**Gamma**	0.240
Percent Tied	1.7	**Tau-a**	0.101
Pairs	9453807	**c**	0.618

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	1	0.0317	0.8587
fp2=2, r2=3 after 2 years, other NH	1	16.5115	<.0001
fp2=2, r2=2 after 2 years, black NH	1	0.0255	0.8730
fp2=2, r2=1 after 2 years, white NH	1	1.1183	0.2903
fp2=1, r2=4 before 2 years, hispanic	1	0.0184	0.8922
fp2=1, r2=3 before 2 years, other NH	1	6.0002	0.0143
fp2=1, r2=2 before 2 years, black NH	1	0.0125	0.9109
fp2=1, r2=1 before 2 years, white NH	1	0.3946	0.5299

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	EXP	1	1.0774	0.4508	0.05	0.4745	2.4463	0.0317	0.8587
fp2=2, r2=3 after 2 years, other NH	EXP	1	0.1153	0.0613	0.05	0.0407	0.3268	16.5115	<.0001
fp2=2, r2=2 after 2 years, black NH	EXP	1	1.0532	0.3413	0.05	0.5580	1.9878	0.0255	0.8730
fp2=2, r2=1 after 2 years, white NH	EXP	1	0.8164	0.1566	0.05	0.5605	1.1890	1.1183	0.2903

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=1, r2=4 before 2 years, hispanic	EXP	1	1.0786	0.6023	0.05	0.3610	3.2226	0.0184	0.8922
fp2=1, r2=3 before 2 years, other NH	EXP	1	0.3134	0.1484	0.05	0.1238	0.7930	6.0002	0.0143
fp2=1, r2=2 before 2 years, black NH	EXP	1	0.9637	0.3181	0.05	0.5047	1.8404	0.0125	0.9109
fp2=1, r2=1 before 2 years, white NH	EXP	1	0.9043	0.1448	0.05	0.6606	1.2378	0.3946	0.5299

The SAS System

Model Information		
Data Set	WORK.THESIS3	
Response Variable	flu1	
Number of Response Levels	2	
Stratum Variable	_STSTR	SAMPLE DESIGN STRATIFICATION VARIABLE
Number of Strata	353	
Cluster Variable	_PSU	PRIMARY SAMPLING UNIT
Number of Clusters	5144	
Weight Variable	_finalwt	
Model	Binary Logit	
Optimization Technique	Fisher's Scoring	
Variance Adjustment	Degrees of Freedom (DF)	

Variance Estimation	
Method	Taylor Series
Variance Adjustment	Degrees of Freedom (DF)

Number of Observations Read	6778
Number of Observations Used	6673
Sum of Weights Read	8916179
Sum of Weights Used	8769484

Response Profile			
Ordered Value	**flu1**	**Total Frequency**	**Total Weight**
1	0	4608	6392410.9
2	1	2065	2377073.5

Probability modeled is flu1=1.

Note: 105 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information		
Class	**Value**	**Design Variables**

Class Level Information				
Class	**Value**	**Design Variables**		
fp2	**0**	0	0	
	1	1	0	
	2	0	1	
_AGE_G	**1**	0	0	
	2	1	0	
	3	0	1	
r2	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
chld	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1
smoke	**0**	0	0	0
	1	1	0	0
	2	0	1	0
	3	0	0	1

Class Level Information				
Class	**Value**	**Design Variables**		
educa1	**1**	0	0	0
	2	1	0	0
	3	0	1	0
	4	0	0	1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	10248236	9899457.9
SC	10248242	9899614.4
-2 Log L	10248234	9899411.9

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	348821.829	22	<.0001
Score	335910.810	22	<.0001
Wald	85.4978	22	<.0001

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	2	0.3027	0.8595
_AGE_G	2	4.2959	0.1167
r2	3	10.5564	0.0144
smoke	3	4.9197	0.1778
chld	3	17.2932	0.0006
educa1	3	20.2808	0.0001
fp2*r2	6	12.4198	0.0532

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	-1.2860	0.3063	17.6297	<.0001
fp2	**1**		1	-0.0546	0.1662	0.1080	0.7424

