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The Impact of Diabetes on the Percent Change in Salary: With a Comparison of Type I and Type II Diabetes

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Abstract

Using family level, cross sectional data from the PSID 2007 and 2013 survey this study examines the effect of having diabetes on the percent change in salary with a comparison between type I diabetes and type II diabetes. Four Standard OLS regressions were run twice each to obtain the results in the years of 2007 and 2013. One group looked at the total population and the other group looked solely at the diabetic population. The results suggest that salaries are negatively impacted type II diabetes in particular, but that limitations due to diabetes have a more significant effect on the percent change in salary. The results indicated that the presence of type I diabetes compared to type II diabetes cause a 568% increase in salary in 2007. However, the results show that the presence of diabetes itself is insignificant and that the limitations of diabetes impact salary the most.

Introduction

What is the impact of diabetes on the percent change in salary? How does having type I diabetes affect salary in comparison to having type II diabetes? How has this changed between 2007 and 2013? Diabetes is a debilitating disease that either stems from an autoimmune dysfunction or a metabolic dysfunction (JDRF, 2016). When the cause is autoimmune, the disease is considered type I diabetes (JDRF, 2016). When the cause is metabolic, the disease is considered type II diabetes (JDRF, 2016). In 2012, 29.1 million (9.3%) of Americans had diabetes, and there are 1.4 million new diagnoses every year (ADA, 2012). This disease is growing at an alarming rate. With that being said, answering this research question could help keep people in the labor force and keep them more productive by educating employers about the disease and spreading awareness.

Previous literature focuses mostly on the impact of type II diabetes on wages or productivity. This literature typically shows a negative average impact of type II diabetes on wages or productivity. Some find that the presence of diabetes, in fact, decreases a person's wage, whether it be from decreased productivity or missed days of work (Jacobs et al., 2001). Others find a negative relationship between wages and diabetes due to complications that go along with diabetes (Minor, 2013). The amount of time one has had diabetes may also negatively impact salary (Minor, 2013).

The purpose of this paper is to understand the impact of diabetes in the entire population on salary and the impact of the type of diabetes in the diabetic population on salary. In this paper, information on a group of people is used to understand the impact of diabetes on the percent change in salary differentiated from those without diabetes in 2007, and is then compared to data from 2013 to see if there is a difference in the impact of diabetes. A subset of people was also taken from the entire population; all of these people had diabetes. They were then separated into type I and type II diabetes based on diagnosis age, and 1% of the type I population was taken out and inserted into the type II population to account for the 1% of teenagers that actually have type II diabetes. This data was also run in 2007 and in 2013 to see if there were differences in salaries during this time.

The contributions of this work are the separation of people with diabetes into type I and type II categories based on diagnosis age, much like Minor (2013) along with the accounting for the 1% of teenagers with type II diabetes. This paper also examines the age-salary function for people with diabetes in the total population and people with type I diabetes in the diabetic population across the years of 2007 and 2013.

The results suggest that salaries are negatively impacted type II diabetes in particular, but that limitations due to diabetes have a more significant effect on the percent change in salary. The results indicate that the presence of type I diabetes compared to type II diabetes cause a 568% increase in salary in 2007. However, the results suggest that the presence of diabetes itself is insignificant and that the limitations of diabetes impact salary the most.

The remainder of this paper is split into several sections. Section I discusses a review of the literature. Section II addresses the analytical framework of the paper. Section III shows the data and methodology of the paper. Section IV contains the hypotheses and expectations of results. Section V is a discussion of the results of the study. Section VI concludes with policy implications.

Section I: Literature Review

The purpose of this paper is to compare the effect of diabetes on salary, and taking it further, to understand the difference in salaries between people with type I and type II diabetes. These results will be considered in 2007 and in 2013 because the financial crisis of 2008 occurred between these years, causing much distress and unfortunate events throughout the United States. The 2008 crisis has been named the worst economic disaster for the United States since the Great Depression in 1929. After the crisis, unemployment increased substantially. The labor force participation rate started at 63% in 2007 before the crisis and it fell to 58.3% in 2013 (Dufour, 2014). Due to the crisis, the number of workers earning incomes below poverty level increased from 23.3% in 2006 to 28% by 2011. The financial crisis had a large effect on income inequality. Income inequality has been rising in the United States since the 1970s, but this trend reversed slightly during the crisis. There was a relative decrease in the CEO-to-worker compensation ratio during the recession (Dufour, 2014), meaning workers either earned more or CEOs earned less than they had before. However, after the crisis, the CEO-to-worker compensation ration returned to the way it was prior to the crisis and income inequality increased again. The crisis also caused public debt and government spending to increase, seeing as employment benefits, disability payments, and welfare/social services payments had all increased to combat the effects of the crisis (Dufour, 2014). The level of public and government spending has been decreasing since the initial increase, but it still remains at more than pre-crisis levels. The events of the 2008 financial crisis have negatively impacted employment rates and wages. Due to the policy changes that resulted from the crisis, the purpose of this paper is to study the impact of diabetes on salaries with a comparison to those without diabetes in order to see if anything has changed.

In order to analyze the percent change in salary, the Mincer Earning's Equation (Mincer, 1958) is used as a baseline. The Mincer Earning's Equation defines the percent change in wages as a function of years of schooling and work experience (Mincer, 1958). The equation suggests that as years of schooling increase, there is a positive percentage increase in wages (Mincer, 1958). Mincer (1958) also finds that work experience has a nonlinear relationship with wages, similar to the inverse U relationship age has with wages (Casanova, 2012). Using the Mincer Earnings Equation (Mincer, 1958) as the base model to analyze the percent change in salary. This is imperative to this study because the percent change in salary will help determine if diabetes has an effect on salary.

Type I diabetes is an autoimmune disease that causes the body's immune system to attack and destroy the cells in the pancreas that create insulin, making it so the pancreas can no longer produce insulin. Type I diabetes is typically diagnosed in children and young adults, though it can present at any age. People with type I need to take insulin injections multiple times per day to stay alive (U.S. Department of Health and Human Services, 2016). Another kind of diabetes, type II, which is typically mentioned along with or instead of type I, is a metabolic disease. This means that the body doesn't make insulin well, or at all, because the cells in the body become insulin resistant. It can develop at any age, and is the most common type of diabetes. Type II diabetes is so common because it occurs due to lifestyle choices and has a high correlation with obesity. Many times it can be controlled or even reversed through diet and exercise (JDRF, 2016). In addition, there are short and long term disability expenses, increased absences, and lower productivity in obese people (Gabel et al., 2009). The purpose of this paper is to compare the salary of those with diabetes to those without diabetes and understand the impact of having type I diabetes compared to type II diabetes on the percent change in salary. It is imperative to make a comparison of salaries between type I diabetes and type II diabetes because the diseases are different from one another, both in their effects on the individual and in their etiologies. Due to these differences, there is reason to investigate the correlation between salaries and the diseases.

