

Estimation of the Economic Burden of Diabetes on the State of Mississippi in 2013

**Prepared for the Mississippi State Department of Health
Office of Preventive Health**

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Summary

The overarching purpose of this study is to examine the burden of diabetes on Mississippi’s population and provide quantifiable estimates of the economic cost of this burden.

Two intermediate steps needed to be taken before these estimates could be derived. The first is an examination of the diabetes prevalence by various socio-economic cohorts in order to define the scope of the disease. It was found that diabetes prevalence is increasing over time for general population youth and adults and that for adults, Whites and Hispanics are the least susceptible to the disease while Blacks/African Americans are the most susceptible. Not only does diabetes prevalence increase with age, but the less wealthy and less educated population groups are more likely to develop the disease.

A surprising finding is that diabetes prevalence in the U.S. and Mississippi youth under the age of 18 cohorts experienced a decline from 2012 to 2013 (the latest year for which comprehensive data are available). It will be interesting to learn whether this trend continues and if it will translate into adulthood.

The second step was to determine the population of Mississippi residents that have diabetes, particularly by income classification. In all, it is estimated that of the 2.98 million residents of the state in 2013, over 310,000 suffered from diabetes. This suggests that the overall prevalence rate for the state is 10.5 percent.

Estimates of the direct and indirect costs of diabetes in Mississippi could then be derived. Utilizing state level estimates for Mississippi from the American Diabetes Association, the following costs were derived:

Direct Medical Costs	\$2,389,290,280
Indirect Costs	
Absenteeism Effects	73,370,901
Presenteeism Effects	304,535,494
Unemployment due to Disability	316,600,465
Reduced Productivity for those not in labor force.....	39,198,153
Premature Mortality	271,371,827
Total Indirect Costs	1,005,080,840
Total Effects.....	\$3,394,371,120

Direct medical costs of a person with diabetes was estimated to be \$7,657 on a per capita basis for 2013 (\$2.4 billion for the entire Mississippi diabetic population). Of this total amount, \$303.5 million are estimated to be direct out-of-pocket expenditures for Mississippians.

But medical costs aren’t the only costs incurred by Mississippians with diabetes or their employers. Indirect costs from absenteeism from work, being unable to participate in the labor force due to the disease (disability), premature mortality, reduced productivity while at work (often labeled “presenteeism”) as a result of the disease or reduced productivity for those persons not in the labor force were estimated to be \$3,221 per diabetic for 2013 or just over \$1 billion for the entire state.

In addition, it was estimated that the induced consequences of lost income due to absenteeism, disability and premature mortality are \$182.4 million in labor income and \$328.6 million in gross regional product. While these consequences cannot be included in the above effects calculations, they do affect almost 5,000 jobs and have over \$80 million in fiscal consequences on both the state/local and federal levels.

There is little doubt that diabetes is a burden on the economic health of Mississippi. While there are several initiatives that are currently underway to combat the increasing loss from this adverse health condition, it seems from the data that an area that has found the most success is education, both in an overall sense and, more specifically, education regarding the dangers of the disease and how it can be prevented.

Introduction

It has often been demonstrated that diabetes imposes a substantial economic burden on the U.S. and state populations through increased direct health care costs, reduced productivity and premature mortality. Of additional note are the induced consequences that result from the loss of productivity due to the indirect effect of diabetes. Several national-, state- and county-level studies have estimated these effects; the American Diabetes Association estimated these costs (net of any spillover effects) to be \$245 billion in 2012 alone.

This study is an attempt to provide a comprehensive estimate for the burden of diabetes in the state of Mississippi in 2013 (the latest year for which comprehensive data is available). The study is divided into five major sections. First, is an overview of the diabetes prevalence in the state by gender and various racial/ethnic categories. The second section estimates the magnitude that subpopulations, by age, are affected by the disease. This estimation is performed to identify the overall population of Mississippians affected by diabetes. The third section estimates the direct medical costs incurred by persons with the disease and the indirect costs as described in a conventional economic burden of diabetes study (i.e., the American Diabetes Association's Economic Cost of Diabetes in the U.S. series). The fourth section extends the analysis is then extended by estimating the spillover consequences of the indirect burden of diabetes on Mississippi's population. The final section provides conclusions.

Prevalence

Overview

The prevalence of diabetes has been of growing concern to the nation's, as well as Mississippi's, health advocates for many years. Health conditions that have been shown to contribute to the onset of diabetes, such as obesity, are on the rise and the resulting burden of diabetes diabetic is detrimental to the state's economy.

This section examines the prevalence of diabetes among various socio-economic characteristics. While a number of factors will be demonstrated in detail, there are several points that can be gleaned from the examination:

General Population Adults

- The prevalence of diabetes and pre-diabetes is increasing over time.
- Diabetes tends to affect older populations at a higher prevalence than younger populations.
- Whites experience lower prevalence rates than other races; Blacks/African Americans tend to experience the highest rates.
- Females have a higher diabetes prevalence than males.
- While the prevalence of diabetes for all income groups has increased over time, diabetes affects lower income groups at much rates (around 2.5 times) than higher income groups.
- As with income, the prevalence among all education levels has increased over time, but the prevalence for the lowest education level is more than three times as high as the prevalence for the highest education level.

Adults in Nursing Facilities/Skilled Nursing Facilities

- The diabetes prevalence for adults in Nursing Facilities/Skilled Nursing Facilities (NF/SNF) rises until age 65, then begins to decline.
- The prevalence rate for adults in NF/SNFs is markedly higher than for adults in the general population.
- Males in NF/SNFs have a higher prevalence than do females in the same group quarters institution type.
- Whites in NF/SNFs experience lower prevalence than do other races.
- The Hispanic NF/SNF population has a higher prevalence than does the non-Hispanic population.

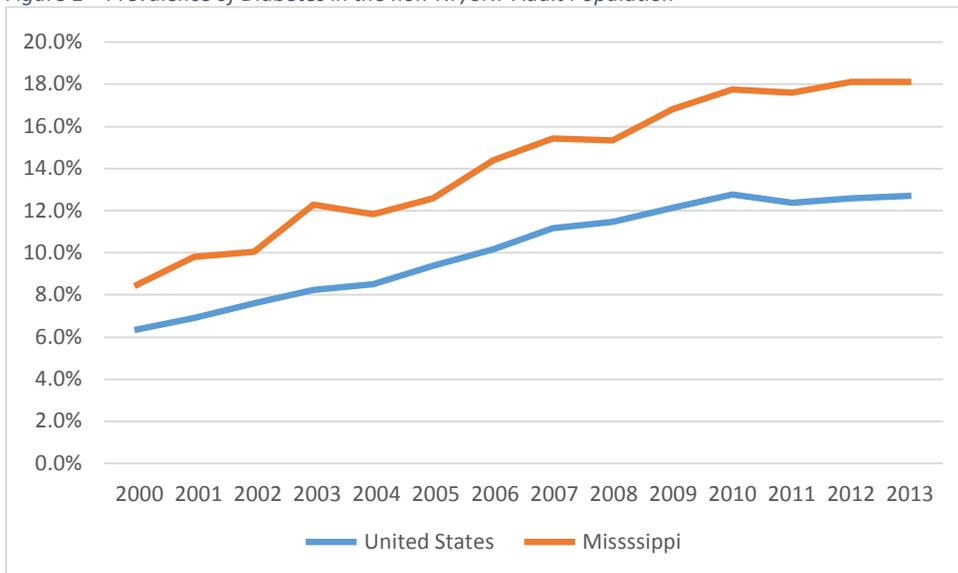
Youth under 18 years of age

- According to the National Health Interview Survey, the diabetes prevalence among persons under the age of 18, in both the United States and Mississippi, peaked in 2006 and has been declining ever since. However, this trend seems to be reversing when individuals reach 18 years of age.
- Females under the age of 18 experience higher prevalence than do males.
- Youths of races other than White or Black/African American have lower prevalence rates than do their White or Black/African American counterparts.
- The prevalence rate for Hispanic youths in Mississippi tends to be approximately the same as for the United States as a whole.

Adults over 18 years of age not in nursing facilities/skilled nursing facilities

The prevalence of diabetes and pre-diabetic conditions among non-nursing facility/skilled nursing facility (NF/SNF) adults 18 years of age and older has been increasing over time. As can be seen in Figure 1, the prevalence for this population in the United States has increased from just over 6 percent in 2000 to nearly 13 percent in 2013. The level of diabetic prevalence and its rate of change has been much higher

Figure 1 – Prevalence of Diabetes in the non-NF/SNF Adult Population

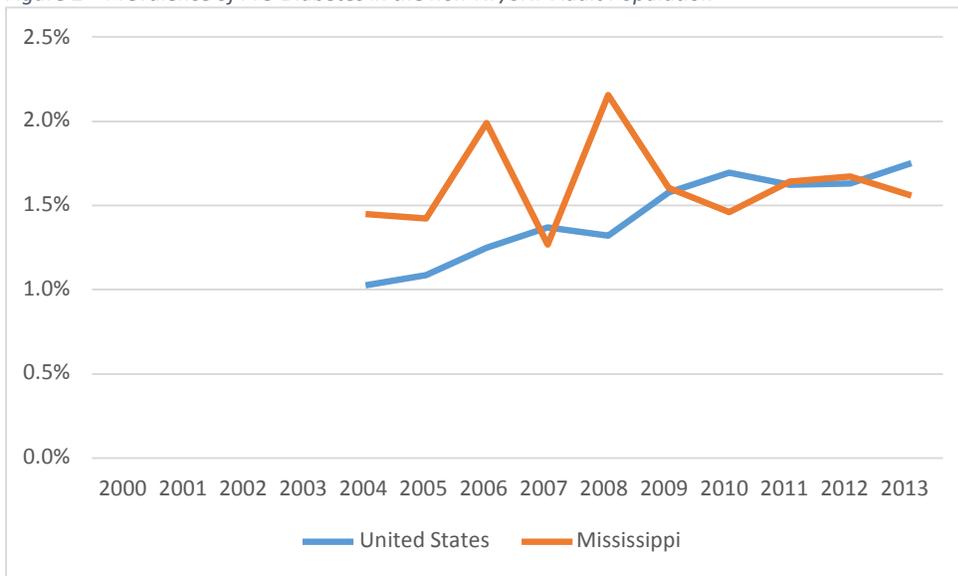


Source: Behavioral Risk Factor Surveillance System

for Mississippi. In 2000, just over 8 percent of this population indicated that they had been told that they had diabetes at some past time; that rate increased to just over 18 percent by 2013.

Figure 2 indicates that the trend holds true for the prevalence of pre-diabetes as well. The prevalence rate for pre-diabetes in the U.S. adult population that did not reside in an NF/SNF rose from just over 1 percent in 2004 (the earliest year that the BRFSS included this variable in its questionnaire) to 1.75 percent in 2013. This translated to an over 70 percent increase in the rate of pre-diabetes prevalence for the country as a whole. While the data are a bit more erratic for Mississippi, the pre-diabetic prevalence rate for the state tends to be higher than for the nation. While there has been a small percentage change in 2004-2013 in an overall sense, the chart Figure 2 demonstrates a fairly erratic pattern that could be attributed to a small annual sample size for the state.

