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Article

Investigating the Early Life Determinants of Type-II Diabetes Using a Project Talent-Medicare Linked Data-set

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ABSTRACT

The increasing prevalence of Type II Diabetes (T2D) presents a serious health and financial public crisis. Our study examines the hypothesis that adolescents' perceptions of economic insecurity, along with absolute and relative socioeconomic status (SES), can contribute to T2D prevalence later in life. Project Talent (PT) Survey data, collected on high school students in 1960, have been linked to Medicare records from 2012, presenting a unique opportunity to examine measures gathered in adolescence and T2D prevalence later-in-life among a large, national, and diverse sample (n = 88,849). Our results provide compelling evidence that real, perceived, and relative SES in adolescence have persistent impacts on later-in-life diabetes risk, even when controlling for possible confounders such as cognitive ability, conscientiousness, and early-adulthood educational attainment.

Introduction

The prevalence of Type II Diabetes (T2D) is on the rise, increasing from 18.8M in 2010 (CDC, 2012b) to 30.3M in 2015 (CDC, 2017). As of 2012, 28% of Medicare enrollees had a formal diagnosis of diabetes (CDC, 2012a). Previous research has largely attributed the T2D epidemic to individual behaviors, such as sedentary lifestyle and poor diet (Kelly & Ismail, 2015; Volaco, Cavalcanti & Filho RP1, 2017). Unfortunately, very few interventions focusing on behavior modification alone have resulted in clinically meaningful differences in patient outcomes (Yoon et al., 2013). It is possible that existing interventions fail to address underlying environmental and psycho-social risk factors for diabetes (Chen & Paterson, 2006; Jiang, Ma, Wang & Liu, 2013; Kelly & Ismail, 2015; Lidfeldt, Li, Hu, Manson & Kawachi, 2007).

The incidence and prevalence of T2D has risen particularly among those with low socioeconomic status (SES) and racial/ethnic minorities (CDC, 2017). Because there are lifestyle risk factors associated with T2D (e.g., Connolly, Unwin, Sherriff, Bilous & Kelly, 2000), and because lifestyles do differ between demographic groups (Jokela, Elovainio, Nyberg, Tabák, Hintsa & Batty, 2014; Kivimäki, Virtanen, Kawachi, Nyberg, Alfredsson & Batty, 2015), these disparities have often been attributed to behaviors (Kelly & Ismail, 2015). However controlling for these factors does not fully attenuate the relationship between SES and T2D (Jiang et al., 2013). In addition, SES-group lifestyle differences alone do not provide a compelling explanation for why economic hardship is particularly damaging when experienced by children (Stringhini, Batty, Bovet, Shipley, Marmot & Kumari, 2013), with health effects persisting into adulthood even when controlling for adult SES (Pikhartova et al., 2014; Tversky & Kahneman, 1992).

The Project Talent (PT) Study linked to Medicare claims and utilization data provides a unique opportunity to examine many of these frequently unobserved early-life psycho-social and environmental characteristics for nearly 90,000 Medicare beneficiaries in their late 60s and early 70s. We explore the role that stress produced by low economic status in adolescence may have on later-in-lifeT2D risk after a 50-year follow-up period, while controlling for a variety of other possible explanations. Accordingly, we examine the impact of objective, relative, and perceived SES, as well as individual characteristics such as cognitive ability and personality on the prevalence of later-in-life T2D.

Literature Review

Psycho-social precursors to T2D

Kelly and Ismail (2015) provide an extensive review of the growing literature regarding the impact that stress caused by psycho-social factors can have on T2D risk. They summarize the evidence for stress from low SES in adulthood (Agardh, Allebeck, Hallqvist, Moradi & Sidorchuk, 2011), low SES in childhood (Tamayo et al., 2010), racial /

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ethnic minority status (Robbins, Vaccarino, Zhang & Kasl, 2001), traumatic experiences (Björntorp, 2001; Pouwer et al., 2010), and post-traumatic stress disorder (Alastalo, Räikkönen, Pesonen, Osmond, Barker & Kajantie, 2009). This research line extends results from animal studies, showing that recurrent stress creates chronic inflammation, followed by metabolic disorders, obesity, and T2D (Black, 2003). Kelly and Ismail conclude that T2D prevention research should focus on psychosocial precursors to T2D including social disparities.

Individual experiences may affect the degree to which life-events are interpreted as stressful (Cohen et al., 1995); indeed there are differences in how subjective experiences can influence people's health through physiological mechanisms such as the speed of cells' aging (Epel, Lin, Wilhelm, Wolkowitz, Cawthon & Adler, 2006). Therefore, it is surprising that Kelly and Ismail (2015) describe only two longitudinal studies examining how self-reported well-being affects diabetes risk and the results did not provide compelling evidence (Kato, Noda, Inoue, Kadowaki & Tsugane, 2009; Strodl & Kenardy, 2006). As Kelly and Ismail remark, objective stress is the better understood predictor of T2D (2015, p. 452).