Studying the impact of type I diabetes and type II diabetes on salary is important because 1.25 million Americans are living with type I diabetes: 200,000 of these people are children (18 years or less) and over 1 million are adults (18 years or older) (JDRF, 2016), additionally, 29 million people in the United States have type II diabetes (JDRF, 2016). It is estimated that in the future, there will be 40,000 diagnoses every year of type I diabetes and 1.4 million diagnoses of type II diabetes in the United States (American Diabetes Association, 2016). This is a large percentage of the American population that is directly affected by a chronic illness, and these people are susceptible to debilitating complications if the disease is not cared for properly. About $14 billion is spent every year on healthcare costs for people with diabetes, largely because less than 1/3 of those diagnosed are able to achieve target blood sugar control (Dall, 2012). People that are unable to obtain target blood sugar control may have complications that arise due to the lack of control. These complications include blindness (partial or complete), gangrene, amputation of lower limbs (toes, feet, legs, etc.), kidney and heart failure, and many other high expense medical problems that need to be treated and may require hospital visits. Between 2001 and 2009, there was a 21% increase in the diagnosis of type I diabetes in people under 20 years old (JDRF, 2016), which provides another reason to study the relationship between type I diabetes and salaries. Studying the impact of diabetes on salary is imperative because if the diagnoses continue to increase at that same rate, an increasing portion of the population will be affected by the disease, which means more of the labor force will be affected or leave the labor force all together. With an increasing amount of the labor force potentially affected by type I diabetes and type II diabetes, it is important to study the impact of the disease on salaries, seeing as people with diabetes may have decreased productivity, may be discriminated against, may have to take time out of their day to test their blood sugars, or may miss more days of work than healthy counterparts (American Diabetes Association, 2016).

Several studies have been conducted to see the impact of diabetes on wages. It is important to note that most of the studies conducted focus on type II diabetes or they do not specify which type of diabetes is being focused on, and they study wages, while this study focuses on salaries. This is a crucial trend to consider because the results for type II diabetes alone may differ from a study that does not separate type I and type II, and it may differ from a study that focuses on only type I diabetes. Even though employers cannot legally discriminate against people with diabetes, there are still some concerning bias issues. Some examples of these issues are discussed below.

In one study, a nurse sent her resume to 16 institutions for which she was well qualified and she mentioned diabetes in her cover letter. She only had two responses, and no offers (Bruyère, 2001). Another example of the discrimination is when a cashier with diabetic neuropathy was unable to complete his job because his employer would not allow him to sit down between customers coming and going, even though standing was not an essential job function (Bruyère, 2001). Type II diabetes may have a different effect on workers than type I due to the different etiologies of the diseases. Many employers incur higher medical claims expenses for obese workers and the chronic conditions that folow. The short and long term disability expenses, increased absences, and lower productivity in obese people (Gabel et al., 2009), are a significant reason to differentiate between the types of diabetes.

Travis Minor (2013) conducted a study in which the effect of type I and type II diabetes on employment status and wages is examined. A semi-log function is used to estimate the effect of diabetes on the percent change in wages (Minor, 2013). The wage equation considers real hourly wage, if the respondent has type II diabetes or not, if the respondent has type I diabetes or not, while controlling for age, education, family size, and other observable influences on the employment decision and wages (Minor, 2013). If a person was diagnosed with diabetes after the age of 20 years old, Minor (2013) counts this as type II diabetes and if the respondent was diagnosed with diabetes before the age of 20, it is considered type I diabetes.

It is important to note that the data collection for Minor's study (2013) may not be completely accurate because the method used to differentiate between type I and type II diabetes has potential for error. This error stems from the fact that not all people with type I diabetes are diagnosed before 20 years old, and not all people with type II diabetes are diagnosed after age 20. The separation of the diagnosis age data was necessary in this study (Minor, 2013) because the information provided by this data is protected under the HIPPA and Privacy Rules. The implementation of these rules was designed to create a set of national standards for the protection of certain health information (HHS Office of the Secretary, 2013). The goal of the HIPPA and Privacy Rules is to ensure that health information for patients is properly protected while allowing access to the healthcare information needed to provide quality healthcare and protect the public's health and well being (HHS Office of the Secretary, 2013). These rules protect patients and make it very difficult to obtain data specific to Minor's question, which is why diagnosis age was used to separate people with type I from people with type II diabetes. He also included the length of time the respondent has had diabetes for which the variable received a value of 1 if diagnosed within the same year, 2 if diagnosed 2-5 years previously, 3 if diagnosed 6-10 years previously, 4 if diagnosed 11-15 years prior, 5 if diagnosed 16-20 years before the study, and 6 if diagnosed more than 21 years before the study. This is an interesting decision to make in the equation because it suggests that diabetes is not the same over the course of the disease, so there are different values for the amount of time someone has been diabetic. Age is another factor Minor (2013) took into consideration when writing his regression. Age is important to include in the research because age has an inverted U relationship with wages (Casanova, 2012).

Furthermore, Minor (2013) discusses how using a linear function to describe diabetes would constrain the disease to having a completely uniform impact over the entire duration of the disease (Minor, 2013). This cannot be accounted for because the disease fluctuates over time and may have periods of time when control over blood sugars is better and control over blood sugars is worse. Minor (2013) found that there are wage penalties for people that have diabetes, and the size of the wage penalty is dependent upon how long the respondent has had diabetes and how well the respondent is able to control his blood sugars.

Minor's study (2013) is very similar to the question posed in this paper, however there are some differences to consider. As far as results go, Minor (2013) did not find significant differences between type I and type II diabetes, but declared that separating out type I and type II diabetes is important and could affect the results. It is imperative to consider the differences between the two types because of the fluctuations in each type. Fluctuations for people with type I depend on how well they control their blood sugars with insulin alone, but people diagnosed with type II have fluctuations that depend on exercise, diet, and other lifestyle choices because it is a metabolic disease. This paper includes interaction terms that show the effect of diabetes on the age-salary relationship and it also shows the effect that type I diabetes has on the age-salary relationship, though Minor's (2013) paper does not address these groups of people specifically.

Other studies, like Minor's (2013), that have been conducted focus on different aspects of diabetes and answer different questions than the one being asked in this paper. One study by Jacobs et al. (2001) posed a question about the effect of any type of diabetes on employment status and days of work missed. The study concluded that diabetes has a large and considerable impact on economic behavior in the labor force. The study found that the presence of diabetes itself reduces employment by 3.5% (Jacobs et. al, 2001), and the presence of complications reduced employment by 12% (Jacobs et. al, 2001). They also found that those with diabetes were not affected in regard to hours worked, but with complications, they worked 3.2 days less every 2 weeks than those without complications (Jacobs et. al, 2001) and that the type of diabetes had no impact. This study uses similar variables to the study conducted by Minor (2013). Further, Jacobs et al. (2001) included whether or not the respondent had complications, focusing on what impact that had on work force participation and employment, though not salary.

Considering whether or not a respondent has complications is important. Complications like heart disease, kidney failure, blindness, gangrene, amputation, and diabetic neuropathy may make everyday life more difficult (JDRF, 2016), thus making working or finding work more complicated. It is also possible that complications cause a worker to be less efficient. It is still significant to differentiate between type I and type II because the diseases are different, and may therefore have different impacts on ability to work and productivity levels.

The studies conducted by Minor (2013) and Jacobs et al. (2001) are similar in many ways, but they do differ in significant areas. Both Minor (2013) and Jacobs et al. (2001) looked at the impact diabetes had on work productivity and how limitations or complications may further impact productivity and wages. However, Minor (2013) split the data into those with type I diabetes and those with type II diabetes, while Jacobs et al. (2001) focused on people with diabetes as a whole. Focusing only on those with diabetes, without separating them into which type they have may impact results. Seeing as type II is much more common than type I, when looking at the impact of having any type of diabetes on wages, type II could skew the results in a way that makes them mostly representative of the impact of type II diabetes on wages.