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
fp2	**2**		1	-0.1034	0.1904	0.2949	0.5871
_AGE_G	**2**		1	-0.3903	0.1918	4.1418	0.0418
_AGE_G	**3**		1	-0.3710	0.2008	3.4137	0.0647
r2	**2**		1	-0.4747	0.2175	4.7614	0.0291
r2	**3**		1	0.4823	0.3013	2.5620	0.1095
r2	**4**		1	-0.4718	0.2789	2.8607	0.0908
smoke	**1**		1	0.1195	0.1548	0.5962	0.4400
smoke	**2**		1	-0.3143	0.1795	3.0659	0.0800
smoke	**3**		1	0.0539	0.2272	0.0562	0.8126
chld	**2**		1	0.2590	0.1536	2.8447	0.0917
chld	**3**		1	0.6192	0.1491	17.2548	<.0001
chld	**4**		1	0.4033	0.1877	4.6173	0.0317
educa1	**2**		1	0.3016	0.2351	1.6461	0.1995
educa1	**3**		1	0.5259	0.2390	4.8420	0.0278
educa1	**4**		1	0.8335	0.2353	12.5518	0.0004
fp2*r2	**1**	**2**	1	0.1243	0.3640	0.1166	0.7327
fp2*r2	**1**	**3**	1	-0.8140	0.4966	2.6870	0.1012
fp2*r2	**1**	**4**	1	0.2669	0.5683	0.2206	0.6386

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
fp2*r2	**2**	**2**	1	0.1824	0.3511	0.2699	0.6034
fp2*r2	**2**	**3**	1	-1.7508	0.5461	10.2764	0.0013
fp2*r2	**2**	**4**	1	0.2610	0.4300	0.3685	0.5438

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
_AGE_G 2 vs 1	0.677	0.465	0.986
_AGE_G 3 vs 1	0.690	0.466	1.023
smoke 1 vs 0	1.127	0.832	1.526
smoke 2 vs 0	0.730	0.514	1.038
smoke 3 vs 0	1.055	0.676	1.647
chld 2 vs 1	1.296	0.959	1.751
chld 3 vs 1	1.857	1.387	2.488
chld 4 vs 1	1.497	1.036	2.162
educa1 2 vs 1	1.352	0.853	2.143
educa1 3 vs 1	1.692	1.059	2.703
educa1 4 vs 1	2.301	1.451	3.650

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	59.4	**Somers' D**	0.198
Percent Discordant	39.6	**Gamma**	0.200
Percent Tied	1.0	**Tau-a**	0.085
Pairs	9515520	**c**	0.599

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	1	0.1502	0.6983
fp2=2, r2=3 after 2 years, other NH	1	12.2466	0.0005
fp2=2, r2=2 after 2 years, black NH	1	0.0583	0.8092
fp2=2, r2=1 after 2 years, white NH	1	0.2949	0.5871
fp2=1, r2=4 before 2 years, hispanic	1	0.1470	0.7014
fp2=1, r2=3 before 2 years, other NH	1	3.3104	0.0688
fp2=1, r2=2 before 2 years, black NH	1	0.0431	0.8356

Contrast Test Results			
Contrast	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
fp2=1, r2=1 before 2 years, white NH	1	0.1080	0.7424

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=2, r2=4 after 2 years, hispanic	EXP	1	1.1707	0.4761	0.05	0.5276	2.5978	0.1502	0.6983
fp2=2, r2=3 after 2 years, other NH	EXP	1	0.1566	0.0830	0.05	0.0554	0.4423	12.2466	0.0005
fp2=2, r2=2 after 2 years, black NH	EXP	1	1.0822	0.3542	0.05	0.5698	2.0554	0.0583	0.8092
fp2=2, r2=1 after 2 years, white NH	EXP	1	0.9018	0.1717	0.05	0.6209	1.3097	0.2949	0.5871
fp2=1, r2=4 before 2 years, hispanic	EXP	1	1.2365	0.6844	0.05	0.4178	3.6589	0.1470	0.7014
fp2=1, r2=3 before 2 years, other NH	EXP	1	0.4195	0.2003	0.05	0.1646	1.0694	3.3104	0.0688
fp2=1, r2=2 before 2 years, black NH	EXP	1	1.0722	0.3599	0.05	0.5553	2.0703	0.0431	0.8356

Contrast Estimation and Testing Results by Row									
Contrast	**Type**	**Row**	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
fp2=1, r2=1 before 2 years, white NH	EXP	1	0.9468	0.1574	0.05	0.6836	1.3115	0.1080	0.7424