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Health investment decisions in response to diabetes information in older Americans

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ABSTRACT

Diabetes is a very common and serious chronic disease, and one of the fastest growing disease burdens in the United States. Further, health behaviors, such as exercise, smoking, drinking, as well as weight status, are instrumental to diabetes management and the reduction of its medical consequences. Nine waves of the Health and Retirement Study are used to model the role of a recent diabetes diagnosis and medication on present and subsequent weight status, exercise, drinking and smoking activity. Several non-linear dynamic population average probit models are estimated. Results suggest that compared to non-diagnosed individuals at risk for high blood sugar, diagnosed diabetics respond initially in terms of increasing exercise, losing weight, and curbing smoking and drinking behavior, but the effect diminishes after diagnosis. Evidence of recidivism is also found in these outcomes, especially weight status and physical activity, suggesting that some behavioral responses to diabetes may be short-lived.

1. Introduction

Diabetes is a collection of diseases[1] that lead to elevated blood sugar levels (hyperglycemia). If untreated, diabetes can lead to complications including nerve damage, blindness, limb amputation, and kidney damage. Diabetics are also more than twice as likely to suffer from heart attacks or strokes. In some cases, diabetes is treatable through lifestyle modifications, without the need for medications. Other chronic diseases, such as high blood pressure, arthritis, and heart disease (among others), can be mitigated by lifestyle modifications as well. However, given the particular risk of long-term complications in the case of diabetes, the cost of a poor lifestyle for diabetics is often higher than for sufferers of these other chronic diseases. This characterization is even more true for older Americans, a population whose disease prevalence is higher (CDC, 2007), and whose ability to manage the disease through lifestyle changes (especially through physical activity) is often much more difficult (e.g. Sinclair et al., 2008).

For the newly diagnosed diabetic, initial medical recommendations would commonly include lowering carbohydrate and fat intakes, increasing exercise, quitting smoking, losing weight, and decreasing alcohol consumption. Unfortunately, only about 45% of diabetics follow recommended care guidelines (McGlynn et al., 2003). The cost of compliance has declined over time due to technologies such as artificial sweeteners, and the benefits have risen over time due to medical advances that can subvert or delay complications. Nevertheless, there have been several explanations put forth as to why people might engage in behaviors that have substantial future health consequences (such as high carbohydrate consumption in diabetics).

Becker and Murphy (1988) suggest that people weigh the total costs and benefits of an addictive behavior and initiate behaviors in a forward-looking, time-consistent manner. A diabetic, for example, might indulge in a slice of cheesecake but commit to going to the gym later that day. Likewise, diabetic patients who anticipate

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[1] There are three major types of diabetes: type I, type II, and gestational. Type I diabetes is an auto-immune condition by which the body attacks the pancreas, leading to an absolute deficiency of insulin, the major hormone that lowers blood sugar. Its onset is generally before age 30. Type II diabetes is the most common form of diabetes (~90–95% of all diabetes cases) that is characterized by insulin resistance and can often be mitigated through diet and lifestyle changes. Gestational diabetes is a transient condition that affects women during pregnancy, though it can raise the risk of developing type II diabetes. This paper focuses on type II diabetes, since new cases of type I or gestational diabetes are extremely unlikely to appear later in life.

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increasing treatment availability and efficacy in the future might be less likely to be compliant with lifestyle recommendations. Thaler and Shefrin (1981) suggest that an individual faces a competition between far-sighted desire to obtain better health and a near-sighted desire for gratification. Cognitive functioning, especially in regard to executive functioning tasks, has been shown to be worse among older diabetics as compared to nondiabetic controls (Yeung et al., 2009). Impairments in executive functioning may obfuscate the costs of noncompliance with lifestyle habits, relative to the immediate benefits. More recent evidence indicates that male diabetics may have deficits associated with the prefrontal cortex that can lead to losses in inhibitory control (Ishizawa et al., 2010).

Even though compliance with recommended guidelines is sometimes absent, there is strong cross-section and pooled longitudinal evidence to suggest that individuals respond (at least somewhat) to health changes. For example, Kahn (1999) employs National, Health and Nutrition Evaluation Survey (NHANES) data to examine the differential effects of a diabetes diagnosis and anti-diabetic medication in determining own-health investment behaviors such as exercise, dietary compliance, and overall calorie intake. Kahn (1999) finds that compared to people with diabetes who are unaware of their condition, diagnosed diabetics tend to invest more in their own health by smoking less and adhering to dietary guidelines surrounding diabetes management. Additionally, Keenan (2009) uses pooled Health and Retirement Survey (HRS) longitudinal data to estimate cross-section "change" regressions, where the difference in smoking status (i.e. quitting) among previous smokers and change in body mass index (BMI) among overweight individuals are outcome variables regressed on a new diagnosis of a health condition, such as lung disease, heart disease, and diabetes. Keenan finds that while a new diabetes diagnosis does increase a smoker's propensity to quit, the effect of a new diabetes diagnosis was smaller in magnitude and significance compared to other chronic conditions. However, these studies do not take into account methodological features such as state-dependence or the dynamic or long-term nature of health behaviors underlying diabetes compliance, which are processes that influence individual decision-making in health and labor domains (e.g. Contoyannis et al., 2004b; Hernández-Quevedo et al., 2008; Slade, 1987).