Another study by Jason Fletcher and Michael Richards (2012) explored the effect of type II diabetes on education and earnings. Similar to the study conducted by Minor (2013), Fletcher and Richards (2012) focus only on type II diabetes. The paper considers clearing up some of the educational and labor market outcomes associated with having type II diabetes. The study then looks at the short and long-term economic effects of developing type II in early adulthood (Fletcher et al., 2012). It is important to compare people that were diagnosed with type II earlier in life to people that had been working for some period of time, who were then diagnosed because it may help in seeing whether or not there was a difference in education or economic standing.

Fletcher and Richards (2012) found that there was a decrease of 8 - 11% in employment in people with Type II diabetes and a substantial decrease in economic status. Fletcher et al. (2012) bring attention to an important point about the implications of type II diabetes. If those that have type II diabetes are experiencing a decrease in economic and employment status (Fletcher et al., 2012), then the increasing number of those diagnosed with type II diabetes may negatively impact the labor market as a whole. The study concludes by stating that the early effects of diabetes (type I or II) on education and wages can destroy future health, leaving people with Type II diabetes trapped in a downward spiral. There is also a large health shock that can happen in younger adults with diabetes. This leads to lower education and lowers chances of employment, meaning one can expect to lose about $160,000 over his or her working life compared to a counterpart without diabetes. There are also large societal costs of diabetes due to decreased employment and higher dropout rates (Fletcher et al., 2012). Again, it is important to consider both type I and type II diabetes in the studies because they are different diseases and have different implications. This study uses panel data, which is useful in answering these types of questions because it allows multiple people to be followed for two or more time periods, which is important when tracking the implications of diabetes.

A different study run by Jonathan Shaw et al. (2010) focused on the economic burden of diabetes on different countries. They compared spending on type I and type II diabetes across countries to understand the true impact of diabetes on factors like personal finances, societal finances and impacts, and loss of productivity and growth of the economy. This study focused more on the health expenditures, financial burdens, and societal impact of the lost economic growth than on individual wage and productivity data. It did, however, consider the societal impacts of productivity loss, which relates indirectly to wages. Shaw (2010) states that the American Diabetes Association estimated the US economy lost $58 billion in 2007 as a result of lost earnings due to missed work days, restricted activity days, lower productivity at work, mortality, and permanent disability caused by diabetes (Shaw et al., 2010), showing a large relationship between diabetes and wages. Shaw et al. (2010) compared the findings for people with diabetes to their non-diabetic counterparts.

The study by Shaw et al. (2010) does not specifically focus on the effect of type I diabetes on wages or productivity loss. Shaw et al. (2010), however, look at the impact of diabetes on earnings and the impact of those lost earnings throughout the whole economy. The information from Shaw et al. (2010) could help further the research of this paper in talking about policy implications and the societal effect that diabetes has on the people and economy.

This relevant literature focuses on the effect of diabetes on the labor market participation rate and the ease of people with diabetes finding employment. Research has revealed that there is a negative correlation between having diabetes and productivity in males (Perez et al., 2011), though control of the diabetes does not have a significant impact (Perez et al., 2011). Management of diabetes is measured through the A1C (glycosylated hemoglobin levels), which is the average blood sugar over the last three months. The ideal A1C for people with diabetes is 6.5% or lower (American Diabetes Association, 2016). In addition, there is a negative correlation between pre-diabetes (A1C levels between 5.7% and 6.4%) and female productivity. Women are 4.4% less likely to remain employed or begin to work if they have diabetes. Men are 7.1% less likely to work if they have diabetes (Tunceli et al., 2005). It is apparent that very few people with diabetes actually control their blood sugars. The lack of control implies that decreased wages and labor market effects are due to both the presence of diabetes and the amount of control one has over his blood sugars (Perez et al., 2011). People with diabetes are also less likely than healthy coworkers to remain working due to work limitations and days of work missed because of diabetes (Tunceli et al., 2005). That being said, diabetes affects not only the patient, but the employers and society as well. This is because a person with diabetes has decreased probability of employment, and if they remain employed, they are likely to contribute less due to work limitations than people without diabetes.

In addition to decreased productivity at work, a substantial percentage people with diabetes apply for work disability. Work disability was reported by 25.6% of individuals with diabetes compared to 7.8% of people without diabetes (Whitecotton et al., 1999). This could be because of the lower productivity that many people with diabetes experience and more frequent absences from work (Tunceli et al., 2005). The more frequent absences and lower productivity led to decreased earnings, approximately $4.7 million lost in earnings in 1987 due to work disability (Whitecotton et al., 1999).

Again, it is important to keep in mind that other research generally do not differentiate between the two types of diabetes, but it is likely it focuses mainly on type II diabetes. Some research mentions "pre-diabetes," which happens when a patient has blood glucose levels higher than normal, but not yet high enough to be diagnosed as diabetes. People with type II diabetes almost always experience pre-diabetes. This is not something that people with type I experience because of the sudden onset (American Diabetes Association, 2016). Another idea to keep in mind while conducting this research is whether or not to include work limitations and decreased productivity. Work limitations and decreased productivity may impact wages or the probability of a worker with diabetes staying in the labor market. Work disability in people with diabetes significantly lowers annual earnings, so looking in to determinants of work disability is worth looking into.

Mark Warshawsky (1997) and several other researchers look at the larger picture. Warshawsky (1997) studied the growing healthcare expenditures as a share of gross domestic product in the United States (Warshawsky, 1997). In most sectors of the economy, a growing portion of expenditure is not necessarily a cause for concern seeing as tastes, technologies and social conditions change, and incomes may increase. However, the United States has especially high healthcare expenditures compared to many other countries (Seuring et al., 2015). The economic burden of diabetes occurring in the United States is one of the highest out of all countries compared (Seuring et al., 2015). This growing state of output represented by healthcare expenditures may be a signal of systematic problems that need attention (Warshawsky, 1997).

Since health care sector is financed mostly by the government or influenced by public policy, programs like Medicare and Medicaid are problematic (Warshawsky, 1997). These programs may go bankrupt in the near future due to their high cost, which could change the status of the standing economy. Medicare is an insurance program that medical bills are paid from, mostly for older people (Digital Communications Division (DCD), 2015), and Medicaid is an assistance program that serves low-income people at any age (Digital Communications Division (DCD), 2015). This is relevant because two million adults with type II diabetes had no health insurance in 2012, taking a large toll on the economy and public health (Casagrande et al., 2012), suggesting many of them use Medicaid because they cannot afford insurance or may not be covered by insurance. This is important in considering policy implications later in this paper.

