The Financial Impact of Diabetes for Older Americans

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It is estimated that over 23 million people in the United States have diabetes (7.8% of the population), with 1.6 million new cases being diagnosed in people aged 20 years and older each year (American Diabetes Association, 2007). The total annual cost of diabetes is estimated to be $174 billion (American Diabetes Association, 2008). Direct medical expenditures account for $116 billion. Indirect costs resulting from lost workdays, restricted activity days, mortality, and permanent disability account for $58 billion. Annual per capita medical expenditures for people with diabetes are $11,744, four times higher than for people without diabetes. People age 65 or older use a significant proportion of the health resources allocated to diabetes since they have insurance primarily through Medicare. What do the numbers imply about the impact of diabetes on the financial well-being of older Americans?

This study examines of the effect of diabetes on the financial position of older Americans. Using data from the 2002 and 2004 Health and Retirement Study (HRS), two models are estimated for a sample of the U.S. population aged 65 or older to estimate the impact that pre-existing and new-onset diabetes have on wealth accumulation and whether the impact is large enough to result in serious financial strain.

Given the prevalence of diabetes and the growing costs associated with this disease, it is hypothesized that there is a strong negative relationship between diabetes and wealth and a strong positive relationship between diabetes and financial strain. This paper finds evidence consistent with these hypotheses. Those with diabetes appear to have significantly lower levels of wealth and a greater likelihood of financial strain compared to those

without diabetes. This research has important implications for consumer educators and financial advisors, because it highlights the value of preventive care and the importance of planning financially for health expenditures through adequate savings and insurance coverage.

Literature Review

Several studies have examined the relationship between health and economic well-being. In particular, health has been found to affect labor market outcomes, wealth, and financial strain. However, research on the impact of specific diseases such as diabetes has been limited.

Labor Market Outcomes

Health problems can impair an individual's ability to work, reducing their wage rate and labor force participation. Bartel and Taubman (1979) found that contracting certain diseases led to a drop in labor force participation and a reduction in earnings of 20-30% among 50 year olds. Interestingly, the relative impact varied by disease.

Diabetes has been found to reduce labor force participation because it leads to early retirement, absenteeism, and disability. Using the 1992 HRS, Vijan, Hayward, and Langa found that individuals, who had been living with diabetes for an average of 9.7 years, lost an incremental $2,800 in wages due to early retirement, $630 due to additional sick days, and $22,100 due to disability over this period compared to those without diabetes. Focusing on a population of middle-aged and older Mexican Americans, Bastida and Pagan (2002) found that diabetes led to lower employment probability among men and lower productivity and earnings among women. Kahn (1998) found that adverse labor market outcomes could be mitigated with medical and technological improvements in diabetes treatment.

Wealth

A large body of literature has documented the association between health and wealth. The direction of causation has been a matter of debate (e.g., Adams et al., 2003; Kim and Lyons, 2008). Some studies have shown that poor economic status leads to poor health, though the effect found has been small (e.g., Meer, Miller, & Rosen, 2003). Most research, however, suggests that the direction of causation is from poor health to lower wealth. Adams et al. (2003) found that poor health decreased the dollar amount of wealth held by an individual. Kim and Lee (2005) and Lee and Kim (2003) used a binary measure to identify individuals who had experienced a depletion in wealth that was greater than 10% or 30%. They found that those with health problems experienced a more accelerated decline in wealth depletion than those without health problems. Berkowitz and Qiu (2006) found that new health events significantly reduced household financial wealth. Households also shifted their financial wealth towards safer assets following a negative health shock.

Insurance has been shown to protect policyholders' wealth from the adverse effects of health shocks. Among individuals with large medical expenses, out-of-pocket expenditures were twice as high for those without health insurance compared to those with health insurance (Smith, 1999).