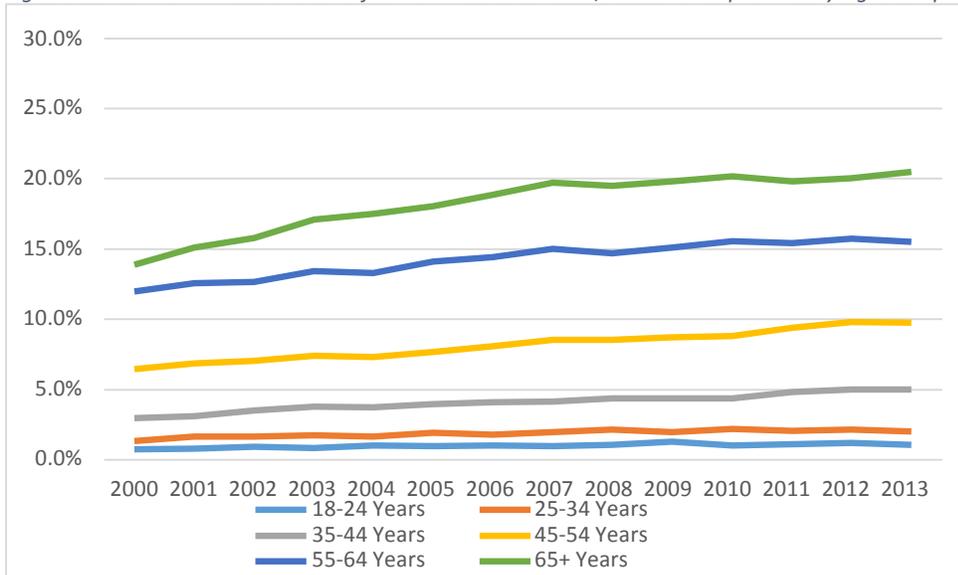
Figure 2 – Prevalence of Pre-Diabetes in the non-NF/SNF Adult Population



Source: Behavioral Risk Factor Surveillance System

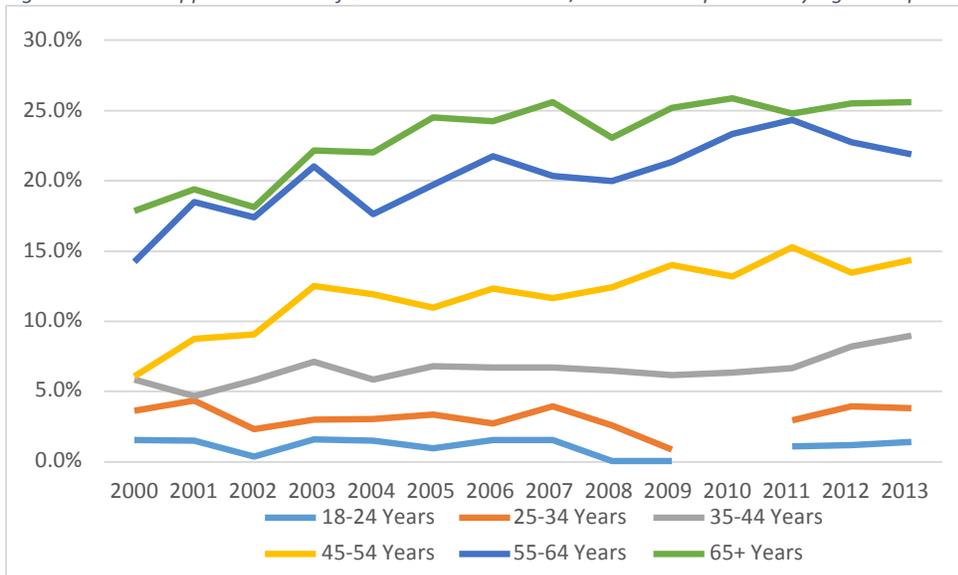
Figures 3 and 4 illustrate the prevalence of diabetes by age group for the adult, non NF/SNF population by age group over time for the United States and Mississippi, respectively. There are four items of interest that can be gleaned from these graphics. First, the prevalence of diabetes increases as age increases. Second, the overall level of diabetic prevalence is increasing over time for every age group. Third, the prevalence of diabetes for all age groups within this population is higher in Mississippi than for the country as a whole. Finally, the change in prevalence for each age group in both the United States and Mississippi seems to be increasing at a steady rate, thus suggesting this is a sustaining trend.

Figure 3 – United States Prevalence of Diabetes in the non-NF/SNF Adult Population by Age Group



Source: Behavioral Risk Factor Surveillance System

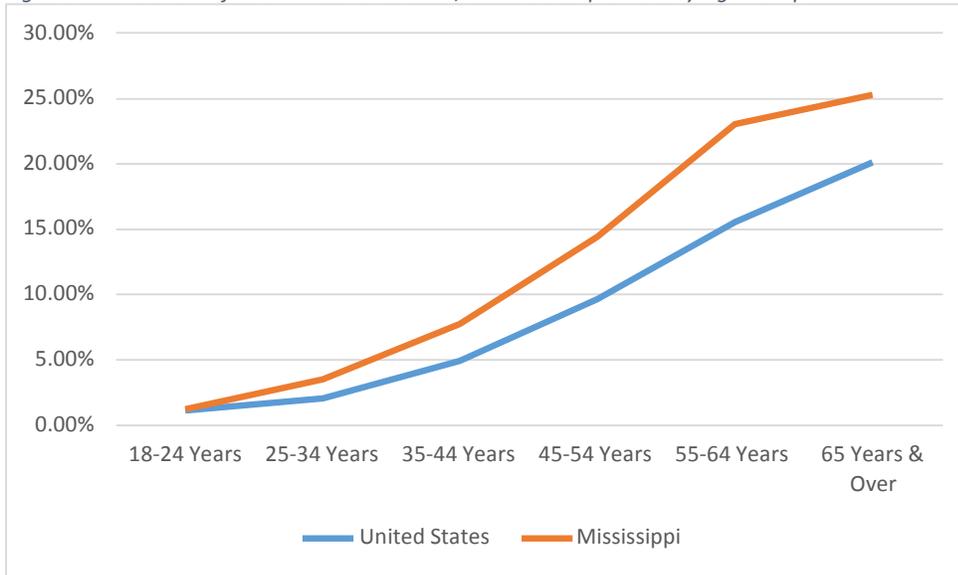
Figure 4 – Mississippi Prevalence of Diabetes in the non-NF/SNF Adult Population by Age Group



Source: Behavioral Risk Factor Surveillance System (Data for the 18-24 Years and the 25-34 Years age groups were not reported for 2010)

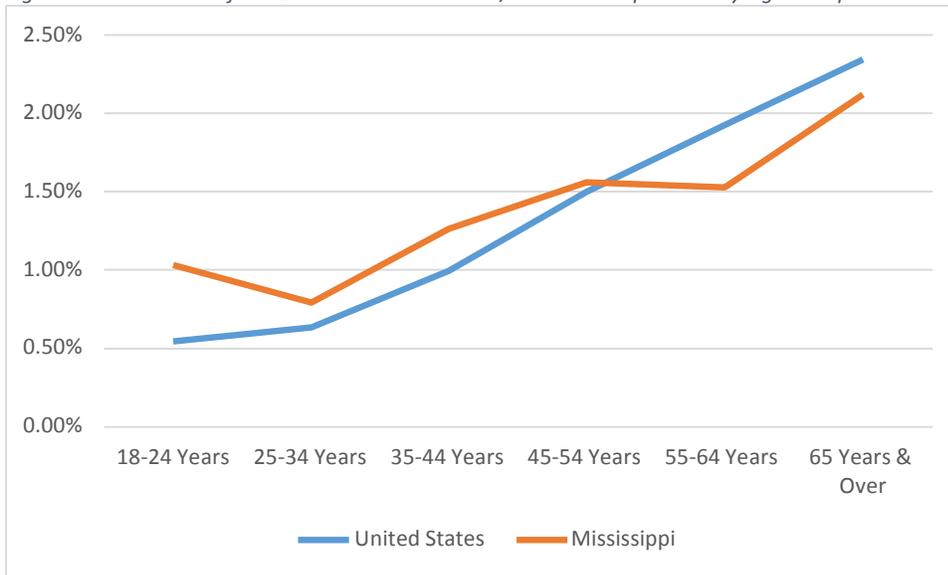
Figures 5 and 6 serve to emphasize the first point made in the preceding paragraph. As more fully discussed in the Data section of Appendix I, the 2011 through 2013 BRFSS data sets were combined to form a larger and more stable data set. Figure 5 illustrates that the prevalence of diabetes increases substantially with age while Figure 6 illustrates the same trend for pre-diabetes. Furthermore, with the exception of pre-diabetes prevalence in the two oldest age groups, Mississippi consistently ranks above the United States in the prevalence of both diabetes and pre-diabetes in this population.

Figure 5 – Prevalence of Diabetes in the non-NF/SNF Adult Population by Age Group



Source: Behavioral Risk Factor Surveillance System (combined 2011-2013 data sets)

Figure 6 – Prevalence of Pre-Diabetes in the non-NF/SNF Adult Population by Age Group

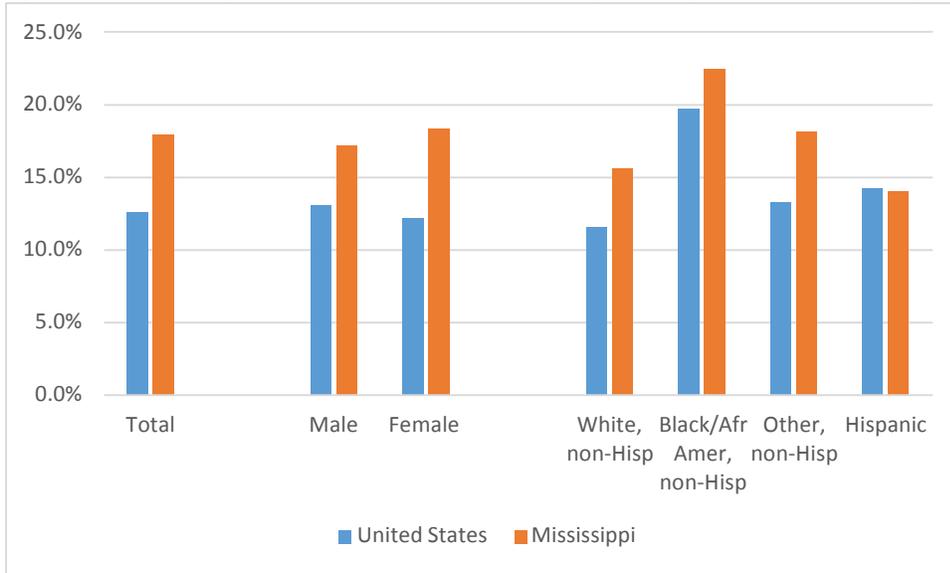


Source: Behavioral Risk Factor Surveillance System (combined 2011-2013 data sets)

Figures 7 and 8 demonstrate the prevalence of diabetes and pre-diabetes by gender, race and Hispanic ethnicity on the adult, non-NF/SNF population in both the United States and Mississippi. As can be seen in Figure 7, the prevalence of diabetes for all populations, with the exception of Hispanic ethnicity, is higher in Mississippi than in the United States. However, there are some differences. While diabetes prevalence for U.S. males is higher in comparison to U.S. females, the prevalence for Mississippi females is higher than that for males. Some similarities also exist when examining the diabetic prevalence rates among racial groups; the prevalence for Black/African American, non-Hispanics prevalence rate is highest while White, non-Hispanics have the lowest prevalence. Diabetic prevalence is approximately

the same among Hispanics for the United States and Mississippi (14.2 percent versus 14.0 percent, respectively).

Figure 7 – Prevalence of Diabetes in the non-NF/SNF Adult Population by Gender, Race and Hispanic Ethnicity

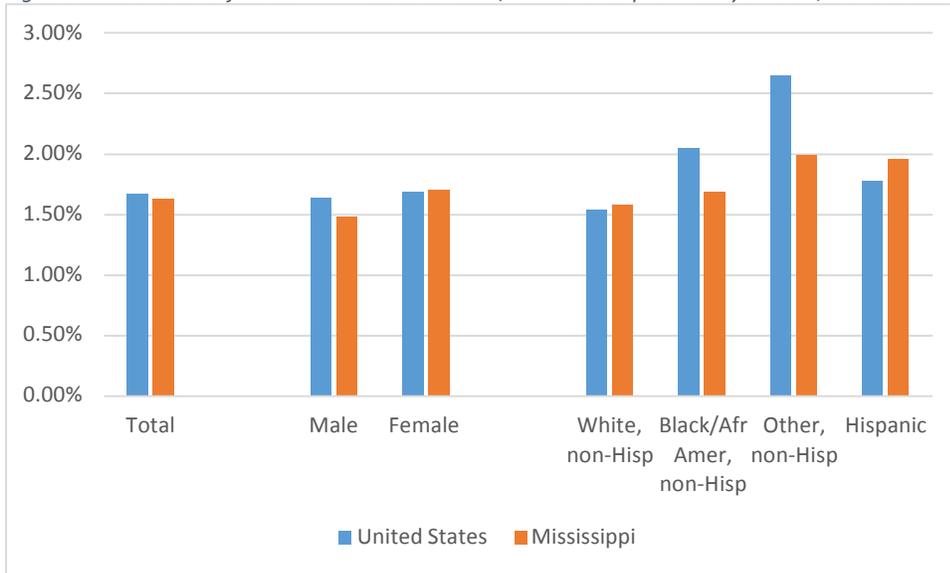


Source: Behavioral Risk Factor Surveillance System (combined 2011-2013 data sets)

Figure 8 illustrates the same type of story for the prevalence of pre-diabetes. The overall pre-diabetes prevalence for the United States and Mississippi population cohorts are approximately equal. With regard to gender, pre-diabetes prevalence for Mississippi males is slightly below that for males across the country and the pre-diabetic prevalence rates of females is approximately equal between the geographies. Furthermore, the prevalence rate for pre-diabetes in females is higher than that of males for both the U.S. and Mississippi.