The above literature is relevant to the research question for this paper. The purpose of this paper is to study the impact of type I diabetes on salaries of people in the work force, with potential to compare type I and type II diabetes data. The study conducted by Minor (2013) lays out very relevant variables and questions. Minor (2013) uses variables like real hourly wage, if the respondent has type II diabetes or not, if the respondent has type I diabetes or not, and controls for age, education, family size, and other observable influences on the employment decision and wages. These variables are important to studying the effect of type I diabetes on wages. It is ideal to differentiate between type I and type II, include real hourly wage as the dependent variable in question, and include the length of time that one has had diabetes to keep in mind the total effect diabetes may have on wages. Some other variables that are important in answering the research question include whether or not the diagnosed person has complications from the diabetes (Jacobs et al., 2001), whether or not the person is employed, and to control for age, education, gender, and family variables. Gender is important to control for because females earn statistically less than males in the work force (Boot et al., 2008).

In reading the other literature, it is clear that using a nonlinear function to describe diabetes and salaries based on panel data is best. Diabetes is not a linear disease; type I is incurable, and type II requires dedication to making different lifestyle choices, and could potentially be cured by these new choices. Blood sugar control goes in cycles because during certain time periods in life, it can be more difficult to control blood sugars and in some periods of time, it is easier to obtain target blood sugar control. It is also important to differentiate between type I diabetes and type II diabetes in order to make sure that the results are not skewed. Type I diabetes is manageable through insulin injections and is not necessarily correlated with any other chronic illnesses. Type II diabetes is manageable through diet and exercise, pills, or insulin and is highly correlated with other chronic health problems, such as obesity, heart disease, and more (American Diabetes Association, 2015). The different etiologies of type I and type II could mean that workers are potentially compensated differently based on if they have diabetes, and if diabetes is present, whether it is type I or type II.

Section II: Analytical Framework

Before addressing the framework of this paper, it is imperative to understand how salary is defined. Salary and wages are very similar to each other, seeing as a salary is a lump sum payment from an employer to an employee made annually (regardless of the hours worked by the employee) (Borjas, 2010). A wage is a payment typically made weekly from an employer to an employee based on the number of hours worked (Borjas, 2010). Most studies focus primarily on hourly earnings as the dependent variable, such as Freeman (1979), Mincer (1958), and Minor (2013); however, in this study wages are being measured in terms of salary.

The framework for the research in this paper is based off the Mincer Earnings Equation. The equation helps depict how the number of years of schooling and years of labor experience determine wage (Mincer, 1958). It shows the percent change in wage as a function of schooling and experience, and it generates an age-earnings profile. Mincer (1958) also indicates that there is a quadratic relationship between experience and wage. This is because experience increases wage until a certain point, but after that point it does not have as much of an effect on wage (diminishing returns).

The experience variables in the Mincer Earnings Equation can be considered representative of an age function with regards to wages. It suggests that experience has diminishing returns in terms of wage (Mincer, 1958), so there is an experience term and an $experience^2$ variable, also creating an inverted U relationship with earnings. This is similar to adding age and age^2 variables to account for the impact of age on wages. These variables will be used in place of the experience variables used in the Mincer Earnings Equation (Mincer, 1958). Age and age^2 also have an inverted U relationship, much like the experience variables from the Mincer Equation (Casanova, 2012). Typically as people age they have gained more experience, so it is viable to include age as an independent variable in place of experience in this equation. The equation states that as a person ages 1 year, the wage will increase by a certain percent, but this only happens until a certain age (Casanova, 2012). After that certain age, the percent increase in wage starts to diminish. This is a well-known wage-age relationship that is included in much other literature (Casanova (2012), Freeman (1979), Borjas (2010)).

To clarify, the percent change in wage is dependent upon years of schooling and the age function. As education increases by 1 year, the percent change in wage increases. Also, for every year that a person ages, there is a certain percent increase in wages that the worker will typically experience. This increase happens at a diminishing rate, and after a certain age wages decrease (Freeman, 1979). Productivity and experience tend to increase with age, so as these factors increase, people are paid more to compensate for the new acquired skills and productivity. After a certain age, wages decrease because productivity starts to decline (Freeman, 1979).

Section III: Data & Methodology

The data for this study comes from the 2007 and 2013 Panel Study of Income Dynamics (PSID). The data is a panel of family level information that focuses on the household head. It contains questions on personal and demographic characteristics, such as race, gender, and age; education information; industry, which is split into manual labor and non-manual labor; and salary, which can also be considered wages in terms of salary. The respondents were educated only in the United States and the survey contains information on the grades completed, including college. The ages of the people in the data range from 21 years to 81 years old.

The data was used to find the impact of type I diabetes and type II diabetes on salary and will be compared to the salary of the respondents' healthy counterparts in 2007 and 2013. In order to do this, two separate groups of regressions have been run for each year. One group looks at the entire population and compares people with diabetes to those without diabetes. The other group looks at a subset of the population, all of whom have diabetes, and it compares those with type I to those with type II. I have chosen these years because 2007 will serve as a base year and 2013 will serve as a comparison year. Between 2007 and 2013 the financial crisis of 2008 occurred. The financial crisis impacted many lives, standards of living, and salaries of people in the United States, and all over the world. The events of the 2008 financial crisis have negatively impacted employment rates and wages (Dufour, 2014). Due to the policy changes that resulted from the crisis, the purpose of this paper is to study the impact of diabetes on salaries with a comparison to those without diabetes in order to see if anything has changed.

The data collected from PSID does have some potential problems due to privacy laws enacted in the United States. This discrepancy in the data is due to HIPPA laws, which protect patients from release of confidential information. In order to compensate for the gap in data, the respondents with diabetes can be separated into two categories (those with type I and those with type II). The PSID data for 2007 and 2013 has information on the age at which the respondent was diagnosed with diabetes, so to account for the different types, I have defined those diagnosed before age 21 as type I and those diagnosed at age 21 or later as type II, which is similar to Minor's study (2013). This information on age of diagnosis is completely separate from age at the time of the study. To clarify, this means that if the respondent is diagnosed at age 3, this person will still be included in the data because the age of diagnosis has no relationship with the current age of the respondent. Also, seeing as 2% of adolescents actually have type II diabetes (American Diabetes Association, 2000), 2% of those in the type I category will be removed and placed in the type II category to account for this shortcoming in the data.

There are 3 standard OLS regressions to understand the impact of diabetes on salaries. The third population regression function is split into a model A and B in order to account for multicollinearity. They appear in a stepwise format to show the impact first the Mincer Earnings Equation (Mincer, 1958), then adding controls for demographic characteristics like race, gender, and industry; and then adding the information on diabetes such as whether diabetes is present and limitations due to diabetes. All three models will be run four separate times, once for the 2007 total population, once for the 2007 diabetic population, once for the 2013 total population, and once for the 2013 diabetic population. These results will then be compared to see the differences across a time period of six years. Model 1 Population Regression Function is based off the Mincer Earnings Equation (Mincer, 1958), but will use age instead of experience (Borjas, 2010).

Model 1 examines the effect of age and education on the percent change of salary. Wages are measured in terms of salary. The model is as follows

$$log(salary)_i = \beta_0 + \beta_1 age_i + \beta_2 age_i^2 + \beta_3 education_i + \varepsilon_i$$

where $log(salary)_i$is defined as the percent change in salary for person *i* in US dollars, dependent upon the other factors. age_i is defined as the age of household head *i* in years. age_i^2 is defined as age^2 of person *i* in years, accounting for the inverted U relationship that age has with the percent change in wages. $education_i$ is defined as the number of grades of school completed for the household head *i* (including college). ε_i is the error term.