Financial Strain

In recent years, researchers have begun to use various financial ratios to measure financial strain (e.g., Kim & Lyons, 2008; Lyons & Yilmazer, 2005). The ratios assess, for example, a household's ability to avoid excessive debt (solvency ratio), maintain adequate liquidity (liquidity ratio), and make progress toward financial goals (investment assets ratio). Lyons and Yilmazer (2005) used a representative sample of U.S. households to investigate the joint relationship between health and financial strain. They found that poor health significantly increased the likelihood of three measures of financial strain (delinquency on loan payments; total assets/total debts less than 1.0; and liquid assets/income less than

0.25). Little evidence was found to show that financial strain contributed to poor health. Kim and Lyons (2008) used a representative sample of older Americans to investigate the impact that new and existing health problems have on the financial strain of older Americans. They also used several financial ratios (i.e., household solvency, liquidity, and investment asset accumulation) and found that health problems significantly increased the likelihood of financial strain, but the effects varied by the measure of financial strain used and how health status was defined. The severity of the condition did not seem to matter as much as whether the condition was chronic.

This paper builds upon previous work to examine the financial impact of diabetes (a specific and prevalent chronic disease) on an individual's ability to accumulate wealth and reduce the likelihood of financial strain.

Theoretical Framework

The empirical analysis in this paper is motivated by insights from the life-cycle model of consumption (Ando & Modigliani, 1963). The model posits that individuals take their expected lifetime earnings and wealth into account when making consumption decisions. How does this work in practice, when future income and expenditures are uncertain? According to Bodie, Treussard, and Willen (2007), consumers make use of "contingent claims"- financial instruments that pay the consumer if a bad outcome is realized. For example, health insurance can be thought of as a contingent claim that pays the consumer in the event that they face poor health and high medical expenses.

The life-cycle framework suggests that older people would run down their accumulated wealth (i.e., dissave) to smooth consumption over their remaining lifetime. It also suggests that when faced with uncertainty about future health expenditures, they might respond by saving more or dissaving at lower rates as a precaution (e.g., Palumbo, 1999). Finally, it suggests that health

insurance can alleviate the impact of unexpected health shocks on their finances by helping them to smooth consumption.

This framework has several implications. First, earnings are a function of age, schooling, and gender. Thus, these demographic factors must be taken into consideration when studying wealth accumulation. Second, when a health shock, such as a serious illness, is realized, one would expect to see savings being drawn down (or an increase in the rate of dissaving) following the shock. Moreover, health shocks tend to be persistent and may lead to low wealth levels for long periods (Hubbard, Skinner, & Zeldes, 1994). Finally, smoothing consumption over time is difficult because individuals do not know the true probability and costs of a future health shock. Insurance can be particularly important in helping to mitigate the negative financial consequences of unexpected health problems.

This paper focuses on these implications by examining the impact of diabetes on the wealth of older Americans and whether the impact is serious enough to increase the likelihood of financial strain.

Empirical Models

Previous research strongly indicates that the dominant direction of causation is from health to financial strain, especially for older Americans. There is also wide recognition in the medical profession that diabetes has a strong genetic component (American Diabetes Association, n.d.). This suggests that it is less likely that the direction of causation runs from financial strain to diabetes. Given previous research and medical evidence, we assume that the relationship for older Americans is primarily from diabetes to financial strain.

For the purposes of this paper, wealth is defined as net worth (total assets less total debts).[1] Financial strain is defined by

[1] Total assets are defined as the sum of financial assets (checking accounts, savings accounts, money market funds, certificates of deposit, mutual funds,

insolvency, a condition in which a person's total assets fall short of their total debts such that their "solvency ratio" is less than one (total assets/total debts <1).

To examine the relationship between diabetes and net worth (NW_t), the following two-period model is estimated:

$$NW_t = \alpha_0 + \alpha_1 D_{t-1} + \alpha_2 D_{t-1,t} + \alpha_3 X_{t-1,t} + \varepsilon_t. \qquad (1)$$

It is hypothesized that net worth can be affected by pre-existing diabetes (D_{t-1}) and new-onset diabetes between the previous and current period ($D_{t-1,t}$).[2] Based on our theoretical framework and previous literature, a vector ($X_{t-1,t}$) of economic, demographic, and health behavior variables that may affect net worth is also included in the model. The economic variables control for household income, negative income shocks, transfers and bequests (such as transfers to adult children or receipt of a lump sum inheritance), and health insurance coverage (including whether the respondent has long-term care insurance). The demographic factors control for the respondent's age, education, gender, race/ethnicity, marital status, living arrangements, homeownership, and work status. Also included in $X_{t-1,t}$ are controls for health behaviors (e.g., whether the respondent smokes, drinks, and exercises), which determine whether environmental health risks are correlated with financial risk.

stocks, bonds, and individual retirement accounts) and nonfinancial assets (primary residence and other real estate). Total debts are all debts including mortgage debt.

