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Can present biasedness explain early onset of diabetes and subsequent disease progression? Exploring causal inference by linking survey and register data

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ABSTRACT

Diabetes is a major cause of morbidity, disability, mortality and health care resource use. The increasing prevalence of diabetes may therefore have dramatic future consequences for western societies. Diabetes entails a significant self-management component and it has previously been estimated that people with diabetes provide about 95% of their own care. Despite increased focus, self-management skills including basic knowledge acquisition, problem solving and setting realistic goals are often not mastered. The main contribution of this paper is to provide evidence that the heterogeneity in self-management and health outcomes amongst diabetes patients is partly attributable to individual differences in time-inconsistent preferences in terms of present biased behaviour. Using a unique data set consisting of survey data from 2014 merged with registry data on a sample of 79 chronically ill patients, we present empirical evidence that present biased individuals are more prone to onset of diabetes at an early age, and have a poorer prognosis after diagnosis. Furthermore, we conclude that present biasedness has a casual effect on the onset and management of diabetes.

1. Background

Diabetes is a growing health care problem and a major cause of morbidity, disability, and mortality. It is the seventh leading cause of death in western countries, and associated with a high incidence of kidney failure, lower limb amputations, and adult-onset blindness. The global prevalence of diabetes in 2014 was estimated to be 8.5% in adults aged 25+ years (WHO, 2016), and is expected to increase markedly between the years 2000 and 2030 (Wild et al., 2004). Well established risk factors of diabetes 2 include among others obesity, inactivity, genetics, ethnicity and age. In addition to the above mentioned human health costs, there are considerable financial costs associated with the illness. Altogether this implies that diabetes may well have dramatic future consequences in western societies.

Diabetes entails a significant self-management component and it has previously been estimated that people with diabetes provide about 95% of their own care (Anderson et al., 1995). Several self-care behaviours have been identified as key behaviours to diabetes self-management including adherence to medication, physical activity, dietary and weight management, and monitoring of blood glucose (Mulcahy et al., 2003). Despite increased focus, self-management skills are often not mastered (Wallace et al., 2010), and factors such as demographics (including education), illness perceptions, self-efficacy, and social support remain predictors of adherence to self-management recommendations (e.g. Abubakari et al., 2015). Given the apparent variation in individuals' abilities to self-manage, an improved understanding of the barriers to optimal diabetes self-management in specific sub-groups is needed to inform effective interventions.

Following the framework of Grossman's classical intertemporal health capital model, an individuals' health stock is influenced by inputs such as time, health care, health behaviours, and time preferences (Grossman, 1972; Fuchs, 1982). In the present study we aim at identifying behavioural characteristics which are not merely reflections of variations in genuine preferences across patients (such as consistent time preference), but which reflect irrational behaviour. A possible failure of rationality that is highly relevant for the ability to lead a healthy life is lack of self-control, often referred

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to as present bias, a tendency to pursue smaller *immediate* rewards instead of rewards that may be more highly valued but are distant and unsure (O'Donoghue and Rabin, 1999). Such type of impulsive behaviour can be captured by a quasi-hyperbolic discounting function, allowing for non-constant and relative discounting between the current period (the present) and all consecutive periods. This type of discounting function accounts for preference reversal over time, i.e. time inconsistency, which is considered an irrational behaviour from a standard economic perspective.

Recent experimental studies have shown that individuals are heterogeneous with respect to time preferences in the monetary domain (Harrison et al., 2015; Andersen et al. 2008, 2014; Harrison et al., 2002) as well as within the health domain (Bleichrodt and Johannesson, 2001; Bleichrodt et al., 2015; Pol and Cairns, 2011). Such heterogeneity may explain why some individuals find it more difficult to comply with health related recommendations such as the intake of medicine, smoking cessation, and healthy life-styles. As noted by Attema (2012), Lawless et al. (2013) and Story et al. (2014), evidence shows that time preferences and lack of self-control are correlated with unhealthy behaviour, whilst the issue of the *causal* relation between both time preferences (including present biasedness) and behaviour and health remains unanswered. To our knowledge only one paper claims to have discovered the causal pathway between time preferences and health behaviour empirically (Courtemanche et al., 2014). They argue that a higher Body Mass Index (BMI) is caused by individuals having a larger discount rate.