The Model 2 Population Regression Function looks at the effect of age, education, race, gender, and industry on the percent change in salary. The model is as follows

$$log(salary)_i = \beta_0 + \beta_1 age_i + \beta_2 age_i^2 + \beta_3 education_i + \beta_4 race_i + \beta_5 gender_i + \beta_6 industry_i + \varepsilon_i$$

where $log(salary)_i, age_i, age_i^2,$ and $education_i$ are defined as above. $race_i$ is defined as the race of household head *i*. It is a dummy variable that receives a value of 0 if nonwhite and 1 if white. $gender_i$ is a dummy variable signifying the gender of household head *i*, receiving a value of 0 if female and 1 if male. $industry_i$ represents the type of work household head *i* does. It is a dummy variable receiving the value of 0 if manual labor and a value of 1 if non-manual labor. ε_i is the error term.

The Model 3A Population Regression Function determines the effect of the above variables with the addition of diabetes on salary. The model is as follows

$$log(salary)_i = \beta_0 + \beta_1 age_i + \beta_2 age_i^2 + \beta_3 education_i + \beta_4 race_i + \beta_5 gender_i + \beta_6 industry_i + \beta_7 diabetes_i + \beta_8 diabetes_i * age_i + \quad_i$$

where $log(salary)_i, age_i, age_i^2, education_i, race_i$, $gender_i$, and $industry_i$ are defined as above. $diabetes_i$ is a dummy variable that represents whether household head *i* has diabetes or not. This variable receives a value of 0 if the person does not have diabetes and a value of 1 if the person has diabetes. However, in the population regression functions representing solely the diabetic populations, this variable is called $type1_i$. It represents whether a person has type I or type II diabetes, receiving a value of 0 if type II and a value of 1 if type I. $diabetes_i * age_i$ shows the impact of age on the percent change in salary in people with diabetes. Also note: in the population regression functions with only the diabetic population, this term is called $type1_i * age_i$. It represents the wage age function for those with type I diabetes. ε_i is the error term.

The Model 3B Population Regression Function determines the effects of the above variables and limitations due to diabetes on the percent change of salary. The model is as follows

$$log(salary)_i = \beta_0 + \beta_1 age_i + \beta_2 age_i^2 + \beta_3 education_i + \beta_4 race_i + \beta_5 gender_i + \beta_6 industry_i + \beta_7 limitations_i + \beta_8 diabetes_i * age_i + \varepsilon_i$$

where $log(salary)_i, age_i, age_i^2, education_i, race_i$, $gender_i, industry_i$, $diabetes_i * age_i$, and ε_i are defined as above. $limitations_i$ is defined as the limitations caused by diabetes. It receives a value of 1 if the household head *i* is very limited, a value of 3 if somewhat limited, a value of 5 if just a little limited, and a value of 7 if not at all limited.

Tables 1, 2, 3, and 4 show summary statistics for the data in this study. Table 1 contains the means the total population (1,920 people) in 2007 for all variables. The average age of household head is 42.23 years old, the average education of the household head is 14.58 years, and the average percent change in salary is 10.07%. Table 2 shows the same information for the diabetic population (114 people) in 2007. The average age of the household head is 51.28 years old, the average education of the household head is 14.28 years, and the average percent change in salary is 9.94%. Table 3 shows the means for all variables for the total population (2,078 people) in 2013. The average age of the household head is 42.38 years old, the average education of the household head is 15.00 years, and the average percent change in salary for the total population in 2013 is 10.14%. Table 4 shows the means for all variables in the diabetic population (132 people) in 2013. The average age of the household head is 51.51 years old, the average education of the household head is 14.68 years, and the average percent change in salary is 9.82%.

<u>Section IV: Hypotheses</u>

The base model for this study comes from the Mincer Earning's Model, where the percent change in wage is a function of education and work experience (Mincer, 1958). Based on the standard age-income theory, it is hypothesized that age and age^2 will have an inverted U relationship with salary (Thornton et al., 1997) for both the total population and the diabetic population. As people age, their income increases until a certain point, and then after a certain age it starts to decrease again (Thornton et al., 1997). Mincer (1958) used experience and $experience^2$ variables to estimate whether there was a nonlinear impact on earnings, however, in this study age is used instead because it can be assumed that people gain experience in the workforce as they age.

It is hypothesized that more years of education causes an increase in salary for both the total and diabetic population. The Mincer Earnings Equation (Mincer, 1958) estimates a positive relationship between years of schooling and percent change in wage (Borjas, 2010).

A positive relationship is expected between gender and salary (Boot et al., 2008), as well as a positive relationship between race and salary (Freeman, 1979). Boot et al. (2008) found that males earned significantly higher wages than females, though the gap has narrowed over the years. Freeman (1979) found that white workers earned significantly more than nonwhite workers.

A positive relationship is expected between industry and salary because unskilled workers typically are confined to manual labor jobs and skilled workers have the opportunity to engage in non-manual labor jobs (Rubery, 1978). That being said, a positive relationship is predicted between industry and salary because as skills increase, workers will likely engage in the non-manual labor jobs, and skilled laborers are paid more than unskilled laborers (Rubery, 1978).

A negative impact of diabetes on salary is expected for the total population (Minor, 2013). Further, a negative impact of age on salary for those with diabetes is predicted. Minor (2013) found that the duration of the disease has a very significant negative impact on earnings. As for the impact of the type of diabetes on salary, it is expected that people with type I diabetes will earn more than people with type II diabetes, solely due to the etiology of and other health conditions that come with type II diabetes (JDRF, 2016). A negative relationship is also predicted for those with type I diabetes as they age because the longer the disease persists, the more difficult it can be to control (Minor, 2013).

Lastly, this paper predicts that as limitations due to diabetes increase and hinder the person, they will negatively impact salary, much like Minor (2013) found with the complications variable in his paper.

Section V: Discussion of Results

To obtain the results for this study, three different Standard OLS models were run. These regressions were run four separate times in order to account for the total population in 2007 and 2013 and the diabetic population in 2007 and 2013. Prior to running these regressions, tests were run in search of multicollinearity and heteroskedasticity in order to find and compensate for any bias that could be present in this study.

Multicollinearity

Due to the potential linear relationship between the diabetes/type 1 variables and limitations variable and the diabetes and diabetes*age variables, bias tests were run to test first for multicollinearity. With the original model including the impact of age, age^2, education, race, gender, industry, diabetes, diabetes*age, and limitations on the percent change in salary, multicollinearity was found. Table 5 shows the results of the multicollinearity test for total and diabetic populations in 2007 and 2013. For the total populations in both years, the VIF is much greater than 5 for diabetes and limitations variables, suggesting imperfect multicollinearity. In the total population for 2007 and 2013, there is also multicollinearity with the diabetes*age variable, which shows the salary-age function for those people with diabetes. However, it is not necessary to act on this multicollinearity.

In order to correct the multicollinearity, Table 6 and Table 7 show Model 3 has been split into two groups: A and B. Model 3A has all prior variables and diabetes, but does not include diabetes; Model 3B has all prior variables and limitations, but does not include diabetes. The same steps have been taken in the diabetic population in order to keep the results consistent.