[2] In both 2002 and 2004, the HRS asked respondents: "Has a doctor ever told you that you have diabetes or high blood sugar?" If they responded "yes" to this question in 2002, they were classified as having pre-existing diabetes. If they responded "no" to this question in 2002 but "yes" in 2004, they were classified as having new-onset diabetes. Note that this question does not distinguish between Type I and Type II diabetes. Type 1 diabetes accounts for only 5% to 10% of diagnosed diabetes cases and is most common in children at puberty (University of Virginia Health System, 2004). Given that this paper uses a survey of older Americans, it is likely that it primarily measures the impact of Type II diabetes.

The key parameters of interest in our model are α_1 and α_2, which measure the impact of pre-existing and new-onset diabetes on net worth. Equation (1) is estimated using Ordinary Least Squares (OLS).

It is also of interest to determine whether diabetes can deplete net worth to the point that it results in serious financial strain – in this case, insolvency. Therefore, pre-existing and new-onset diabetes are regressed on current insolvency. That is,

$$I_t=\beta_0+\beta_1 D_{t-1}+\beta_2 D_{t-1,t}+\beta_3 X_{t-1,t}+\varepsilon_t. \qquad (2)$$

I_t is a dichotomous variable that equals 1 if the individual has a solvency ratio less than one and 0 otherwise. To estimate the two-period model, the probit method is used to obtain unbiased estimates of β_1 and β_2, which measure the degree to which pre-existing and new-onset diabetes result in insolvency.

Data

Data for this paper were taken from the Health and Retirement Study (HRS), a national longitudinal survey of older Americans that began in 1992. The HRS is sponsored by the National Institute of Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. It provides detailed financial information on respondents' assets and debts, which is used to construct measures of net worth and insolvency. It also provides comprehensive information on the health status of individual respondents including whether they have a specific health condition such as diabetes.

This paper uses data from the 2002 and 2004 waves of the HRS. The 2002 HRS surveyed a nationally-representative probability sample of 18,167 respondents born prior to 1948. Note that, for married couples, both the husband and wife may have been included in the HRS even if only one of them was born before 1948. To focus on older Americans, the sample was restricted to respondents aged 65 years or older in 2002 (10,867

respondents out of 18,167) who participated in both the 2002 and 2004 waves of the survey (9,394 respondents out of 10,867). Respondents who did not answer key survey questions or who reported unusually high or low wealth holdings were also excluded. The final sample for this study consisted of 9,157 older Americans.

In the HRS, health status is reported at the individual level while financial information is reported at the household level. Our analysis is conducted at the individual level, so when the data includes both spouses, the financial measures are calculated at the household level and the same values are assigned to both the husband and wife. For the same reason, respondent-level weights are used to yield unbiased estimates of the population parameters. The weights take into account the marital status of the respondent and the number of age-eligible persons in the household (Heeringa & Connor, 1995). Note that all of the data have been weighted.

The HRS sample is also clustered and stratified. Unless this is taken into account, standard errors based on simple random sampling may be biased downward. For our analysis, standard errors were adjusted for sample clustering and stratification.

Descriptive Statistics

Table 1 presents a descriptive overview of the entire sample. The table includes weighted mean values for key variables included in the regressions. All of the financial values are reported in 2004 dollars. In general, of the 9,157 older Americans in the sample, 17.2% (n=1,575) reported having diabetes in 2002 (pre-existing diabetes), and 2.8% (n=256) indicated that they developed diabetes between 2002 and 2004 (new-onset diabetes). In addition, average net worth was $406,200. Yet, 4.9% reported that they were insolvent. See Table 1 for additional details on the demographic composition of the sample.