The overall picture of pre-diabetes prevalence is different from diabetic prevalence with regard to race and Hispanic ethnicity. Pre-diabetes prevalence is similar for non-Hispanic whites for both the United States and Mississippi, but the prevalence rate for non-Hispanic blacks/African Americans and the non-Hispanic members of other races is lower for Mississippi than for the United States. It is also interesting to note that in contrast to the prevalence rate for diabetes, the rate of pre-diabetes prevalence for non-Hispanic members of races other than white or black/African American is higher than that of the black/African American cohort. Pre-diabetes prevalence for Mississippians of Hispanic ethnicity is slightly higher than for the nation as a whole.

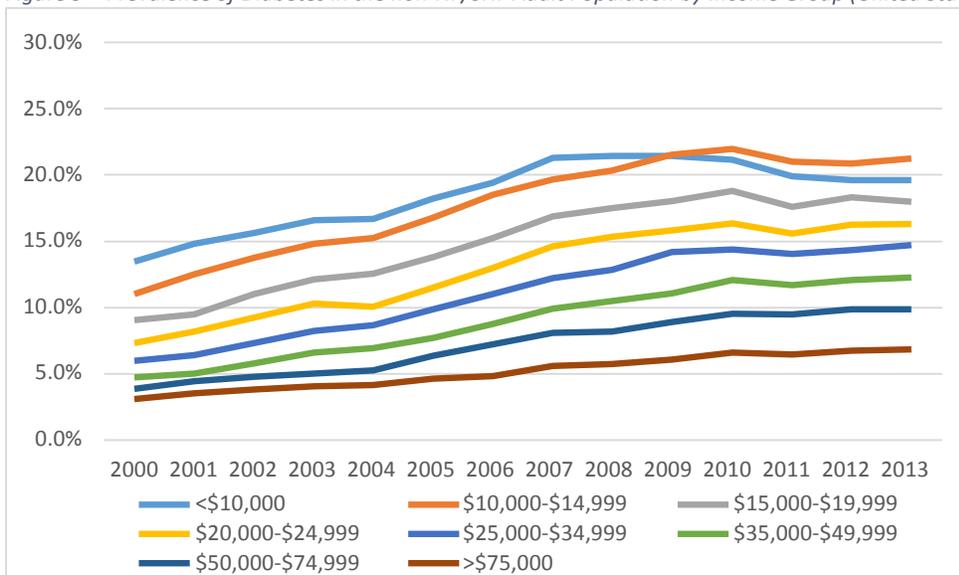
Figure 8 – Prevalence of Pre-Diabetes in the non-NF/SNF Adult Population by Gender, Race and Hispanic Ethnicity



Source: Behavioral Risk Factor Surveillance System (combined 2011-2013 data sets)

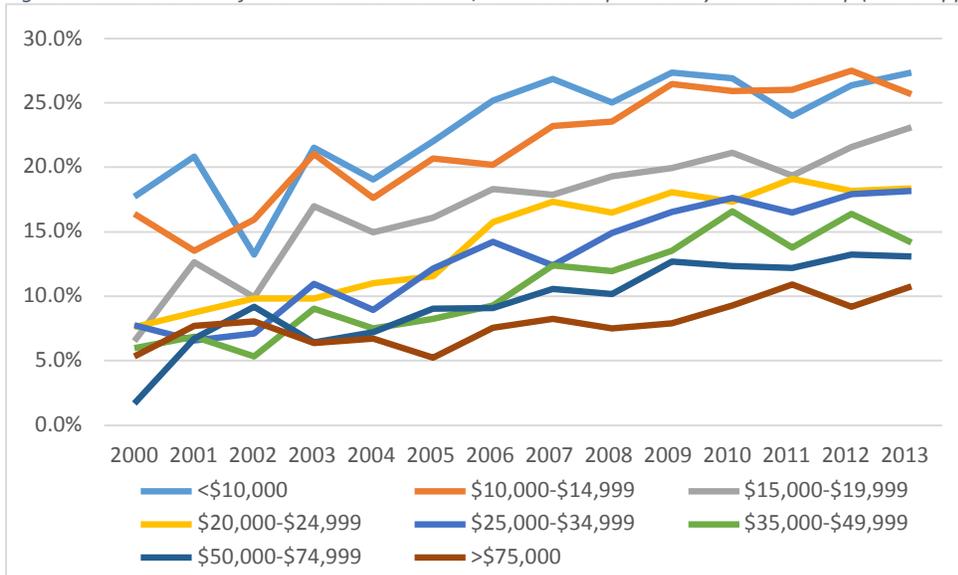
Figures 9 and 10 demonstrates diabetes prevalence by income group over time for the United States and Mississippi, respectively. While the Mississippi data show an erratic pattern (again, this is likely due to the smaller sample size), there are some noteworthy trends. First, the prevalence of diabetes has increased over time at a steady pace, regardless of the population stratification used. Second, diabetes prevalence declines as income levels increase. There could be several explanations for this including the accessibility of healthy foods in low income neighborhoods; the availability of or accessibility to quality exercise facilities; and an accessibility to a knowledge of healthy lifestyle choices.

Figure 9 – Prevalence of Diabetes in the non-NF/SNF Adult Population by Income Group (United States)



Source: Behavioral Risk Factor Surveillance System

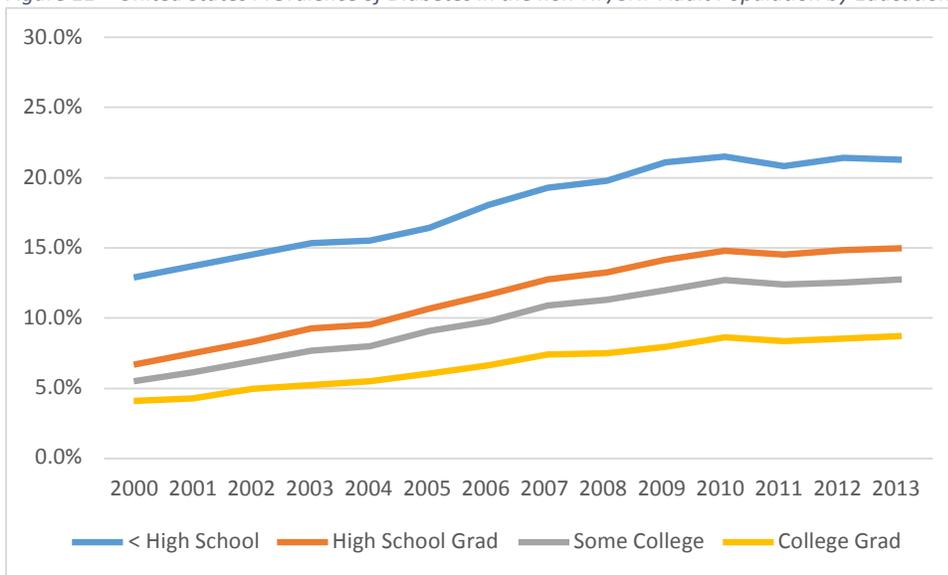
Figure 10 – Prevalence of Diabetes in the non-NF/SNF Adult Population by Income Group (Mississippi)



Source: Behavioral Risk Factor Surveillance System

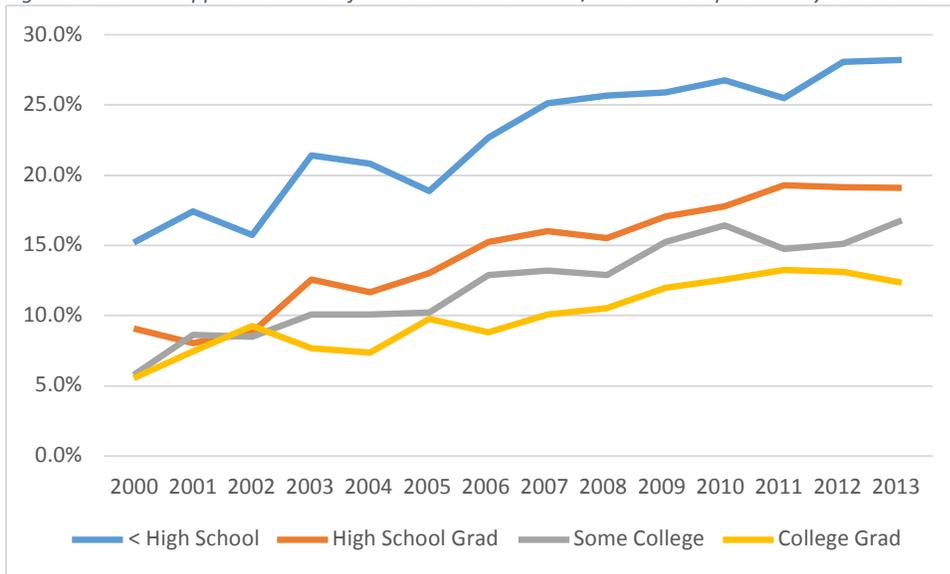
Figures 11 and 12 show diabetes prevalence by education levels for U.S. and Mississippi adult populations who do not reside in a nursing home/skilled nursing facility. A similar pattern emerges for this variable as with diabetes prevalence by income group since education and income levels tend to be highly correlated. Again, it can be readily observed that the prevalence of diabetes does increase over time. Furthermore, these graphics demonstrate that prevalence rates tend to decline as the level of education increases with the largest drop seen between residents who have less than a high school diploma and those who have graduated from high school or have obtained a GED.

Figure 11 – United States Prevalence of Diabetes in the non-NF/SNF Adult Population by Education



Source: Behavioral Risk Factor Surveillance System

Figure 12 – Mississippi Prevalence of Diabetes in the non-NF/SNF Adult Population by Education



Source: Behavioral Risk Factor Surveillance System

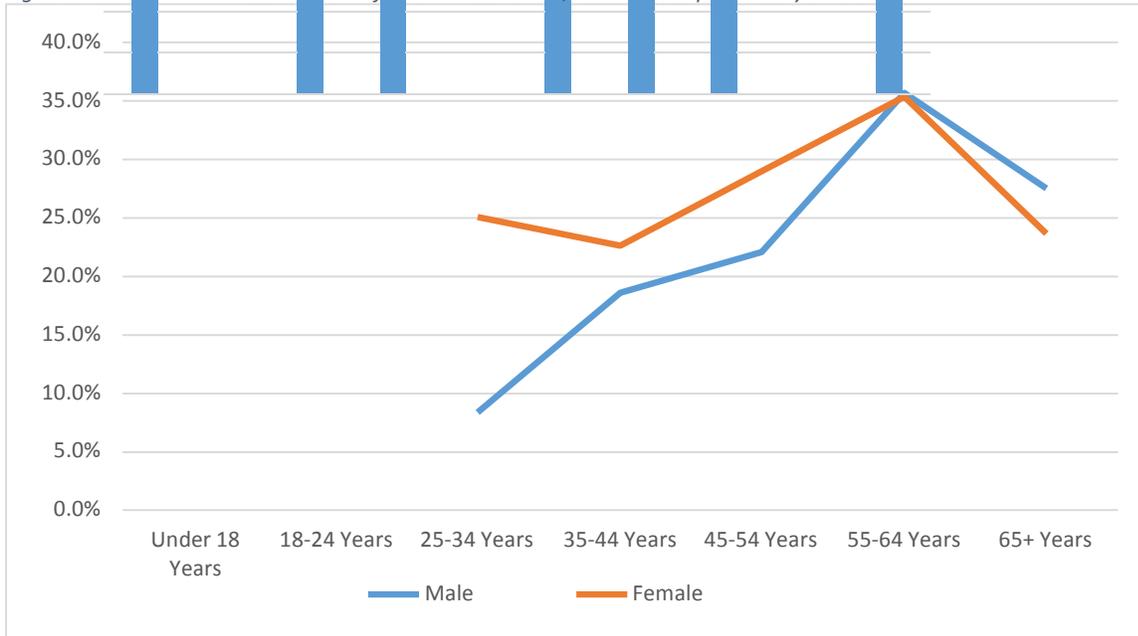
Adults in Nursing Facilities/Skilled Nursing Facilities

Adults who reside in nursing homes or skilled nursing facilities represent a population with different characteristics than the overall general, non-institutionalized population. Data to examine these characteristics are limited; the most current and widely accepted data set is the 2004 National Nursing Home Survey (NNHS). A fuller description of the data set and how it was used in this analysis can be found in the Data section of Appendix I.