State dependence can be thought of as the role of the previous period's behavior on current behavior. As an example from the Health and Retirement Study (HRS), the correlation between whether a respondent currently smokes any cigarettes in a two-year period t and the previous period, $t-1$, is 0.84. Similarly, whether an individual ever drinks any alcoholic beverages in a two-year period has a 0.70 correlation from one period to the next. Obesity, or having a BMI of 30 or above at a survey interview, has a correlation of 0.76 between one period and the next. While these correlations may appear small relative to other studies, the two-year gap between HRS survey periods allows processes that are not captured by the lagged outcome to influence the contemporaneous outcomes. Self-reported smoking or drinking behavior may also be measured with error. These relatively high correlations reflect not only the importance of previous behavior in explaining present behavior, but also the likely difficulty in changing these behaviors.

Similarly, recidivism – individuals falling back on poor health habits (e.g. smoking, alcohol use, and low levels of exercise) after making behavioral modifications, is an important issue from a policy and clinical standpoint. Adhering to scheduled provider appointments, which is often how diabetes control is assessed, can also be a problem among diabetic patients (Schectman et al., 2008). As a result, providers for diabetic patients often make it a priority to help patients not only to change lifestyle behaviors, but also to maintain these changes (Anderson and Funnell, 2000).

As a result of the overwhelming medical evidence that exists about the mitigating effects of a healthy lifestyle on the consequences of diabetes, this paper aims to study four behavioral "flows" that can ameliorate the deleterious effects of diabetes and improve the prognosis of diabetics: smoking, alcoholic beverage consumption, frequent exercise, and body mass. These "flows" can affect health stocks relevant to diabetics, such as long-term blood sugar levels. The most important flows in the case of glycemic control in diabetes would include diet and physical activity, which can directly affect blood sugars. However, there are flows that have indirect benefits as well, such as curtailing smoking and drinking behavior. Current body weight, which is not directly a "flow" to glycemic control, is important to consider, as weight loss can improve insulin sensitivity and potentially mitigate reliance on medication. Body weight can also serve as proxy for energy intake versus expenditure, albeit crudely. However, given the extremely powerful biological ties between body weight and diabetes, overweight or obese status (corresponding to a BMI ≥ 25) is used as one of the four outcome measures in this analysis.

In this study, reduced form demand equations are estimated for these health behaviors and weight status. Any smoking, frequent physical activity (at least 3 times per week), any alcoholic beverage consumption, and overweight or obese status are considered as discrete outcomes when estimating their demands, because the risk for developing diabetic complications is often mitigated by achieving these particular threshold values. For instance, evidence from clinical trials suggests that exercise at least three times a week can significantly reduce long-term blood sugar levels and rates of microvascular complications (Boulé et al., 2001; Sigal et al., 2006). Similarly, achieving and maintaining weight goals is a major component of diabetes management (American Diabetes Association, 2008). Evidence suggests that diabetics require at least a 5% reduction in body weight in order to achieve any significant glycemic improvement among type II diabetics (Wing et al., 1987). Further, completely quitting smoking is particularly beneficial for decreasing the risk of vascular problems that can often accompany diabetes.

The costs of smoking in the context of diabetes are high. In addition to serving as an independent risk factor for the development of diabetes, smoking also tends to increase the risk of complications of diabetes, including heart and vascular disease. Drinking behavior is not as well characterized in the literature, though it is an important aspect of diabetes self-management. Because the effects of alcohol on blood sugar are often difficult to predict, glycemic control is often more difficult for diabetics who choose to drink. However, the clinical evidence on alcohol and diabetes is somewhat mixed. While the beneficial effects of some alcohol consumption on cardiovascular disease are well characterized even among diabetics (Howard et al., 2004), the American Diabetes Association currently recommends keeping alcohol consumption to a minimum, with a maximum daily consumption of one drink for women and two drinks for men (Wheeler et al., 2004).

This study makes contributions on the role of diabetes information in health behavior modification and health outcomes. Specifically, this paper presents a dynamic framework for understanding the role of a recent diabetes diagnosis as a "shock" for people to initiate health behavior, and how diagnostic information persists subsequent to the initial diagnosis. I also consider the role of anti-diabetic medication in the evolution of these health outcomes, which can physiologically affect the outcomes themselves, as well as serve as a proxy for the current clinical stage of the diabetes.