Table 1
Descriptive Statistics for Sample of Older Americans (HRS, N=9,157)

Weighted Mean Values[a]	All (9,157)
Diabetes	
Pre-existing diabetes (2002)	17.2
New-onset diabetes (2002-2004)	2.8
Wealth and Insolvency	
Net worth ($1,000) (2004)	406.2
% Insolvent (2004)	4.9
Income Measures	
Household income ($1,000) (2002)	44.2
Negative income change (2002-2004)	47.9
Transfer to child (2002-2004)	29.6
Receive lump sum (2002-2004)	4.6
Demographics	
Age (years)	74.2
Education (years)	12.1
Female	58.3
White	85.6
Black	7.6
Hispanic	2.1
Other race/ethnicity	2.0
Immigrant	8.1
Married (2002)	57.3
Change in married status (2002-2004)	3.8
Living with a child (2002)	15.9
Homeowner (2002)	72.7
Working (full- and part-time) (2002)	18.6
Health Behaviors	
Drinks (2002)	44.7
Smokes (2002)	9.3
Exercises (2002)	41.0
Health Insurance[b]	
Medicare A and B only (2002)	19.9
Medicare+ Employer insurance (2002)	32.3
Medicare+ Medigap (2002)	27.3
Medicare+ Medicaid (2002)	6.8
Medicare HMO (2002)	13.7
Long-term care insurance (2002)	13.5

[a] Variables are reported as weighted percentages unless otherwise indicated.
[b] Note that the health insurance variables related to Medicare sum to 100%.

Table 2 provides insight into the specific relationships that may exist between diabetes, net worth, and financial strain. Those with pre-existing and new-onset diabetes have lower net worth than those without diabetes. Specifically, those who had diabetes in 2002 accumulated on average $124,000 less in net worth in 2004 than those who did not have diabetes ($303,600 compared to $427,600). Similarly, those who developed diabetes between 2002 and 2004 accumulated $70,100 less in 2004 than those who did not develop diabetes ($338,100 compared to $408,200). Table 2 also shows that individuals with pre-existing and new-onset diabetes are more likely to be insolvent. Almost 7.0% of those who had diabetes in 2002 were insolvent in 2004 compared to 4.5% of those who did not have diabetes. Likewise, 7.5% of those who developed diabetes between 2002 and 2004 were insolvent in 2004 compared to 4.8% of those who did not develop diabetes.

These preliminary statistics seem to support the hypotheses that diabetes is negatively associated with net worth and positively associated with insolvency. The next step is to determine, after controlling for as many factors as possible, the extent to which a household's financial position may be affected by diabetes.

Table 2
Diabetes, Net Worth, and Insolvency for Older Americans (HRS, N=9,157)

		Pre-existing Condition (2002)	
Weighted Mean Values[a]	All (9,157)	Diabetes (n=1,575)	No diabetes (n=7,582)
Net worth (2004)[b]	406.2	303.6	427.6
% Insolvent (2004)	5.3	6.9	4.5
		New-onset Condition (2002-2004)	
	All (9,157)	Diabetes (n=256)	No diabetes (n=8,901)
Net worth (2004)	406.2	338.1	408.2
% Insolvent (2004)	5.3	7.5	4.8

Results

Table 3 presents the results from the OLS regression for net worth and the probit model for the probability of insolvency. The findings from the OLS model show that those who had diabetes in 2002 had significantly lower net worth in 2004 ($p<0.10$). Those who developed diabetes between 2002 and 2004 also had lower net worth, but the effect was insignificant. The results from the probit model show that having diabetes in 2002 significantly increased the probability of being insolvent in 2004 ($p<0.05$). Developing diabetes between 2002 and 2004 also increased the probability of being insolvent but again the effect was insignificant.

What do the findings mean in real economic terms? Marginal effects were calculated at the weighted sample means to determine the financial impact of diabetes on net worth and insolvency. The results showed that the net worth of individuals with diabetes in 2002 was $54,373 lower in 2004 than the net worth of those without diabetes. The probability of insolvency was 1.2 percentage points higher for those with diabetes. The magnitudes of the effects were not small. Pre-existing diabetes reduced net worth by 13.4% and increased the probability of being insolvent by 24.5%. These figures were based on the fact that the average net worth for the sample in 2004 was $406,246 and the percentage insolvent was 4.9%.