A key statistic relevant to this study is the prevalence of diabetes by patient age (Figure 13). This figure demonstrates that diabetes prevalence for male patients is lower than that for female patients in the lower age groups, but rises above that of females in the upper age groups. Another interesting observation is the decline of both male and female prevalence rates from the 55-64 Years age group to the 65+ Years age group. The author is not aware of a widely accepted reason for this decline, but postulates that persons in nursing homes tend to suffer from a variety of maladies and the portion of the population with diabetes tend to suffer a markedly higher mortality rate as they age, thus increasing the proportion of patients who are not afflicted with the disease.

It is interesting, however, to note that while diabetes prevalence for males aged 65+ years residing in these facilities is higher than that for 65+ year old males who are not residents of this type of facility, diabetes prevalence for females in the 65+ year old age group who reside in nursing homes/skilled nursing facilities is lower than those who are not nursing home/skilled nursing facility residents.

Figure 13 – United States Prevalence of Diabetes in the NF/SNF Adult Population by Gender



Source: 2004 National Nursing Home Survey (data for the Under 18 Years and 18-24 were not deemed to be reliable due to the extremely small sample size)

Figure 14 illustrates diabetes prevalence for adults institutionalized in nursing homes/skilled nursing facilities by gender, race and Hispanic ethnicity. The overall tone of this graphic follows that of Figure 7, but prevalence rate levels tend to be higher since the populations in nursing homes and skilled nursing facilities tend to be older (it has previously been demonstrated that diabetes tends to affect older populations to a greater extent than younger populations – see Figure 6).

Figure 14 – United States Prevalence of Diabetes in the NF/SNF Adult Population by Gender, Race and Hispanic Ethnicity



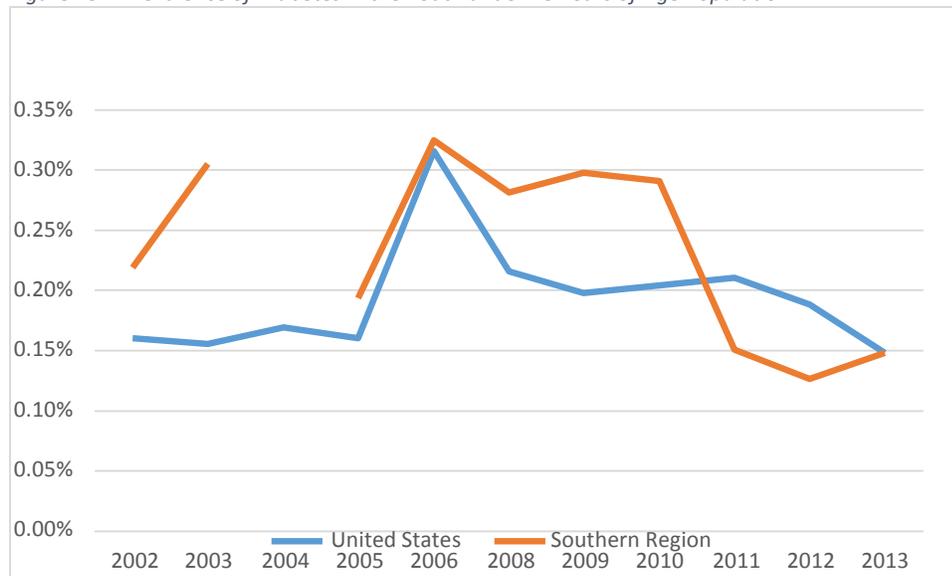
Source: 2004 National Nursing Home Survey

From an overall standpoint, males residing in these facilities have a higher diabetes prevalence than do females; the non-Hispanic black/African American cohort has the highest prevalence among the racial groupings (although diabetes prevalence for the non-Hispanic, other race category is approximately equal to the diabetes prevalence for the non-Hispanic black/African American race category). Of note is the relatively high prevalence rate for ethnic Hispanics.

Youth under 18 Years of Age

Figure 15 depicts the diabetes prevalence for youth under 18 years of age over time using single year datasets from the National Health Interview Survey (NHIS). As might be expected, Figure 15 shows diabetes prevalence for youth (the NHIS only reports data based on geographic groupings of states, hence the use of “Southern Region”) to be lower than for adults (see Figure 6). Diabetes prevalence for the Southern Region is higher than the national average for 2002-2010. However, this trend reversed for 2011 and 2012. In an overall sense, the trend from 2005-2012 was a decline in diabetes prevalence for the Southern Region youth under 18 years of age diabetic population. However, 2013 showed an increase in diabetes prevalence for Southern Region youth, but the 2013 level was below the national average.

Figure 15 – Prevalence of Diabetes in the Youth under 18 Years of Age Population



Source: National Health Interview Survey (regional data were not reported in the 2004 dataset)

Figure 16 depicts diabetes prevalence for various cohorts in the youth under 18 years of age population utilizing the 2011-2013 combined NHIS dataset. This graphic shows that diabetes prevalence for gender, racial and Hispanic ethnicity groupings for youth closely follow the patterns of diabetes prevalence for the non-nursing home/skilled nursing facility adult population. However, it is very interesting to note that diabetes prevalence the Southern region for all subpopulation gender, racial and Hispanic ethnicity groupings are lower than the prevalence rates for the nation as a whole. This subset of the NHIS data indicates that the Southern region has the lowest level of diabetes prevalence for non-institutionalized youth of the four geographic groupings (Southern, Northeast, Midwest and Western), primarily due to the generally increasing prevalence for the populations in the other regions from 2011-2013.

Figure 16 – Prevalence of Diabetes in the Youth under 18 Years of Age Population by Gender, Race and Hispanic Ethnicity



Source: 2011-2013 National Health Interview Survey combined dataset

Populations

Mississippi total and diabetic populations were generally derived either directly from the American Community Survey 2009-2013 5-year population estimates for the state or by applying the diabetes prevalence estimated in the previous section to the 2009-2013 ACS estimates.

Table 1 – 2013 Estimates of Mississippi Population in NF/SNFs by Gender, Age, Race and Hispanic Ethnicity

7,087 43 2,468 8 116 14

Source: 2004 National Nursing Home Survey, 2010 Census Summary Form 1 100% data file, 2009-2013 American Community Survey 5 Year Estimates – Tables B01001A-I

Table 2 – 2013 Estimates of Mississippi Population in NF/SNFs with Diabetes by Gender, Age, Race and Hispanic Ethnicity (Diabetes prevalence for specific cohorts shown parenthetically)

	White Alone		African American/Black Alone		Other Races	
	Not Hispanic	Hispanic	Not Hispanic	Hispanic	Not Hispanic	Hispanic
Male:						
45-54 Years	243 (83.8%)	3 (63.6%)	98 (64.4%)	1 (50.0%)	7 (83.3%)	0 (0.0%)
55-64 Years	398 (66.9%)	3 (53.8%)	149 (56.5%)	1 (100.0%)	9 (72.2%)	2 (50.0%)
65+ Years	2,165 (73.4%)	13 (70.7%)	601 (68.6%)	0 (0.0%)	31 (68.0%)	0 (0.0%)
Female:						
45-54 Years	163 (69.6%)	1 (40.0%)	113 (77.3%)	1 (100.0%)	6 (77.8%)	0 (0.0%)
55-64 Years	340 (67.5%)	3 (76.5%)	122 (49.2%)	0 (0.0%)	8 (60.0%)	0 (0.0%)
65+ Years						

Source: 2004 National Nursing Home Survey, 2010 Census Summary Form 1 100% data file, 2009-2013 American Community Survey 5 Year Estimates – Tables B01001A-I

Estimates of the total Mississippi population residing in NF/SNFs are shown in Table 1 with the estimates of the number of persons in this population with diabetes shown in Table 2 (an explanation of the method of calculating these estimates is provided in the Data section of Appendix I).

Table 3 – 2013 Mississippi non-NF/SNF Population by Gender, Age, Race and Hispanic Ethnicity

157,255 1,053 54,850 448 2,835 9

Source: 2009-2013 American Community Survey 5 Year Estimates – Tables B01001A-I

The primary users of NF/SNFs are non-Hispanic whites comprising over 72 percent of these facilities' residents. Non-Hispanic African Americans blacks comprise almost 26 percent of residents.

As illustrated in the previous section, diabetes prevalence in NF/SNFs is higher than for the rest of the population. Table 2 shows the effect of diabetes prevalence on the NF/SNF diabetic populations. Over 72 percent of the diabetic patients in these facilities are non-Hispanic whites and 58 percent of the residents with diabetes are non-Hispanic white females.

Table 3 provides estimates of Mississippi residents that do not reside in NF/SNFs and Table 4 provides estimates of this population that have diabetes. There are several insights which one can glean from these estimates. First is the absence of diabetes among non-Hispanic African American or black males in the 25-34 years age group due to no member of this cohort indicating that they had ever been told that they had diabetes in the 2011-2013 BRFSS surveys.

Second, diabetes prevalence for the African American/black population not residing in NF/SNFs translates to relatively high diabetic numbers for this subpopulation. This subpopulation (including both non-Hispanic as well as Hispanic ethnicities) comprise just over 37 percent of the overall population, but comprise over 46 percent of Mississippi's estimated diabetic population. This is particularly true for

Table 4 – 2013 Estimates of Mississippi non-NF/SNF Population with Diabetes by Gender, Age, Race and Hispanic Ethnicity
(Prevalence rates for specific cohorts shown parenthetically)

	White Alone		African American/Black Alone		Other Races	
	Not Hispanic	Hispanic	Not Hispanic	Hispanic	Not Hispanic	Hispanic
	Total:	145,493 (8.5%)	4,158 (8.5%)	136,915 (12.8%)	2,586 (8.8%)	10,964 (11.3%)
Male:	74,036 (8.8%)	2,054 (7.5%)	57,097 (11.4%)	1,446 (8.1%)	5,179 (10.4%)	147 (8.4%)
Under 18 years	188 (0.1%)	5 (0.1%)	278 (0.2%)	0 (0.0%)	31 (0.2%)	0 (0.0%)
18-24 Years	1,447 (0.8%)	34 (0.4%)	0 (0.0%)	19 (0.4%)	0 (0.0%)	2 (0.4%)
25-34 Years	1,401 (1.7%)	98 (2.7%)	2,417 (3.9%)	64 (2.7%)	0 (0.0%)	7 (2.7%)
35-44 Years	3,619 (3.5%)	430 (6.5%)	7,103 (10.5%)	282 (6.5%)	2,214 (25.0%)	37 (6.5%)
45-54 Years	13,803 (12.7%)	533 (14.5%)	10,890 (18.3%)	497 (14.5%)	1,114 (15.8%)	59 (14.5%)
55-64 Years	25,063 (20.3%)	565 (23.1%)	19,444 (30.6%)	397 (23.1%)	1,016 (19.6%)	31 (23.1%)
65+ Years	28,515 (25.3%)	389 (27.0%)	16,965 (32.9%)	187 (27.0%)	804 (25.0%)	11 (27.0%)
Female:	71,457 (8.2%)	2,104 (9.6%)	79,818 (14.0%)	1,140 (9.8%)	5,785 (12.3%)	94 (9.9%)
Under 18 years	382 (0.2%)	16 (0.2%)	278 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
18-24 Years	3,225 (1.8%)	621 (7.1%)	2,407 (1.5%)	286 (7.1%)	834 (5.0%)	30 (7.1%)
25-34 Years	2,806 (3.6%)	134 (5.6%)	3,035 (4.5%)	82 (5.6%)	495 (9.5%)	6 (5.6%)
35-44 Years	6,394 (6.3%)	473 (12.0%)	9,714 (12.1%)	280 (12.0%)	519 (7.3%)	25 (12.0%)
45-54 Years	11,847 (11.1%)	166 (6.3%)	15,002 (20.2%)	101 (6.3%)	1,222 (19.6%)	8 (6.3%)
55-64 Years	22,388 (18.0%)	416 (22.2%)	25,081 (32.5%)	227 (22.2%)	1,556 (30.4%)	15 (22.2%)
65+ Years						

Source: 2009-2013 American Community Survey 5 Year Estimates – Tables B01001A-I, Behavioral Risk Factor Surveillance System 2011-2013 Combined Dataset, National Health Interview Survey 2011-2013 Combined Dataset

non-Hispanic, African American/black females While the total population of these women is just less than half of the population of non-Hispanic white females of the same age, the prevalence rate for this population is so high that the number of these women exceed their white counterparts in each of the

three highest age categories. The relatively high diabetes prevalence could be due to inaccessibility to health care and health care education; this population is one that has relatively low enrollment in public/private insurance programs and this is likely to lead to an increase in undiagnosed diabetes.