Park Test for Heteroskedasticity

The Park Test was conducted to test for Heteroskedasticity in the cross sectional data. The Null Hypothesis is $\alpha_1 = 0$ (errors are homoskedastic), and the Alternate Hypothesis is $\alpha_1 \neq 0$ (errors are heteroskedastic). The Park Test was run for all four models in both years for both population groups. Table 8 shows the Null Hypothesis should be rejected, and therefore, there is heteroskedasticity for Model 1, Model 2, and Model 3B in the total population for 2007. Table 9 shows no heteroskedasticity in any model for the diabetic population in 2007. Table 10 shows heteroskedasticity in Model 2, Model 3A, and Model 3B for the total population in 2013. Table 11 shows no heteroskedasticity for the diabetic population in 2013. The heteroskedasticity bias was corrected for by using robust standard errors.

2007 General Results

Table 12 shows all models in 2007 for the total population and the diabetic population. Model 1 shows the percent change in salary as a function of education, age, and age^2 (Mincer, 1958). The total population is significantly impacted by both age and education in Model 1; one additional completed grade of education has a positive impact on the percent change in salary, similar to what Mincer found in his own study (Mincer, 1958). Model 1 also shows an inverted U relationship between age and the percent change in salary; as age increases, salary increases until a certain point, then salary decreases after a certain age. Mincer (1958) found similar results in his own earnings equation. The diabetic population is also significantly impacted by education, age, and age^2. Comparatively, the inverted U relationship between age and the percent change in salary is larger for those who are diabetic than those who are not diabetic. This may be explained by the much smaller sample size of the diabetic population. Education also has a positive, significant impact on the percent change in salary for people with diabetes, though it is not as beneficial an impact as for those without diabetes. This is consistent with the study conducted by Jacobs et al. (2001), which suggests people with diabetes do not fully reap the benefits of opportunities that their healthy counterparts are able to due to productivity loss. The R^2 values for these models suggest 19% of the variation in the total population and 25% of the variation in the diabetic population is explained by each model.

Model 2 in Table 12 for the total population shows the impact of age, age^2, education, race, gender, and industry type on the percent change in salary. These demographic characteristics add more explanatory variables to the model. In the total population, there is still a significant, positive impact of education on the percent change in salary and there is still a significant inverted U relationship between age and salary (Mincer, 1958). The results for race in this study are consistent with those that Freeman (1979) found, white workers are found to earn significantly more than nonwhite workers. However, the results of the impact of industry on percent change in salary are surprising. People that engage in non-manual labor earn significantly less than people that engage in manual labor. This is not consistent with the findings of Rubery (1978), which indicated that unskilled workers typically engage in manual labor and earn less than those more skilled workers who engage in non-manual labor jobs. In comparison, people with diabetes still experience a more extreme inverted U relationship with age and salary than those without diabetes. Again, this may be explained by the much smaller sample size of the diabetic population. The findings of the study conducted by Jacobs et al. (2001) are still consistent with those found in this study for the impact of education of people with diabetes on the percent change in salary. Jacobs et al. (2001) found that people with diabetes are not as productive as their healthy counterparts and that they are not as able to reap the benefits of the opportunities as their healthy counterparts. The results of this study also show that white workers with diabetes do not earn as much as white workers without diabetes. The results do not show a significant impact of gender of people with diabetes on percent change in salary. Further, the results are inconsistent with the expectations stated earlier in this paper about the impact of industry type on the percent change in salary. It was expected that manual labor would have a negative impact on salary for people with diabetes (Bruyère, 2001) because productivity could be lowered due to the disease and difficulty of the work. However, the results show that people with diabetes actually earn lower salaries in non-manual labor jobs than in manual labor jobs. The R^2 values for these populations are 21% and 32%, respectively.

In Model 3A, for the 2007 total population, the above stated results are applicable here as well. In this model, a diabetes variable and an age-salary function based only on those who have diabetes variable is added. The expectations for both of these variables were to be negative, based on prior literature (Minor, 2013). However, these results do not hold any significance for the total population of 2007. In Model 3A for the diabetic population of 2007, all of the above stated results are applicable here as well and are still significant. In this model, a dummy variable (type I) was added to address whether the person had type II diabetes (0) or type I diabetes (1). Additionally, an interaction term between the type I dummy and age was included to understand the impact of the age-salary function for people with type I diabetes only. The results show that people with type I diabetes earn 568% more in their salary than people with type II diabetes; this is not consistent with any literature. The limitations of diabetes are not significant. The R^2 values for these populations are 21% and 34%.

In Model 3B for the total population of 2007, the age-salary function, education, race, gender, and industry all have the same impact on the percent change in salary. However, in this model, the diabetes variable is not included because of the multicollinearity issue with limitations. The age-salary function of those with diabetes is included in this model, as is the limitations variable. The results show that as a person with diabetes ages, the salary will decrease. This is consistent with the results of Minor's study (2013), where he explores the impact of the duration of diabetes on wages. The limitations from diabetes also caused a significant positive impact on the percent change in salary, which was to be expected based on the structure of the data (no complications received a value of 7). This is consistent with Minor's (2013) findings that complications from diabetes make it more difficult to work and even discourage working, thus leading to lower wages. In Model 3B for the diabetic population in 2007, all of the variables from Model 3A are included and have the same results, except limitations are included instead of whether the person has type I or type II diabetes. Those with no limitations earn significantly more than those with limitations. The age-salary function of those with type I diabetes is insignificant. The R^2 values for these populations are 22% and 34%.

2013 General Results

Table 13 shows all models for the total and diabetic populations. Model 1 for the total population in 2013 is based off the Mincer Earning's Equation (Mincer, 1958), though Model 1 uses age instead of work experience. Typically, as people age, their work experience also increases. For the total population, age has an inverse U relationship with the percent change in salary, consistent with what Mincer (1958) found. Education also has a positive and significant relationship with percent change in salary, again, consistent with Mincer's findings (1958). For the diabetic population the age-salary function is not significant, but education has a positive and significant effect on percent change in salary. A completion of one additional grade creates the same percentage increase in the total population as in the diabetic population. The R^2 value for the total population is 22% and 19% for the diabetic population.

Model 2 shows the age-salary function and education, as well as race, gender, and industry. The age-salary function and education variables have the same effect on salary as they did in Model 1 for both the total population and the diabetic population. In the total population for 2013, white workers earned significantly more than nonwhite workers, consistent with the findings of Freeman (1979), which indicated white workers earned significantly higher wages than nonwhite workers. Males also earn significantly more than female workers according to the results. These findings are consistent with the findings of Tunceli et al. (2005) that indicate a gender wage gap exists. Additionally, the results show that workers engaging in non-manual labor earn significantly less than workers engaging in manual labor, this is inconsistent with the results Rubery (1978) finds in her study, which suggests that less educated, more unskilled laborers are paid less than more educated and skilled workers. In the diabetic population, the age-salary function is insignificant, as is gender and industry. Education causes the exact same percentage increase in salary for the diabetic population as the entire population. The results also show that white workers with diabetes earn 74% more than nonwhite workers with diabetes, compared to 46% higher in the total population. These results are similar to those of Freeman (1979). The R^2 value for the total population is 25% and 23% for the diabetic population.