The results also showed that those who had supplemental health and long-term care insurance had higher net worth and lower probabilities of insolvency. In particular, marginal effects revealed that having long-term care insurance increased net worth by 18.8% and reduced the probability of insolvency by over 55.0%. These findings suggest that being prepared for the unexpected and maintaining adequate health insurance coverage can help to significantly mitigate the costs and financial strain associated with chronic diseases such as diabetes.

Table 3

OLS and Probit Models: Financial Impact of Diabetes (HRS, N=9,157)

	OLS		Probit	
	Net worth (2004)		Insolvent (2004)	
Variable	Coeff	SE	Coeff	SE
Pre-existing diabetes (2002)	-0.544	(0.284) *	0.141	(0.058) **
New-onset diabetes (2002-2004)	-0.220	(0.279)	0.197	(0.155)
Household income (2002)	3.165	(0.554) ***	-0.344	(0.141) **
Neg income change (2002-2004)	-1.003	(0.374) ***	-0.088	(0.065)
Age	0.019	(0.022)	-0.033	(0.004) ***
Education	0.320	(0.049) ***	0.007	(0.010)
Female	-0.672	(0.343) *	-0.044	(0.044)
Black	-1.223	(0.181) ***	0.405	(0.080) ***
Hispanic	-0.460	(0.303)	-0.061	(0.194)
Other race/ethnicity	-1.140	(0.628) *	0.075	(0.183)
Immigrant	0.552	(0.399)	0.063	(0.138)
Married (2002)	0.612	(0.333) *	0.076	(0.083)
Change in married status (2002-2004)	-0.926	(0.316) ***	0.001	(0.182)
Living with a child (2002)	-0.525	(0.189) ***	0.193	(0.073) **
Homeowner (2002)	1.650	(0.253) ***	-0.208	(0.070) ***
Working (2002)	-0.954	(0.375) **	0.178	(0.070) **
Transfer to child (2002-2004)	0.993	(0.377) **	-0.115	(0.093)
Receive lump sum (2002-2004)	0.304	(0.451)	-0.014	(0.130)
Drinks (2002)	0.650	(0.390) *	-0.093	(0.064)
Smokes (2002)	-0.457	(0.333)	0.134	(0.097)
Exercises (2002)	-0.003	(0.375)	-0.145	(0.058) **
Medicare+ Employer insurance (2002)	0.199	(0.305)	-0.224	(0.076) ***
Medicare+ Medigap (2002)	0.493	(0.204) **	-0.239	(0.094) **
Medicare+ Medicaid (2002)	0.424	(0.202) **	-0.275	(0.100) ***
Medicare HMO (2002)	0.746	(0.615)	-0.193	(0.089) **
Long-term care insurance (2002)	0.762	(0.410) *	-0.318	(0.108) ***
Constant	-3.801	(1.958) *	1.105	(0.308) ***

Notes: "Coeff" represents the coefficient estimates. Standard errors are reported in parentheses and have been adjusted for sample clustering and stratification. Net worth and household income are reported as 2004 dollar values and are reported in $100,000. Variables with "(2002)" are reported as 2002 values; all other variables are 2004 values. "Insolvent" represents individuals in 2004 with assets/debts<1.0. "Diabetes - new condition" represents individuals who reported that they developed diabetes between 2002 and 2004. "Neg income change" is defined as respondents who reported a negative drop in income between 2002 and 2004. Omitted categories include: white, unmarried, and not receiving Medicare.

*p < 0.10; **p < 0.05; ***p < 0.01

Other factors were also found to have a significant impact on net worth and insolvency. The results were fairly consistent with previous research in sign and significance. The findings from the net worth equation showed that respondents with higher household income had higher net worth while those who

experienced a negative income shock had lower net worth. Those who were female, black, working (part-time or full-time), and living with an adult child also had lower net worth. However, those who were more educated, owned a home, and gave financial transfers to a child had higher net worth. Those who were married also had higher net worth while those who experienced a change in marital status had lower net worth. The results from the solvency equation were similar to those from the net worth equation with a few exceptions. A negative income shock, higher levels of education, and a change in marital status had a significant effect on net worth but not on the probability of insolvency. Age had a significant and negative effect on the probability of insolvency but not on net worth. The impact of health behaviors (i.e., drinking, smoking, and exercise) on net worth and insolvency was minimal and mostly insignificant.