The total population of persons in Mississippi in 2013 is 2,976,872 (summing the totals of Tables 1 and 3) while the total estimate of persons in Mississippi with diabetes for 2013 is 312,040 (summing the totals of Tables 2 and 4). This suggests that the overall Mississippi diabetes prevalence for 2013 is 10.5 percent.

Direct Costs

The classical method of estimating the burden of a disease or other adverse health conditions on a population begins with estimating the direct costs of the condition on the population in excess of the amount that the non-diabetic population would be expected to spend (in economic terms, this excess refers to the marginal cost resulting from the onset of diabetes). As explained in the ADA study, diabetes onset results in two conditions that contribute to these marginal costs. First, diabetes increases the risk of developing certain conditions that adversely affect health (see ADA Supplementary Data – Table 2 for a fairly comprehensive list of these conditions). Second, the costs of treating general health conditions for a patient with diabetes increases over the cost of treating these general health conditions for a person not suffering from the disease.

Due to state-based data limitations and the complex of co-morbidities associated with diabetes, the state-based estimate developed for Mississippi by the American Diabetes Association is used for the estimation of the direct medical costs. These costs were estimated for 2012 at \$7,251 on a per capita basis. The Centers for Medicare and Medicaid Services (CMS) projects an annual average overall medical cost increase of 5.7 percent; this suggests that the appropriate per capital cost level should be \$7,657 for 2013. Given our total estimated diabetes population of 312,040, this suggests that the direct medical costs associated with the increased cost of treating Mississippi residents with diabetes are estimated to be \$2,389,290,280 in 2013.

While this direct cost estimation utilizes cost factors from the ADA report, another estimation of direct cost by state is provided by the Centers for Disease Control through its Chronic Disease Cost Calculator. This tool estimates the average direct medical cost per diabetic patient from the 2004-2008 Medical Expenditure Panel Survey datasets and provides an estimate of \$5,560 in 2010 dollars. Converting this estimate to 2013 dollars by using the Centers for Medicare and Medicaid annual medical cost change projections of 5.7 percent, the Chronic Disease Cost Calculator's per person estimate of diabetes attributable direct medical cost is \$6,566, \$1,109 or 14.5 percent lower than the ADA estimate for 2013.

There are likely several possible explanations for the differences in these estimates, but one explanation that seems plausible is based on the difference in estimation periods between the CDC tool and the ADA study. Advancements in treatment methods and medical technologies have likely occurred in the intervening years, so using the concept of inflation to explain the full cost estimate differential does not consider all factors of the diabetes-related medical care production function. Therefore, this study advocates use of the ADA study as the source of the direct medical cost factor.

Indirect Costs

Indirect costs in the typical disease/adverse behavior burden study is comprised of four basic components (absenteeism, presenteeism, unemployment due to disability and premature mortality). The American Diabetes Association has developed diabetes-specific state level estimates of these components (along with reduced productivity for those not in the labor force) that will be used in this analysis. These components include:

- **Absenteeism** – Absenteeism is the number of days missed from work due to the adverse health condition(s). National estimates indicate that the average person with diabetes misses three more days of work per year than the average non-diabetic person.
- **Presenteeism** – Presenteeism refers to the reduced work productivity while working due to the adverse health condition. The ADA estimates the loss of productivity (output) due to presenteeism is 6.6 percent.
- **Disability** – Disability refers to the loss in workforce participation due to disability resulting from the adverse health condition or its associated co-morbidities. Regression analysis of the NHIS suggests that persons with diabetes have an approximately ten percent lower participation in the labor workforce than do people without the disease.
- **Premature Mortality** – Premature mortality associated with diabetes not only reduces worker productivity in the current year, but also in future years as well. Therefore, the ADA estimated the number of premature deaths associated with diabetes and calculated the present value of their future expected earnings.
- **Reduced productivity for those not in labor force** – includes the productivity lost that is associated with the care for family members with diabetes and individuals with diabetes who are not in the labor not due to disability. Not included in this estimate is the productivity loss for adults who take time off from work to care for a child or elderly parent with diabetes nor is travel time except when these costs are included in the direct medical costs as ambulance costs.

Utilizing these cost measures, the American Diabetes Association has estimated the level of indirect costs of persons with diabetes as \$3,113 per person in 2012. Utilizing the Consumer Price Index to calculate the rate of inflation between 2012 and 2013, the level of indirect costs for 2013 are estimated to be \$3,221 on a per capita basis or \$1,005,080,840 for Mississippi’s diabetic population. These costs are apportioned in Table 5 using national fractions from the American Diabetes Association report.

Table 5 – Estimates of Indirect Costs by Cost Category for Mississippi

Cost Category	Cost Percentage	Per Capita Indirect Cost	Total Indirect Cost
Unemployment	31.5%	\$1,014	\$316,600,465
Presenteeism	30.3%	\$976	\$304,535,494
Premature mortality	27.0%	\$870	\$271,371,827
Absent Workdays	7.3%	\$235	\$73,370,901
Reduced productivity for those not in labor force	3.9%	\$102	\$39,198,153
Totals	100.0%	\$3,221	\$1,005,080,840

Source: American Diabetes Association “Economic Costs of Diabetes in the U.S. in 2012” report, Medical Expenditure Panel Survey (2010-2012 combined dataset), Behavioral Risk Factor Surveillance System (2011-2013 combined dataset)

Induced Consequences Related to Lost Wages

The Direct and Indirect costs previously estimated demonstrate the diabetes-attributable costs incurred by individuals who are afflicted with the disease. There are, however, other analysis tools which can provide valuable perspectives to stakeholders and policy makers. Input-output analysis can provide insight into the additional economic activity that would occur if diabetes were to be eradicated in Mississippi and the monies used for the direct and indirect costs could be spent on other goods and services.

This analysis provides estimates for an induced effect. This effect refers to the economic activity that would occur in the economy due to households purchasing goods and services from businesses. While these induced effects cannot be included in our economic burden analysis for two distinct reasons¹, they do offer a unique insight into implications that diabetes has on the Mississippi economy. However, to provide an accurate estimate of the induced effect, the direct and indirect effects must be decomposed to obtain appropriate analysis factors.

Direct Costs

Direct medical costs have two components: out-of-pocket costs that are paid by the diabetic patient and the costs that are paid by a third party such as an insurance company, government agency, etc. Only the direct out-of-pocket costs will be utilized for this analysis since the portion of costs paid by third parties is not a cost incurred by the individual and, in many cases, the monies used to cover these costs effectively originate outside the state (i.e., pass-through Medicaid dollars).

Table 6 – Estimates of the Out-of-Pocket (OoP) Direct Medical Costs for Mississippi by Income Category

Household Income Category	OoP Expense Pct	Average OoP Expenditures	Number of Diabetic Patients	Total OoP Expenditures
Less than \$10,000	5.97%	\$457	52,165	\$37,549,890
\$10,000-\$15,000	7.27%	\$557	49,837	\$44,122,615
\$15,000-\$25,000	8.66%	\$663	81,739	\$74,346,898
\$25,000-\$35,000	9.77%	\$478	38,283	\$43,258,948
\$35,000-\$50,000	12.19%	\$933	33,023	\$38,130,733
\$50,000-\$75,000	13.17%	\$1,008	27,160	\$30,496,036
\$75,000-\$100,000	12.82%	\$981	15,860	\$18,669,425
\$100,000-\$150,000	13.37%	\$1,024	13,973	\$16,900,008
Totals			312,040	\$303,474,253

Source: American Diabetes Association “Economic Costs of Diabetes in the U.S. in 2012” report, Medical Expenditure Panel Survey (2010-2012 combined dataset), Behavioral Risk Factor Surveillance System (2011-2013 combined dataset)

¹ First, it must be realized that the monies used to cover the direct medical costs do accrue to individuals and firms within the state and that these entities will generate economic activity on their own. Second, it is likely that at least some portion of the workers hired to replace the productivity lost due to diabetes (captured by the indirect cost estimates) will be hired from within the state; this means that productivity replacement will, in at least some cases, utilize labor substitution and will have a diminished effect on the aggregate induced economic activity. However, there is likely to be some income redistribution effects since the replacement workers may not have the same spending patterns as the workers afflicted with diabetes.

Table 6 provides estimates of the out-of-pocket direct medical costs by annual household income category. These estimates can be viewed as an increase in the effective disposable income² of the persons afflicted with diabetes if the disease were to be suddenly eradicated in Mississippi.

Indirect Costs

Following the same logic, only those indirect costs which affect incomes of those suffering from diabetes should be included in the analysis. By examining the indirect cost components identified in Table 5, each of these conditions effectively reduce individual income with the exception of presenteeism (in the case of presenteeism, the worker is still at work and being paid even though productivity is diminished; therefore, at least in the short term, this is a cost borne by the employer). Deducting the average presenteeism cost (\$976) and the reduced productivity from those not in the labor force (\$102) from the average total indirect cost (\$3,221) suggests that the average diabetic patient’s income is reduced by \$2,143 due to indirect costs (referred to as “Redefined Indirect Costs” in Table 7). Table 7 provides estimates of these costs by annual household income category.

Table 7 – Estimates of the Indirect Costs for Mississippi by Income Category

312,040 \$668,701,720

Source: American Diabetes Association “Economic Costs of Diabetes in the U.S. in 2012” report, Medical Expenditure Panel Survey (2010-2012 combined dataset), Behavioral Risk Factor Surveillance System (2011-2013 combined dataset)

However, it should be realized that the total of direct and indirect costs will likely not be spent within Mississippi. Some of these funds are placed in savings accounts or other types of financial institutional investments and some are spent outside the state; these leakages would not have an economic impact on the state. The economic modeling software IMPLAN (described in Appendix II) provides insight into the portion of earnings that is spent within the state by household income category. Table 8 provides these estimates by annual household income category.

² In its strictest sense, disposable income is calculated by subtracting taxes from gross wages. In layman’s parlance, this difference is commonly referred to as net income. We are modifying this term for the purposes of this study to mean gross wages minus taxes **and** out-of-pocket medical expenses.

Table 8 – Mississippi Estimates of Instate Consumption of Out-of-Pocket (OoP) Direct Medical Costs and Indirect Costs minus Presenteeism

Household Income Category	MS Cons Pct	Total OoP Expenditures	MS Cons of OoP Expenditures	Total Indirect Expenditures	MS Cons of Indirect Expenditures
Less than \$10,000	65.42%	\$37,549,890	\$24,565,138	\$111,789,595	\$73,132,753
\$10,000-\$15,000	65.48%	\$44,122,615	\$28,891,488	\$106,800,691	\$69,933,092
\$15,000-\$25,000	65.75%	\$74,346,898	\$48,883,085	\$175,166,677	\$115,172,090
\$25,000-\$35,000	65.79%	\$43,258,948	\$28,460,062	\$82,040,469	\$53,974,425
\$35,000-\$50,000	65.62%	\$38,130,733	\$25,021,387	\$70,768,289	\$46,438,151
\$50,000-\$75,000	64.83%	\$30,496,036	\$19,770,580	\$58,203,880	\$37,733,575
\$75,000-\$100,000	65.18%	\$18,669,425	\$12,168,731	\$33,987,980	\$22,153,365
\$100,000-\$150,000	66.03%	\$16,900,008	\$11,159,075	\$29,944,139	\$19,772,115
Totals		\$303,474,253	\$198,919,546	\$668,701,720	\$438,309,566

Source: American Diabetes Association “Economic Costs of Diabetes in the U.S. in 2012” report, Medical Expenditure Panel Survey (2010-2012 combined dataset), Behavioral Risk Factor Surveillance System (2011-2013 combined dataset), IMPLAN 2013 dataset

Induced Effect Estimation

There are multiple methodologies that can be used to model the induced costs and each has its merits. As previously mentioned, input-output analysis is the methodology chose for this analysis. As implemented by the economic modeling software IMPLAN, this methodology provides a variety of information that is valuable in gaining insight into the effects of specific economic events.

Table 9 provides insight into the economic effects of enabling diabetic patients to recoup income lost from the direct and indirect effects of diabetes and to utilize this income according to normal spending patterns. As can be seen in Table 9, the lost wages to employees resulting from direct and indirect costs attributable to diabetes are estimated to be \$188,344,578 and would support 5,134 full- and part-time jobs. Furthermore, the additional value added (gross regional product) to the economy is estimated to be \$339,406,081 and the total fiscal impacts for state/local and federal are estimated to be \$83,670,545 (\$40,356,602 and \$43,313,943, respectively).