Model 3A shows the age-salary function, education, race, gender, and industry for both the total and diabetic population. Diabetes and a variable that shows the age-salary function for those with diabetes are included in this model for the total population. The impact age, education, race, gender, and industry have on the percent change in salary remain exactly the same as they did in Model 2. The impact of diabetes and the diabetes-age variable do not hold any significance. For the diabetic population, neither having type I diabetes, nor the age-salary function for those with type I diabetes yield significant results. The R^2 value for the total population in this model is 26% and 23% for the diabetic population.

Model 3B shows the age-salary function, education, race, gender, and industry for both the total and diabetic population yield similar results to those in prior models. In this model, limitations due to diabetes and the age-salary function for those with diabetes are included. These do not yield significant results for the total population. For the diabetic population, limitations due to diabetes have significant results (those with less complications have increased percentage of salary compared to those with more complications). The type I age-salary function does not show significant results. The R^2 value for both populations in this model is 26%.

Section VI: Conclusion

Estimates from this study indicate that the sole presence of diabetes in the total population in 2007 and in 2013 is statistically insignificant. However, the estimates show that in 2007, as a person with diabetes ages one year, salary decreases by 3%. The results also indicate that in 2007, people with type I diabetes earn approximately 568% more than those with type II diabetes. This difference in salaries could be due to productivity loss of those with type II diabetes (Fletcher et al., 2012) and due to the health complications that can occur with type II diabetes, such as obesity, heart disease, and neuropathy to name a few (JDRF, 2016). Type I diabetes does not have a significant impact on salary in 2013, potentially due to policy changes that occurred after the financial crisis of 2008. These policy changes include transitions into Patient Protection and Affordable Care Act, and alterations to Medicare and Medicaid (Dufour, 2014).

Estimates also show that limitations due to diabetes negatively impact the total population and the diabetic population in 2007. People with no limitations due to diabetes earn 24% more than those with limitations from diabetes. People with type I diabetes who are not limited by the disease earn 39% more than those with limitations from diabetes. In 2013, this number dropped to 26% more for type I diabetics without limitations than with limitations.

These results may have a couple significant impacts on the American labor force: First, people are continually being diagnosed with diabetes (type I and type II), so the salary differences between those with type I and type II should be addressed. Second, if more people with diabetes continue to opt out of the labor force, then the rising number of people with diabetes could decrease the amount of people in the available labor force. This statement also holds true for people whose productivity is decreased because of their diabetes. Third, limitations due to diabetes seem to be the largest and most significant issue. If these limitations are causing lower productivity, and the population with diabetes is being paid less due to lower productivity, as suggested by Jacobs et al. (2001), and more people continue to be diagnosed at the current rate, there could be more people with diabetes in the labor force who are earning and producing less than their healthy coworkers.

In the end, there is a significant trend in having diabetes and being disabled in the work force. This trend shows that the presence of diabetes does not always significantly impact salary; however, if limitations due to diabetes are present, then salary is significantly impacted in a negative way. This holds implications for the entire work force due to the rising number of diabetes diagnoses and the salary gaps. These salary gaps may be due decreased productivity, missed days of work, or even discrimination. Thus, using more resources to study these salary gaps may be beneficial.

Appendix

Table 1: Summary Statistics 2007 (Whole Population)

Variables	Mean	Minimum	Maximum
Percent Change in Salary	10.07 (1.84)	0	14.98
Age of Household Head	42.23 (11.81)	18	81
Age of Household Head (Squared)	1923.75 (1038.30)	324	6561
Education of Household Head	14.58 (2.16)	0	17
Race of Household Head	0.75 (0.43)	0	1
Gender of Household Head	0.78 (0.41)	0	1
Industry	0.66 (0.47)	0	1
Limitations	0.37 (1.52)	0	7
*Diabetes * Age*	3.04 (12.34)	0	80
Observations		1,920	

Table 2: Summary Statistics 2007 (Diabetic Population)

Variables	Mean	Minimum	Maximum
Percent Change in Salary	9.94 (1.98)	3.04	12.61
Age of Household Head	51.28 (9.40)	26	80
Age of Household Head (Squared)	2718.15 (938.26)	676	6400
Education of Household Head	14.28 (2.45)	4	17
Race of Household Head	0.70 (0.46)	0	1
Gender of Household Head	0.82 (0.38)	0	1
Industry	0.66 (0.47)	0	1
Limitations	6.29 (1.33)	1	7
*Type I * Age*	2.58 (9.67)	0	49
Observations		114	

Table 3: Summary Statistics 2013 (Whole Population)

Variables	Mean	Minimum	Maximum
Percent Change in Salary	10.14 (1.92)	0	15.42
Age of Household Head	42.38 (12.34)	19	81
Age of Household Head (Squared)	1948.70 (1119.15)	361	6561
Education of Household Head	15.00 (2.04)	1	17
Race of Household Head	0.73 (0.44)	0	1
Gender of Household Head	0.77 (0.48)	0	1
Industry	0.65 (0.48)	0	1
Limitations	0.39 (1.56)	0	7
*Diabetes * Age*	3.30 (12.92)	0	81
Observations		2,078	

Table 4: Summary Statistics 2013 (Diabetic Population)

Variables	Mean	Minimum	Maximum
Percent Change in Salary	9.82 (2.13)	0	12.77
Age of Household Head	51.51 (10.84)	21	81
Age of Household Head (Squared)	2770.44 (1076.94)	441	6561
Education of Household Head	14.68 (2.04)	9	17
Race of Household Head	0.65 (0.48)	0	1
Gender of Household Head	0.75 (0.43)	0	1
Industry	0.68 (0.47)	0	1
Limitations	6.21 (1.43)	1	7
*Type I * Age*	2.48 (9.50)	0	54
Observations		132	

Table 5: Test for Multicollinearity

Variable	2007 Complete VIF	2007 Subset VIF	2013 Complete VIF	2013 Subset VIF
Diabetes	47.10	-	36.87	-
*Diabetes*Age*	30.78	-	23.91	-
Type 1	-	23.90	-	19.51
*Type 1*Age*	-	60.37	-	18.69
Limitations	22.53	1.06	18.93	1.05
Gender	1.12	1.19	1.11	1.24
Age	1.09	20.38	1.10	1.30
Race	1.11	1.16	1.10	1.17
Industry	1.04	1.07	1.05	1.06
Education	1.03	1.07	1.03	1.04

Table 6: Corrected For Multicollinearity

Variable	**2007 Complete (A) VIF**	**2007 Complete (B) VIF**	**2007 Subset (A) VIF**	**2007 Subset (B) VIF**
Diabetes	30.07	-	-	-
*Diabetes*Age*	30.51	14.60	-	-
Type 1	-	-	23.66	-
*Type 1*Age*	-	-	59.54	3.23
Limitations	-	14.38	-	1.05
Gender	1.12	1.12	1.19	1.17
Age	1.09	1.07	20.21	3.30
Race	1.11	1.11	1.15	1.15
Industry	1.04	1.04	1.05	1.06
Education	1.03	1.03	1.06	1.07

Table 7: Corrected for Multicollinearity

Variable	**2013 Complete (A) VIF**	**2013 Complete (B) VIF**	**2013 Subset (A) VIF**	**2013Subset (B) VIF**
Diabetes	23.18	-	-	-
*Diabetes*Age*	23.62	12.12	-	-
Type 1	-	-	19.33	-
*Type 1*Age*	-	-	18.53	1.13
Limitations	-	11.90	-	1.05
Gender	1.11	1.10	1.21	1.24
Age	1.10	1.10	1.28	1.17
Race	1.10	1.08	1.16	1.17
Industry	1.05	1.05	1.06	1.06
Education	1.03	1.03	1.04	1.03