Discussion and Conclusions

Previous research has analyzed the impact of health on various economic and financial variables, including labor market outcomes, wealth, and financial strain. Few studies have focused specifically on the impact of diabetes even though aggregate data has shown that diabetes imposes substantial economic costs. This study built upon previous research by estimating the impact of pre-existing and new-onset diabetes on the financial position of older Americans. The findings showed that pre-existing diabetes may reduce the net worth of older Americans by 13.4% and increase the probability of insolvency by 24.5%. The results suggest that the financial impact of diabetes might be mitigated if individuals more adequately plan for unexpected health events and medical expenditures.

It is important to acknowledge a few limitations of this study. First, it assumed a direction of causality from diabetes to financial strain. While there are strong arguments for why this is a reasonable assumption, it must be acknowledged that financial strain may lead to poor health. Although diabetes has a strong

genetic component, it also has been linked to environmental factors such as diet and exercise, which in turn, may be influenced by an individual's financial status.

Another limitation arises from the fact that the models estimated were not able to control for diet, genetic predisposition, time preference, and other potential health and environmental factors that could have financial impact. Therefore, the results may be subject to omitted variable bias such that unobservable characteristics may affect both the probability of having diabetes and the accumulation of net worth over the life cycle. Given this, the results presented in this paper may be overstating the financial impact of diabetes.

The estimates could also be understating the impact of diabetes. Diabetes is often associated with other chronic diseases and disabilities such as heart disease, stroke, kidney disease, blindness, amputation, and neuropathy (American Diabetes Association, 2007). This study did not take into account additional financial strain resulting from other health conditions that could limit an individual's ability to work and accumulate wealth over the life cycle.

As one can see, the relationship between diabetes and wealth is complex. Ideally, longitudinal data is needed to track individuals from childhood to retirement and beyond to gain a more accurate understanding of the financial impact of chronic diseases such as diabetes. In the absence of such data, we used a two-period approach to examine the impact of "pre-existing" versus "new-onset" diabetes on levels of net worth and financial strain at the end of the life cycle. This approach, however, was not able to account for missing information prior to 2002 that may have affected savings and investment decisions and ultimately total net worth in 2004.

Given the above limitations, the results in this paper should be treated as estimates rather than measures of the "true" financial impact of diabetes. These estimates are valuable in that they demonstrate that the impact on wealth is likely to be large – and large enough to result in serious financial consequences such

as insolvency. The findings also offer some important implications for financial educators. In the process of financial planning, consumers need to be able to assess the probability and costs of contracting a chronic disease such as diabetes and make life-cycle savings decisions based on their assessment. However, perfectly estimating future health costs is difficult, and our results show that older Americans face an increased risk of insolvency after contracting diabetes. That said, the estimates of the financial impact of diabetes presented in this paper can still help younger people better anticipate future health needs and formulate long-term financial plans accordingly. Financial advisors and consumer educators can share these estimates with their clients to show that preventive care can save them money and reduce health care expenses in the future.

Finally, recall that our results also showed that those with adequate health and long-term care insurance are better able to accumulate wealth and less likely to be insolvent. While this may just follow from the observation that wealthy people tend to buy more insurance, it suggests that financial educators might want to encourage consumers to think about insurance as a substitute or supplement to precautionary savings. Insurance can help patients pay for the long-term care costs associated with a chronic condition such as diabetes. Financially vulnerable populations are especially in need of more information about the range of medical, personal, and social services available to assist with their health care needs (i.e., low-cost medical services, insurance plans, and government support programs such as Medicaid) (Kim & Lyons, 2008). Educational interventions such as these can help individuals better prepare for potentially large and negative effects associated with diabetes and other chronic health conditions.

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