Table 9 – Estimates of the Economic Consequences of Diabetes on Mississippi Residents if Out-of-Pocket Direct Medical Costs and Indirect Effects Were Allocated to Normal Spending Patterns

Effect Category	Induced Consequences (Direct Effects)	Induced Consequences (Indirect Effects)	Total Induced Consequences (Direct + Indirect)
Supported Employment (Jobs)	1,545	3,426	4,971
Labor Income	\$56,760,737	\$125,605,421	\$182,366,158
Value Added	\$102,199,416	\$226,429,346	\$328,628,762
Output	\$184,805,385	\$409,286,002	\$594,091,387
State/Local Tax Impacts	\$12,166,204	\$26,909,586	\$39,075,790
Federal Tax Impacts	\$13,047,888	\$28,890,937	\$41,938,825

Source: IMPLAN 2013 model

Conclusions

The goal of this analysis is to present a comprehensive look at the economic burden of diabetes on Mississippi. There are several key findings as a result of this effort:

- The prevalence of diabetes is increasing over time for every socio-economic category. Minorities such as African American/blacks and Hispanics tend to be more susceptible to the disease and these residents tend to be found in the lower educational and social strata as well.
- Typical measures used to estimate the burden of an adverse health condition on a population (Direct and Indirect Effects) are large for the state. Utilizing state level factors estimated by the American Diabetes Association (which are likely understated for Mississippi), the Direct Effects (cost of medical care) is estimated to be almost \$2.4 billion in 2013 and the Indirect Effects (loss of earnings, diminished quality of life, premature morbidity, etc.) is estimated to be over \$1 billion for 2013.
- In addition, induced consequences of lost income due to absenteeism, disability and premature mortality are estimated to be over \$188 million. While these consequences cannot be included in the above effects discussion, they do affect over 5,100 jobs and have over \$83 million in fiscal implications.
- Finally, the effects estimated in this study almost certainly understate the true cost of diabetes on the Mississippi economic and social structure. While the Indirect Effects attempt to capture the cost to the individual from the disease and the application of the input-output analysis provides a somewhat more holistic accounting of the total spending effects on the state, there are many other costs which may or may not be quantifiable when considering the implications of diabetes. It would be extremely difficult to measure the impact of the loss of a dynamic political or social leader who would have taken Mississippi to the “next level” but for a diabetes-induced disability or premature mortality. The same could be applicable to the business, scientific and arts communities as well. And who knows what inspiration a young person might have gleaned in a classroom if s/he had not suffered from pain or discomfort related to this disease. Furthermore, it is almost certain that family and other social interactions are strained as one or more members suffer the mental anguish of pain, loss of earnings and perhaps even impending death.

Appendix I – Data and Methodologies

Data Sources

Data used for estimations of prevalence, populations and costs in the study were derived from the following sources:

Behavioral Risk Factor Surveillance System (BRFSS)

Rates of diabetes prevalence for persons age 18 years and older who were not institutionalized in a nursing facility or skilled nursing facility were calculated from published BRFSS data. Annual time series prevalence rates were obtained by calculating the annual prevalence based on gender, income, race, ethnicity, etc., as reported in the data. Rates used in analysis for 2013 were calculated by utilizing a composite data set comprised of the most current three years of available data. This method follows the American Diabetes Association's method as used in its biannual Economic Costs of Diabetes in the U.S. reports (ADA uses this method to obtain a larger sample size and to offer a more accurate estimate of diabetes prevalence).

Year(s) utilized: 2001-2013

www.cdc.gov/brfss

National Nursing Home Survey (NNHS)

Rates of diabetic prevalence for persons 45 years of age and older who were institutionalized in a nursing facility or skilled nursing facility were calculated from published NNHS data. The most recent update of this survey is 2004. While this data is over 10 years old, it is felt that the estimates that it offers would understate the actual rate of NF/SNF patients given the trends of diabetic prevalence found in other data sources.

Year(s) utilized: 2004 (last update)

www.cdc.gov/nchs/nnhs.htm

National Health Interview Survey (NHIS)

Rates of diabetic prevalence for persons 18 years of age and under were calculated from published NHIS data. Annual time series prevalence rates were obtained by calculating the annual prevalence based on gender, income, race and ethnicity as reported in the data. Rates used in analysis for 2013 were calculated by utilizing a composite data set comprised of the most current three years of available data. This method follows the American Diabetes Association's method as used in its biannual Economic Costs of Diabetes in the U.S. reports (ADA uses this method to obtain a larger sample size and to offer a more accurate estimate of diabetes prevalence for this cohort).

Year(s) utilized: 2011-2013

www.cdc.gov/nchs/nhis.htm

Medical Expenditures Panel Survey (MEPS)

Proportions of total direct medical expenditures attributable to out-of-pocket costs stratified by income group were calculated from published MEPS data. Out-of-pocket cost rates were calculated by utilizing a composite data set composed of the most current three years of available data.

Year(s) utilized: 2010-2012

meps.ahrq.gov/mepsweb (see Data Files link)

U.S. Census Bureau

U.S. Census Bureau estimates were used for the 2013 base population estimates as well as the group quarters population. The most accurate set of current estimates available are the 2009-2013 5-year population estimates from the American Community Survey. The calculations used to estimate the current population of diabetic nursing facility/skilled nursing facility residents utilized the 2010 Census Summary File 1 data due to the presence in that dataset of the stratified populations of all group quarters institutions.

American Community Survey (ACS)

Tables B01001A through B01001I, B26001 (2009-2013 5-year Population Estimates)

2010 Decennial Census

Tables PC05, PCT12, P42 (2010 Summary File 1 100% Data)

These sources were accessed using factfinder.census.gov (Advanced Search)

Centers for Medicare and Medicaid

Health expenditure projections from the Centers for Medicare and Medicaid were used to inflate the American Diabetes Association's estimate for direct medical costs to 2013 dollars.

National Health Expenditure Projections 2013-2023

<http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/Proj2013.pdf>

Bureau of Labor Statistics

Consumer Price Index annual averages from the Bureau of Labor Statistics were used to inflate the American Diabetes Association's estimate for indirect costs to 2013 dollars.

CPI (Consumer Price Index) Detailed Report – Data for January 2014

Table 25C, page 112

<http://www.bls.gov/cpi/cpid1401.pdf>

Prevalence Rates

Nursing Facility/Skilled Nursing Facility Prevalence Rate

The prevalence rates for persons residing in NF/SNFs were estimated through survey data obtained from the National Nursing Home Survey (NNHS) administered in 2004 (the last year that this survey was updated). As this survey has not been updated in several years and the prevalence of diabetes has increased in the intervening years, it is likely that the prevalence rate utilized in this analysis is understated.

Estimates of diabetic prevalence for the various cohorts of the NF/SNF population were calculated by stratifying the data for the Southern region (the dataset does not report responses on a state-level basis) by having a diabetic diagnosis (Diabetic, non-Diabetic), age (Under 18 years of age; 18-24 years of age; 25-34 years of age; 35-44 years of age; 45-54 years of age; 55-64 years of age; and 65 years of age and over), gender (Male, Female), race (White, African American/Black, Other) and Hispanic ethnicity (Hispanic, non-Hispanic). Upon review of the data, responses from individuals under 45 years of age were not included in the analysis to determine NF/SNF diabetic prevalence due to very small sample sizes.

After each stratification was accomplished, the stratified population with diabetes was divided by the total number of diabetic and non-diabetic persons within the specific age, gender, race and ethnicity cohort. Mathematically, this concept can be expressed as:

$$Prev[Diabetic NF/SNF Population]_{D=Diabetic,A,S,R,E} = \frac{\sum_{i=1}^n NF/SNF Population_{D=Diabetic,A,S,R,E}}{\sum_{i=1}^n NF/SNF Population_{D,A,S,R,E}}$$

where:

Prev[Diabetic NF/SNF Population]_{D=Diabetic,A,S,R,E} represents the diabetic prevalence rate for each age (A), gender (S), race (R) and ethnicity (E) strata for Nursing Facilities/Skilled Nursing Facilities residents in the Southern region

NF/SNF Population_{D,A,S,R,E} represents the size of the NF/SNF cohort as stratified by diabetic condition (D), age (A), gender (S), race (R) and ethnicity (E) strata for Nursing Facilities/Skilled Nursing Facilities residents in the Southern region

D represents diabetic condition (Diabetic, non-Diabetic)

A represents age (45-54 Years, 55-64 Years, and 65+ Years)

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Example

By stratifying the NNHS data, we find that there are 82 white, non-Hispanic males 65 years of age or over in the survey sample who had been diagnosed with diabetes. The total cohort size of sample (diabetic and non-diabetic) is 116. Therefore, the prevalence rate for this cohort is $82 \div 116 = 0.707$ or 70.7 percent.

Youth Prevalence Rates

Prevalence rates for persons under 18 years of age were estimated through data obtained from the National Health Information Survey (NHIS). Estimates of diabetic prevalence for the various cohorts of the Youth Under 18 Years of Age population were calculated by stratifying the data for the Southern region (the dataset does not report responses on a state-level basis) by having a diabetic diagnosis (Diabetic, non-Diabetic), gender (Male, Female), race (White, African American/Black, Other) and Hispanic ethnicity (Hispanic, non-Hispanic). As previously mentioned, the 2011, 2012 and 2013 datasets were combined. This method follows the American Diabetes Association's method to obtain a larger and more stable sample.

After each stratification was accomplished, the stratified population with diabetes was divided by the total number of diabetic and non-diabetic persons within the specific age, gender, race and ethnicity cohort. Mathematically, this concept can be expressed as:

$$\text{Prev}[\text{Diabetic Youth Under 18 Population}]_{D=\text{Diabetic},S,R,E} =$$

$$\frac{\sum_{i=1}^n \text{Youth Under 18 Population}_{D=\text{Diabetic},S,R,E}}{\sum_{i=1}^n \text{Youth Under 18 Population}_{D,S,R,E}}$$

where:

- Prev[Diabetic Youth Under 18 Population]_{D=Diabetic,S,R,E} represents the diabetic prevalence rate for each gender (S), race (R) and ethnicity (E) strata for the Youth Under 18 Years of Age cohort in the Southern region
- Youth Under 18 Population_{D,S,R,E} represents the size of the NF/SNF cohort as stratified by diabetic condition (D), gender (S), race (R) and ethnicity (E) strata for Nursing Facilities/Skilled Nursing Facilities residents in the Southern region
- D represents diabetic condition (Diabetic, non-Diabetic)
- S represents gender (Male, Female)
- R represents race (White, African American/Black, and Other)
- E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Example

By stratifying the NHIS Child Sample data, we find that there are 3 white, non-Hispanic males under 18 years of age who have been diagnosed with diabetes. The total cohort size of the sample (diabetic plus non-diabetic) is 3,039. Therefore, the prevalence rate for this cohort is $3 \div 3,039 = 0.001$ or 0.1 percent.

Adult (non-NF/SNF) Prevalence Rates

The prevalence rates for persons 18 years of age and older who do not reside in NF/SNFs were estimated through survey data obtained from the Behavior Risk Factor Surveillance System (BRFSS).

Estimates of diabetic prevalence for the various cohorts of the Adults Over 18 Years of Age not residing in NF/SNFs population were calculated by stratifying the data for Mississippi by having a diabetic diagnosis (Diabetic, non-Diabetic), age (18-24 years of age; 25-34 years of age; 35-44 years of age; 45-54 years of age; 55-64 years of age; and 65 years of age and over), gender (Male, Female), race (White, African American/Black, Other) and Hispanic ethnicity (Hispanic, non-Hispanic). As previously mentioned, the 2011, 2012 and 2013 datasets were combined. This method follows the American Diabetes Association’s method to obtain a larger and more stable sample.

After each stratification was accomplished, the stratified population with diabetes was divided by the total number of diabetic and non-diabetic persons within the specific age, gender, race and ethnicity cohort. Mathematically, this concept can be expressed as:

$$\text{Prev}[\text{Diabetic Adults Over 18 Population}]_{D=\text{Diabetic},A,S,R,E} =$$

$$\frac{\sum_{i=1}^n \text{Adults Over 18 Population}_{D=\text{Diabetic},A,S,R,E}}{\sum_{i=1}^n \text{Adults Over 18 Population}_{D,A,S,R,E}}$$

where:

- Prev[Diabetic Adults Over 18 Population]_{D=Diabetic,A,S,R,E} represents the diabetic prevalence rate for each age (A), gender (S), race (R) and ethnicity (E) strata for Adults Over 18 Years of Age not residing in Nursing Facilities/Skilled Nursing Facilities residents in Mississippi
- Adults Over 18 Population_{D,A,S,R,E} represents the size of the Adults Over 18 Years of Age not residing in NF/SNFs cohort as stratified by diabetic condition (D), age (A), gender (S), race (R) and ethnicity (E) strata in Mississippi
- D represents diabetic condition (Diabetic, non-Diabetic)
- A represents age (45-54 Years, 55-64 Years, and 65+ Years)
- S represents gender (Male, Female)
- R represents race (White, African American/Black, and Other)
- E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Example

By stratifying the BRFSS data, we find that there are 492 white, non-Hispanic males 65 years of age and over who have been diagnosed with diabetes. The total cohort size of the sample (diabetic plus non-diabetic) is 1,942. Therefore, the prevalence rate for this cohort is $492 \div 1,942 = 0.253$ or 25.3 percent.