Table 8: Testing for Heteroskedasticity in 2007 Total Population

Test Variables	**Model 1**	**Model 2**	**Model 3A**	**Model 3B**
Coefficient	0.57	0.39	0.37	0.38
P-Value	0.00	0.03	0.04	0.04
Std. Error	0.18	0.18	0.18	0.19
T-Value	3.20	2.20	2.05	2.06
Critical Value	3.17	2.17	2.06	2.00
Null Hypothesis	Reject	Reject	Fail to Reject	Reject

Table 9: Testing for Heteroskedasticity in 2007 Diabetic Population

Test Variables	**Model 1**	**Model 2**	**Model 3A**	**Model 3B**
Coefficient	0.57	0.72	1.63	1.06
P-Value	0.61	0.47	0.20	0.30
Std. Error	1.13	1.00	1.28	1.02
T-Value	0.51	0.72	1.28	1.04
Critical Value	0.50	0.72	78.12	1.04
Null Hypothesis	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject

Table 10: Testing for Heteroskedasticity in 2013 Total Population

Test Variables	**Model 1**	**Model 2**	**Model 3A**	**Model 3B**
Coefficient	0.71	0.56	0.54	0.56
P-Value	0.00	0.00	0.00	0.00
Std. Error	0.17	0.18	0.18	0.18
T-Value	4.05	3.17	3.02	3.19
Critical Value	4.18	3.11	3.00	3.11
Null Hypothesis	Fail to Reject	Reject	Reject	Reject

Table 11: Testing for Heteroskedasticity in 2013 Diabetic Population for Age

Test Variables	**Model 1**	**Model 2**	**Model 3A**	**Model 3B**
Coefficient	0.33	0.26	0.20	0.20
P-Value	0.69	0.74	0.80	0.80
Std. Error	0.85	0.80	0.82	0.82
T-Value	0.39	0.33	0.25	0.25
Critical Value	0.39	0.32	0.24	0.24
Null Hypothesis	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject

Table 12: Total Population of 2007 Compared to Diabetic Population of 2007

Variables	**2007 Total Population**				**2007 Diabetic Population**			
	Model 1	**Model 2**	**Model 3A**	**Model 3B**	**Model 1**	**Model 2**	**Model 3A**	**Model 3B**
Age	0.14***	0.13***	0.13***	0.13***	0.42***	0.39***	0.53***	0.48***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.12)	(0.12)	(0.14)	(0.12)
Age Squared	-0.001***	-	-0.001***	-	-	-	-0.005***	-0.005***
	(0.00)	0.002***	(0.00)	0.001***	0.004***	0.004***	(0.00)	(0.00)
		(0.00)		(0.00)	(0.00)	(0.00)		
Education	0.36***	0.36***	0.36***	0.36***	0.30***	0.30***	0.30***	0.28***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.07)	(0.07)	(0.07)	(0.06)
Race	-	0.40***	0.40***	0.40***	-	0.35	0.32	0.42
		(0.09)	(0.09)	(0.09)		(0.37)	(0.37)	(0.36)
Gender	-	0.17*	0.17*	0.17*	-	0.26	0.33	0.29
		(0.10)	(0.09)	(0.10)		(0.45)	(0.45)	(0.43)
Industry	-	-0.25***	-0.25***	-0.24***	-	-0.98***	-1.02***	-0.83**
		(0.08)	(0.08)	(0.08)		(0.34)	(0.34)	(0.33)
Diabetes	-	-	0.34	-	-	-	-	-
			(0.02)					
*Diabetes*Age*	-	-	0.008	-0.03*	-	-	-	-
			(0.02)	(0.02)				
Type 1	-	-	-	-	-	-	5.68*	-
							(3.38)	
*Type 1*Age*	-	-	-	-	-	-	-0.13	0.02
							(0.08)	(0.02)
Limitations	-	-	-	0.24*	-	-	-	0.39***
				(0.14)				(0.12)
Constant	1.87***	1.76***	1.79***	1.82***	-3.81	-3.00	-6.76*	-7.38**
	(0.58)	(0.57)	(0.53)	(0.02)	(3.09)	(3.00)	(3.64)	(3.20)
R^2	0.19	0.21	0.21	0.22	0.25	0.32	0.34	0.39
$\overline{R^2}$	-	-	0.21	-	0.23	0.28	0.29	0.34

All standard errors are in parentheses
* indicates significance at 10% level of significance
** indicates significance at 5% level of significance
*** indicates significance at 1% level of significance

Table 13: Total Population of 2013 Compared to Diabetic Population of 2013

Variables	**2013 Total Population**				**2013 Diabetic Population**			
	Model 1	**Model 2**	**Model 3A**	**Model 3B**	**Model 1**	**Model 2**	**Model 3A**	**Model 3B**
Age	0.15***	0.15***	0.15***	0.15***	-0.11	-0.09	-0.14	-0.08
	(0.02)	(0.02)	(0.02)	(0.02)	(0.11)	(0.11)	(0.12)	(0.11)
Age Squared	-0.002***	-	-	-	0.001	0.001	0.001	0.001
	(0.00)	0.002***	0.002***	0.002***	(0.001)	(0.001)	(0.001)	(0.001)
		(0.00)	(0.00)	(0.00)				
Education	0.43***	0.43***	0.43***	0.43***	0.43***	0.43***	0.42***	0.43***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.08)	(0.08)	(0.08)	(0.08)
Race	-	0.46***	0.45***	0.46***	-	0.74*	0.71*	0.82**
		(0.09)	(0.09)	(0.09)		(0.38)	(0.38)	(0.38)
Gender	-	0.26***	0.26***	0.26***	-	0.31	0.32	0.15
		(0.09)	(0.09)	(0.09)		(0.43)	(0.43)	(0.43)
Industry	-	-0.27***	-0.27***	-0.27***	-	-0.08	-0.06	-0.07
		(0.08)	(0.08)	(0.08)		(0.37)	(0.38)	(0.37)
Diabetes	-	-	-0.85	-	-	-	-	-
			(0.73)					
*Diabetes*Age*	-	-	0.01	-0.02	-	-	-	-
			(0.01)	(0.02)				
Type 1	-	-	-	-	-	-	-2.65	-
							(3.21)	
*Type 1*Age*	-	-	-	-	-	-	0.07	0.005
							(0.08)	(0.02)
Limitations	-	-	-	0.12	-	-	-	0.26**
				(0.12)				(0.12)
Constant	0.36	0.15	0.11	0.18	5.64*	4.85	6.10*	2.99
	(0.52)	(0.53)	(0.53)	(0.53)	(3.01)	(2.99)	(3.47)	(3.09)
R^2	0.22	0.25	0.26	0.26	0.19	0.23	0.23	0.26
$\overline{R^2}$	0.22	-	-	-	0.17	0.19	0.18	0.21

All standard errors are in parentheses
* indicates significance at 10% level of significance
** indicates significance at 5% level of significance
*** indicates significance at 1% level of significance

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