This paper seeks to address this existing gap in the literature. Our main contribution is to provide evidence that differences in self-management and health outcomes amongst diabetes patients is partly attributable to heterogeneity in time preferences. For this purpose we use a unique combination of survey and registry data. We elicit time preferences using the Discrete Choice Experiment (DCE) method, amongst a sample of diabetes patients. We subsequently merge the preference data at the individual level with other survey data and registry data. While experimentally elicited time and risk preferences have previously been linked to self-reported health behaviours, we believe that we are the first to link time and risk preferences to clinical registry data on chronically ill patients, and the first to investigate to what degree present biasedness can be related to the behaviour and health of chronic patients.

From the register we have information on the year-of-debut of diabetes, which indicates the time period that the patient has lived with a diabetes diagnosis. This offers an opportunity to test whether present bias is exogenous, i.e. a fixed personality trait, or whether it is endogenous, i.e. changing over the course of a chronic disease. Hence our data allow us to test whether it is present bias that drives early onset of disease or whether it is the progression of the disease that results in present bias. Our results suggest that present bias is an independent driver of early onset of diabetes. While our results also suggest that present biased preferences to some extent may be formed by the status of the chronic illness (i.e. the duration of illness generating present bias) further analyses show that this effect is markedly weakened, when controlling for age-at-onset of diabetes. This suggests that it is mainly present bias that drives early onset of diabetes whereas the reversed causality is much less pronounced. Second, we test for the impact of present bias on health outcomes amongst diabetes patients. We observe a negative association between present bias and health outcomes, diabetes literacy, physical activity, and glycaemic control. Moreover, present bias is positively associated with obesity. These associations hold even when we have controlled for age-at-onset and year-of-debut (duration of illness) suggesting that the associations between present bias and the aforementioned outcomes are not only driven by age-at-onset and year-of-debut, but that present bias is also independently related to diabetes health related behaviours and prognosis.

2. Recent literature linking health and health behaviour to intertemporal preferences

The relation between time preferences and health behaviour/outcomes has recently received increased attention in the literature (e.g. Sassi and Hurst, 2008). Most of the studies base their analyses on surveys in which intertemporal preferences are elicited and information on health behaviours and health outcomes collected.

There is a bulk of literature investigating the association between time (consistent) preferences and health related behaviours (e.g. Adams and Nettle, 2009; Anderson and Mellor, 2008; Bradford, 2010; Chabris et al., 2008; Chapman and Coups, 1999; Ida and Goto, 2009; James et al., 2015; Khwaja et al., 2007; Leonard et al., 2013). In most cases they found a negative association between time preferences and activities relating to primary and secondary preventions.

More recently, a few studies have focused on the association between time-inconsistent preferences (present biasedness) and health related behaviours. Harrison et al. (2015), Ida (2014) and Mitchell and Wilson (2012) applied quasi-hyperbolic discounting, while Harrison et al. (2010) applied hyperbolic discounting, when exploring the association between time preferences and smoking behaviour. Harrison et al. (2015) and Ida (2014) found that smokers are more prone to being present biased than non-smokers. In contrast, Mitchell and Wilson (2012) found no association. Pol and Cairns (2001) showed a negative correlation between time-inconsistent behaviour and self-assessed health. Ikeda et al. (2010) found that individuals with higher bodyweight more frequently exhibited time preferences characterized by hyperbolic discounting. This latter finding is supported by Courtemanche et al. (2014), who showed that both time preferences and present bias predict BMI.

Of special interest for the present paper are the findings by Sloan et al. (2009), who investigated the associations between diabetes patients' time preferences and adherence to recommended care, self-assessed control of diabetes as well as HbA1c levels. Despite the conceptually clear link between time preferences and health investments, they do not find any significant relations. They argue that a potential reason for lack of correlation could be their very simple measure of time preferences, which is based on the level of agreement to the single question. In the present study we use a much more advanced method for eliciting temporal preferences.

While some evidence exists that time (inconsistent) preferences and lack of self-control are correlated with unhealthy behaviour, the issue of the causal relation between time (inconsistent) preferences and behaviour and health remains largely unanswered. The implicit assumption, which is aligned with Grossman's investment model, is that time preferences are exogenous personal characteristics, which lead to behavioural patterns, which again lead to health outcomes (see Fuchs, 1982; Ehrlich and Chuma, 1990 and Eisenring, 1999 for relevant extensions of the Grossman model). In contrast, both Chavas (2013) and Becker and Mulligan (1997) present a model, which allows for endogeneity of time preferences. Whereas Becker and Mulligan (1997) allow endogeneity to be driven by factors such as wealth, mortality, addictions and uncertainty, Chavas (2013) specifically focuses on the relation between malnutrition (both under- and overweight) and its influence on investment decisions, allowing time preference rate to vary with nutritional status. Given the theoretical model proposed by Becker and Mulligan one may hypothesize that