Populations

Estimates of populations with diabetes were calculated by applying the estimated prevalence rates to appropriate 2013 populations as estimated by the American Community Survey’s 2009-2013 5-year estimates. Specific procedures for determining the population levels for specific age/gender/race/ethnic/institutionalized cohorts are as follows.

NF/SNF Population

Due to the fact that the 2009-2013 5-year American Community Survey Group Quarters Population estimates do not provide a breakdown of populations in the various types of group quarters, it is necessary to perform a series of intermediate calculations in order to achieve an estimate for the 2013 NF/SNF population.

The first step is to determine the proportion of total group quarters residents stratified by age, gender and ethnicity that reside in NF/SNFs. This is accomplished using the 2010 Census File 1 100% Data dataset (Table B26001). This can be mathematically expressed as:

*Proportion[NF/SNF Group Quarters Population]*_{2010,A,S,R,E}

$$= \frac{\text{Population[NF/SNF]}_{2010,A,S,R,E}}{\text{Population[Group Quarters]}_{2010,A,S,R,E}}$$

where:

*Proportion[NF/SNF Group Quarters Population]*_{2010,A,S,R,E} = represents the proportion of the 2010 Group Quarters Population residing in NF/SNFs by age (A), gender (S), race (R) and ethnicity (E) in Mississippi.

*Population[NF/SNF]*_{2010, A,S,R,E} represents the estimated 2010 population by age (A), gender (S), race (R) and ethnicity (E) strata of Nursing Facility/Skilled Nursing Facility residents in Mississippi as reported by the 2010 Census File 1 100% Data dataset (Table B26001).

*Population[Group Quarters]*_{2010, A,S,R,E} represents the estimated 2010 Group Quarters population by age (A) and gender in Mississippi as reported by the 2010 Census Summary File 1 100% Data (Table B26001) dataset.

A represents age (45-54 Years, 55-64 Years, and 65+ Years)

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

This proportion is then applied to the 2013 Group Quarters Population as estimated by the 2009-2013 5-year American Community Survey Group Quarters Population estimates to obtain an estimate of the 2013 Group Quarters population who reside in NF/SNFs.

*Pop[Estimated NF/SNF Residents of General Quarters Pop]*_{2013,A,S,R,E}

$$= \text{Proportion[NF/SNF Group Quarters Population]}_{2010,A,S,R,E}$$

$$\times \text{Pop[Group Quarters]}_{2013,A,S}$$

where:

*Pop[Estimated NF/SNF Residents of Group Quarters Pop]*_{2013,A,S,R,E} = represents the estimates of the number of persons that resided in NF/SNFs in 2013 by age (A), gender (S), race (R) and ethnicity (E) in Mississippi.

*Population[NF/SNF]*_{2010, A,S,R,E} represents the estimated 2010 population by age (A), gender (S), race (R) and ethnicity (E) strata of Nursing Facility/Skilled Nursing Facility residents in Mississippi as reported by the 2010 Census File 1 100% Data dataset (Table B26001).

*Pop[Group Quarters]*_{2013, A,S} represents the estimated 2013 Group Quarters population by age and gender in Mississippi as reported by the 2009-2013 5-year American Community Survey Group Quarters Population estimates.

A represents age (45-54 Years, 55-64 Years, and 65+ Years)

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

It should be noted that the proportions for race and ethnicity are estimated by applying the *Proportion[NF/SNF Group Quarters Population]*_{2010,A,S,R,E} to the respective age and gender stratifications in *Pop[Group Quarters]*_{2013,A,S}.

$$\begin{aligned}
& \text{Pop}[\text{NF/SNF Residents}]_{2013, D=\text{Diabetic}, A, S, R, E} \\
& = \text{Pop}[\text{Estimated NF/SNF Group Quarters Population}]_{2013, A, S, R, E} \\
& \times \text{Prev}[\text{Diabetic NF/SNF Population}]_{D=\text{Diabetic}, A, S, R, E}
\end{aligned}$$

Pop[NF/SNF Residents]_{2013, D=Diabetic, A, S, R, E} = represents the estimates of the number of persons that resided in NF/SNFs who suffered from diabetes in 2013 by age (A), gender (S), race (R) and ethnicity (E) in Mississippi.

Pop[Estimated NF/SNF Residents of Group Quarters Pop]_{2013, A, S, R, E} = represents the estimates of the number of persons that resided in NF/SNFs in 2013 by age (A), gender (S), race (R) and ethnicity (E) in Mississippi.

Prev[Diabetic NF/SNF Population]_{D=Diabetic, A, S, R, E} represents the diabetic prevalence rate for each age (A), gender (S), race (R) and ethnicity (E) strata for Nursing Facilities/Skilled Nursing Facilities residents in the Southern region derived from the 2004 NNHS dataset.

D represents diabetic condition (Diabetic, non-Diabetic)

A represents age (45-54 Years, 55-64 Years, and 65+ Years)

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Youth Population

Population estimates for the diabetic youth population were derived by applying the youth prevalence rate estimated earlier to the stratified 2009-2013 American Community Survey 5-year Population Estimates.

$$\begin{aligned}
& \text{Pop}[\text{Youth Under 18}]_{2013, D=\text{Diabetic}, S, R, E} \\
& = \text{Prev}[\text{Diabetic Youth Under 18 Population}]_{D=\text{Diabetic}, S, R, E} \\
& \times \text{Pop}[\text{Youth Under 18}]_{2013, S, R, E}
\end{aligned}$$

where:

Pop[Youth Under 18]_{2013, D=Diabetic, S, R, E} represents the 2013 diabetic population by gender (S), race (R) and ethnicity (E) strata of youth under the age of 18 who reside in Mississippi

Prev[Diabetic Youth Under 18 Population]_{S, R, E} represents the diabetic prevalence rate by gender (S), race (R) and ethnicity (E) strata for youth under the age of 18 years in the Southern region

Pop[Youth Under 18]_{2013, S, R, E} represents the 2013 population by gender (S), race (R) and ethnicity (E) strata of youth under the age of 18 who reside in Mississippi

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Adult Population Over 18 Years of Age

The population of adults over 18 years of age who do not reside in nursing facilities or skilled nursing facilities was estimated by applying the previously estimated prevalence rate to the 2009-2013

American Community Survey 5-year Population Estimates and then subtracting the estimated diabetic NF/SNF residents.

$$\begin{aligned} & \text{Pop[Adults Over 18 non-NF/SNF]}_{2013,D=Diabetic,A,S,R,E} \\ &= \text{Prev[Adults Over 18 Population]}_{A,S,R,E} \\ & \times \text{Pop[Adults Over 18 non-NF/SNF]}_{2013,A,S,R,E} \end{aligned}$$

where:

Pop[Adults Over 18 non-NF/SNF]_{2013,D=Diabetic,A,S,R,E} represents the 2013 diabetic population by age (A), gender (S), race (R) and ethnicity (E) strata of adults over 18 years of age who reside in Mississippi

Prev[Adults Over 18 Population]_{S,R,E} represents the diabetic prevalence rate by age (A), gender (S), race (R) and ethnicity (E) strata for adults over 18 years of age who reside in Mississippi

Pop[Adults Over 18 non-NF/SNF]_{2013,A,S,R,E} represents the 2013 population by age (A), gender (S), race (R) and ethnicity (E) strata of adults over 18 years of age who reside in Mississippi

D represents diabetic condition (Diabetic, non-Diabetic)

A represents age (18-24 Years, 25-34 Years, 35-44 Years, 45-54 Years, 55-64 Years, and 65+ Years)

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Economic Burden

Direct Effects

Estimation of the direct effects of diabetes (direct medical costs) was accomplished by using the 2012 per capita Direct Effects estimation for Mississippi and applying this to the estimated 2013 Mississippi diabetic population after adjusting the rate for inflation using the Centers for Medicare and Medicaid Services National Health Expenditure Projections. This estimation can be mathematically represented as:

$$\begin{aligned} \text{Cost [Total Direct]}_{2013} &= \text{ADA Per Capita Direct Medical Costs}_{2012} \\ & \times \text{CMS Medical Inflation Factor}_{2013} \\ & \times \sum_{\forall HHI} \text{Pop[Total]}_{2013,D=Diabetic,HHI} \end{aligned}$$

$$\text{ADA Per Capita Direct Medical Costs}_{2012,MS} = \frac{\text{Total ADA Direct Costs}_{2012,MS}}{\text{ADA Diabetic Population}_{2012,MS}}$$

$$\text{Pop[Total]}_{2013,D=Diabetic,HHI} = \sum_{\forall A,S,R,E} (\text{Pop[NF/SNF Residents]}_{2013,D=Diabetic,HHI,A,S,R,E} + \text{Pop[Youth Under 18]}_{2013,D=Diabetic,HHI,S,R,E} + \text{Pop[Adults Over 18, non-NF/SNF]}_{2013,D=Diabetic,HHI,A,S,R,E})$$

where:

Cost[Total Direct]₂₀₁₃ is the 2013 direct cost of diabetes in Mississippi

ADA Per Capita Direct Medical Costs_{2012,MS} are the Direct Medical Costs estimated by the American Diabetic Association in its 2012 report for Mississippi established on a per capita basis

Total ADA Direct Costs_{2012,MS} are the total Direct Medical Costs estimated by the American Diabetic Association for Mississippi in 2012

ADA Diabetic Population_{2012,MS} is the total diabetic population estimate by the American Diabetic Association for Mississippi in 2012

CMS Medical Inflation Factor₂₀₁₃ is the medical inflation rate from 2012 to 2013 as calculated by the Centers for Medicare and Medicaid Services

Pop[Total]_{2013,D=Diabetic,HHI} is the 2013 estimated diabetic population in Mississippi stratified by household income level

HHI represents household income (Less than \$10,000; \$10,000-\$15,000; \$15,000-\$25,000; \$25,000-\$35,000; \$35,000-\$50,000; \$50,000-\$75,000; \$75,000-\$100,000; and \$100,000-\$150,000)

A represents age (18-24 Years, 25-34 Years, 35-44 Years, 45-54 Years, 55-64 Years, and 65+ Years)

S represents gender (Male, Female)

R represents race (White, African American/Black, and Other)

E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Indirect Effects

Estimation of indirect costs associated with diabetes for Mississippi in 2013 closely follows the direct cost estimation format except that the Consumer Price Index was used to adjust the 2012 ADA Indirect Effects rate for inflation to 2013 values. This calculation can be represented as:

$$\begin{aligned} \text{Cost [Total Indirect]}_{2013} &= \text{ADA Per Capita Indirect Medical Costs}_{2012} \\ &\times \text{CMS Medical Inflation Factor}_{2013} \\ &\times \sum_{\forall \text{HHI}} \text{Pop[Total]}_{2013,D=\text{Diabetic},\text{HHI}} \end{aligned}$$

$$\text{ADA Per Capita Indirect Medical Costs}_{2012,MS} = \frac{\text{Total ADA Indirect Costs}_{2012,MS}}{\text{ADA Diabetic Population}_{2012,MS}}$$

$$\text{Pop[Total]}_{2013,D=\text{Diabetic},\text{HHI}} = \sum_{\forall A,S,R,E} (\text{Pop[NF/SNF Residents]}_{2013,D=\text{Diabetic},\text{HHI},A,S,R,E} + \text{Pop[Youth Under 18]}_{2013,D=\text{Diabetic},\text{HHI},S,R,E} + \text{Pop[Adults Over 18, non-NF/SNF]}_{2013,D=\text{Diabetic},\text{HHI},A,S,R,E})$$

where:

- Cost[Total Indirect]₂₀₁₃ is the 2013 estimated indirect cost of diabetes in Mississippi
- ADA Per Capita Direct Medical Costs_{2012,MS} are the Indirect Medical Costs estimated by the American Diabetic Association in its 2012 report for Mississippi established on a per capita basis
- Total ADA Direct Costs_{2012,MS} are the total Indirect Medical Costs estimated by the American Diabetic Association for Mississippi in 2012
- ADA Diabetic Population_{2012,MS} is the total diabetic population estimate by the American Diabetic Association for Mississippi in 2012
- CMS Medical Inflation Factor₂₀₁₃ is the medical inflation rate from 2012 to 2013 as calculated by the Centers for Medicare and Medicaid Services
- Pop[Total]_{2013,D=Diabetic,HHI} is the 2013 estimated diabetic population in Mississippi stratified by household income level
- HHI represents household income (Less than \$10,000; \$10,000-\$15,000; \$15,000-\$25,000; \$25,000-\$35,000; \$35,000-\$50,000; \$50,000-\$75,000; \$75,000-\$100,000; and \$100,000-\$150,000)
- A represents age (18-24 Years, 25-34 Years, 35-44 Years, 45-54 Years, 55-64 Years, and 65+ Years)
- S represents gender (Male, Female)
- R represents race (White, African American/Black, and Other)
- E represents Hispanic ethnicity (Hispanic, non-Hispanic)

Out-of-Pocket Medical Expenditures

Out-of-pocket medical costs were estimated by using the proportion of total medical costs that were paid out of pocket by income class from the Medical Expenditures Panel Survey 2010-2012 combined data set and applying that proportion to the total Direct Effects by income class. This can be depicted as:

$$\text{Cost[Out-of-Pocket Direct]}_{2013,HHI} = \frac{\text{MEPS Out-of-Pocket Direct Medical Costs}_{2010-2012,HHI}}{\text{MEPS Total Direct Medical Costs}_{2010-2012,HHI}} \times \text{Cost[Total Direct]}_{2013,HHI}$$

where:

- Cost[Out-of-Pocket Direct]_{2013,HHI} is the 2013 out-of-pocket direct medical cost of diabetes for Mississippi by household income category
- MEPS Out-of-Pocket Direct Medical Costs_{2010-2012,HHI} represents the individual Southern Region out-of-pocket cost responses by household income category for the 2010-2012 combined Medical Expenditure Panel Survey
- MEPS Total Direct Medical Costs_{2010-2012,HHI} represents the individual Southern region total medical cost responses by household income category for the 2010-2012 Medical Expenditure Panel Survey

Note: $MEPS\ Out-of-Pocket\ Direct\ Medical\ Costs_{2010-2012,HHI}$ divided by $MEPS\ Total\ Direct\ Medical\ Costs_{2010-2012,HHI}$ represents the proportion of total medical costs that are out-of-pocket expenditures for the consumer

$Cost[Total\ Direct]_{2013,HHI}$ is the 2013 direct cost of diabetes in Mississippi for each household income category

HHI represents household income (Less than \$10,000; \$10,000-\$15,000; \$15,000-\$25,000; \$25,000-\$35,000; \$35,000-\$50,000; \$50,000-\$75,000; \$75,000-\$100,000; and \$100,000-\$150,000)

Mississippi Consumption Percentage

The Mississippi Consumption Percentage is a measure of the instate spending on goods and services by household income class. In classical economic terms, it is the marginal propensity to consumer limited to purchases made from entities located within the state’s boundaries. The mathematical representation of this estimation can be depicted as:

Marginal Consumption Pct_{2013,HHI}

$$= \sum_{\forall i} (IMPLAN\ Budget\ Coefficient_{2013,HHI,i} \times IMPLAN\ Local\ Purchase\ Pct_{2013,HHI,i})$$

where:

Marginal Consumption Pct_{2013,HHI} is the 2013 Marginal Consumption Percentage for each Mississippi household income category

IMPLAN Budget Coefficient_{2013,HHI,i} represents the budget coefficient for the *i*th spending sector in each 2013 IMPLAN household income spending pattern

IMPLAN Local Purchase Pct_{2013,HHI,i} represents the Local Purchase Percentage for the *i*th spending sector in each 2013 IMPLAN household income spending pattern

HHI represents household income (Less than \$10,000; \$10,000-\$15,000; \$15,000-\$25,000; \$25,000-\$35,000; \$35,000-\$50,000; \$50,000-\$75,000; \$75,000-\$100,000; and \$100,000-\$150,000)

Mississippi Consumption of Out-of-Pocket Medical Expenditures

The Mississippi Consumption of Out-of-Pocket Medical Expenditures is an estimation of the level of instate purchases of goods and services that would be made if these monies were not solely allocated to the health care sectors. The calculation of these estimates by household income class can be shown as:

Consumption of Out-of-Pocket Expenditures_{2013,HHI}

$$= Cost[Out-of-Pocket\ Direct]_{2013,HHI} \times Marginal\ Consumption\ Pct_{2013,HHI}$$

where:

MCOoP_{HHI,2013} represents the instate consumption of out-of-pocket medical expenditures for each Mississippi household income category

OoPCOST_{HHI,2013} is the 2013 out-of-pocket direct medical cost of diabetes for each Mississippi household income category

MCP_{HHI,2013} is the 2013 Mississippi Consumption Percentage for each household income category

HHI represents household income (Less than \$10,000; \$10,000-\$15,000; \$15,000-\$25,000; \$25,000-\$35,000; \$35,000-\$50,000; \$50,000-\$75,000; \$75,000-\$100,000; and \$100,000-\$150,000)

Mississippi Consumption of Indirect Effects

The Mississippi Consumption of Indirect Effects follows the same type of logic as the Mississippi Consumption of Out-of-Pocket Direct Medical Expenditures. It is realized that many of the items included in the Indirect Effects category may not be viewed as actual spending, but it is felt that these items have a basis in the level of household income and their inclusion is legitimate. The mathematical representation of these estimation calculations is:

$$\text{Consumption of Indirect Expenditures}_{2013,HHI} = \text{Cost}[\text{Total Indirect}]_{2013,HHI} \times \text{Marginal Consumption Pct}_{2013,HHI}$$

where:

Consumption of Indirect Expenditures_{2013,HHI} represents the 2013 instate consumption of indirect effects for each Mississippi household income category

Cost[Total Indirect]_{2013,HHI} represents the 2013 indirect effects resulting from diabetes for each Mississippi household income category

Marginal Consumption Pct_{2013,HHI} is the 2013 Mississippi Consumption Percentage for each household income category

HHI represents household income (Less than \$10,000; \$10,000-\$15,000; \$15,000-\$25,000; \$25,000-\$35,000; \$35,000-\$50,000; \$50,000-\$75,000; \$75,000-\$100,000; and \$100,000-\$150,000)

Economic Impact Assessment

The estimation of the economic impacts of the burden of diabetes on the state is calculated in an input-output analysis framework using the IMPLAN software with the 2013 Mississippi dataset and functional relationships (structural matrix). The initial analysis was conducted under the assumption that diabetes in the state was eradicated and that the current population of diabetic residents were free to spend the out-of-pocket direct medical expenditures and the total level of indirect effects according to proven consumption patterns for particular income classes.

Three models were developed for this estimation including Direct Effects (only out-of-pocket medical expenses were included), Indirect Effects and Total Effects (the input values for the Total Effects model were simply the sum of the Direct Effects and Indirect Effects by household income class). Impacts were modeled using the Household Income Change activity feature of the software. This approach was taken because the ability to utilize the subset of direct and indirect costs identified in the analysis is analogous to increasing the income of the household.

Appendix II – Input-Output Methodology and IMPLAN

Public policy makers, elected officials and decision makers at the local level frequently assess the priority of potential and ongoing projects. These projects often take the form of either a new industry locating in an area or the expansion of an existing industry. In either case, there is often an expectation that a new project will expand the labor market through increased demand for employment and local services. As new jobs are added, total income increases and local unemployment decreases. Demographic aspects of the economy, such as population and commuting patterns, also change. New businesses are created to support expansion and provide locally available inputs to production. Increased income stimulates the growth of retail and service sectors. These changes to the economic and fiscal landscape of a local area, or region, have implications on further economic development, as well as on tax policy and the provision of public services, such as education and public safety.

Input-output analysis was developed in the 1930's by Wasily Leontief, who won the Nobel Prize in 1973 for his contributions to economics. Since then it has become one of the best-known and most widely used techniques for assessing regional economic impacts. It excels at analyzing the economic relationships or linkages among major sectors of the economy. Input-output analysis is based on the fact that an initial change (increase or decrease in sales) in one sector of the economy can affect other sectors of the economy.

The initial change is often referred to as an impact, or a direct effect. The direct effect is measured in terms of sales to final demand, and it is the economic variable that drives an input-output model. The initial impact requires increased production by secondary industries, the suppliers of goods and services to the primary industry. Increased production by secondary industries is referred to collectively as indirect effects. Additionally, induced effects arise as a result of spending of the new income by households. Through careful examination of the relationships among industries themselves and between industries and households one can estimate the total effect, which is the sum of the direct, indirect and induced effects.

IMPLAN is a commercial software product from IMPLAN, LLC, located in Huntersville, North Carolina. Its popularity is due to its geographic and model formulation flexibility and the provision of extensive economic information. IMPLAN, developed originally for use by the U.S. Forest Service, has been in use since 1979 and is capable of developing input-output models for any county, state or group of counties or states in the United States.

The data is put together to create a large table that shows all transactions that occur between industries, households and governments. The basis of the industry accounts (or input-output matrix allows for the building of *multipliers* for input-output analysis) which allow us to make estimations of how changes in the target industry's production will result in additional production in the economy on the basis of business to business purchases. The addition of the social accounts allows us to also examine changes in the economy that result from *labor income* spending (all forms of paid employee-based income including benefits). The result is a model that allows users to estimate, based on actual collected federal data, how an increase or decrease in production of an industry or industries in a local economy might affect the remaining industries.

To illustrate in a simplified fashion, let's say that demand for windows increase by \$10 million within a specific geographical region. In IMPLAN, we can see how this increase in production will affect the rest of the economy of this area. In this example, the appropriate Sector is 99 (the Sector defines the type of industry that experiences the change in production). We can create the *event* (or transaction) that describes an increase in sales for Sector 99 and then enter the value of \$10 million dollars into the *industry sales* field. Based on the relationships for the region (that are derived from the accounts described above), there is an established annual relationship of production to total employment and to total labor payments, tax collection and profits.

From these annual relationships, IMPLAN can estimate the *employment* in Sector 99 associated to those sales, as well as estimated labor payments associated to this increase in production. If the *employment* and *income* values are known, these can also be entered into IMPLAN overwriting the underlying regional data for just that one firm. Then, based on what that industry purchases to make its products (basically a grocery list of all the goods and services needed to produce a product in our example) and the underlying data which can be used to determine how much locally produced supply can be used to meet demand, the software estimates what additional production will be required in the local economy to meet this increase in production (*indirect effects*) and the additional production required from the local economy to meet the spending associated to the increase in labor payments (*induced effects*). However, since all of the spending in our analyses were derived from households, the total level of spending are induced effects.

Definitions and Relationships

The following provides definitions of the input-output methodology or IMPLAN® specific terms used in the analysis. These definitions were taken directly from *Principles of Impact Analysis & IMPLAN Applications*.

Term	Definition and Relationships
Induced Effects	The results of local spending of employee's wages and salaries for both employees of the directly affected industry and the employees of the indirectly affected industries.
Jobs	A job in IMPLAN equals the average of monthly jobs in a specific industry (this is the same definition used by QCEW, BLS and BEA nationally). One job that lasts twelve months is equivalent to two jobs lasting six months each or three jobs lasting four months each. A job can be either full-time or part time.
Labor Income	Defines the total value paid to local workers within a region. Labor Income is the income source for induced household spending estimations. Labor Income = Employee Compensation + Proprietor Income

Term	Definition and Relationships
Value Added	<p>Comprised of Labor Income, Indirect Business Taxes, and Other Type Property Income. Value Added demonstrates an industry’s value of production over the cost of its purchasing the goods and services required to make its products. Value Added is often referred to as Gross Regional Product.</p> <p style="text-align: center;">Value Added = Labor Income + Indirect Business Taxes + Other Property Type Income</p>
Output	<p>The total value of an industry’s production, comprised of the value of the Intermediate Inputs and Value Added. This is typically viewed as the value of a change in sales or the value of increased production. However, annual production is not always equal to annual sales. If production levels are higher than sales, surpluses become inventory. Because inventory does not drive additional impacts in the year it was produced, in IMPLAN® Direct Industry Sales equals Direct Output.</p> <p style="text-align: center;">Output = Intermediate Inputs + Value Added</p>

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