Data limitations in existing studies may account for Kelly and Ismail's (2015) conclusion that subjective stress is not an important predictor of T2D. In their table describing the variables, samples, and follow-up periods of datasets currently in use, most large datasets rely on clinical or medical record data only and do not include subjective experiences (e.g., the Netherlands Medical Practice Database; N = 68,004; 25 year follow-up). Among the databases with self-reported data, several are relatively small and limited in sample scope (e.g., the Baltimore Epidemiologic Catchment Area Study; N = 1,070; 23 year follow-up) or have short follow-up periods (e.g., the Australian Women's Health Survey; N = 8,896; 3 year follow-up). There are three exceptions. First, the Japanese Public Health Center-Based Prospective Study (N = 55,826; 10 year follow-up) includes some general items on subjective stress (e.g., "How much stress do you feel in your daily life?") and measures Type A personality; Kato et al (2009) find that subjective stress increases the risk of T2D, particularly among adult men. Next, investigators using the UK-based Whitehall II study (N = 7,237; 14 years) show compelling evidence that T2D associates with work-stress (Chandola et al., 2006; Heraclides, Chandola, Witte & Brunner, 2012),clinical depression, and anxiety (Virtanen, Ferrie, Tabak, Akbaraly, Vahtera & Singh-Manoux, 2014). Both the Japanese and the Whitehall samples include only adults and therefore cannot be used to examine the impact of early life stress. Finally, only the UK 1958 Birth Cohort (N = 7,784; 45 years) includes early-life self-reported measures. Data on this cohort have been used to demonstrate that low childhood SES and poor parenting puts adults at risk for T2D (Thomas et al., 2008).

However, none of the datasets discussed above include items measuring subjective SES in adolescence or adulthood. Low subjective SES may reflect stress caused by low SES, but might also exist among individuals who are not strictly low-SES, but who feel financially insecure or concerned about their economic prospects nonetheless. Previous research has shown that low subjective SES increases susceptibility to the common cold (Cohen, Alper, Adler, Treanor & Turner, 2008), leads to lower overall health in adults (Cohen, Janicki-Deverts, Doyle, Miller, Frank & Rabin, 2012), predicts concurrent diabetes prevalence among adolescents (Goodman, Huang, Schafer-Kalkhoff & Adler, 2007), and associates with poorer health outcomes for diabetic adults (Doshi, Smalls, Williams, Wolfman & Egede, 2016). Do such perceptions and anxieties during the formative years of adolescence lead to a higher prevalence of T2D? The existing literature has left this important question unanswered.

Cognitive ability and personality in early life

Including cognitive ability and personality in models of T2D development is important for two reasons. First, it is possible that these characteristics will explain some of the relationship between the SES measures and health outcomes; if there are differences in the prevalence of these personal traits between groups, this might explain relationships observed. Second, understanding these precursors to disease may allow for earlier and more effective interventions, particularly if specific intelligence and personality profiles respond differently to interventions.

Previous research has established relationships between health outcomes and both cognitive ability and personality (e.g., Batty et al., 2007; Deary et al., 2010). For example, although IQ is well-documented as protective against early mortality and a wide range of morbidities, researchers have debated whether IQ affects health risk directly or through some other avenue, such as through adult SES and lifestyle. Since T2D and dementia are common comorbidities (Bunn, Burn, Goodman, Rait, Norton & Robinson, 2014), contemporaneous measures of cognitive ability are subject to bias; thus it is important to note that our current studies focuses on *adolescent IQ*.

Personality characteristics, generally categorized using the Big Five taxonomy (i.e., conscientiousness, extraversion, neuroticism, agreeableness, and openness) (Gosling et al., 2003), have also been studied in relation to later-in-life health outcomes (Bogg & Roberts, 2004; Deary et al., 2010). This research has found that high conscientiousness is reliably protective against early mortality and morbidity (Chapman, Fiscella, Kawachi & Duberstein, 2009; Hill, Turiano, Hurd, Mroczek & Roberts, 2011; Kern, Friedman, Martin, Reynolds & Luong, 2009; Roberts, Kuncel, Shiner, Caspi & Goldberg, 2007; Terracciano, Löckenhoff, Zonderman, Ferrucci & Costa, 2008), and this might be driven by health behaviors (Bogg & Roberts, 2004; Turiano, Chapman, Gruenewald & Mroczek, 2015). Conscientiousness has also been linked to superior diabetes control in cross-sectional studies (Wheeler et al., 2012) and reduced risk of T2D in longitudinal studies (Goodwin & Friedman, 2006; Jokela et al., 2014; Kern et al., 2009). Mixed evidence is found for the other traits (Chapman et al., 2009; Turiano, Mroczek, Moynihan & Chapman, 2013; Wilson, Krueger, Gu, Bienias, de Leon & Evans, 2005).

This study

This study's primary innovation is the window it provides into how adolescent characteristics such as subjective SES are associated with *later-in-life T2D risk*. We posit that the stress associated with SES may be a function of both *real* and *perceived* SES, and that this measure will explain some of the mechanism through which SES impacts diabetes risk. Accordingly, this paper focuses on real, relative, and perceived SES, combined with cognitive and personal characteristics. We explore pathways from economic hardship in adolescence to health outcomes in later life with the goal of providing insights into how interventions might be tailored to individuals for maximum impact.

Methodology

Data Sources

The data for this study come from a linked subset of PT participants in 1960 and Medicare claims data from 2012. In this section, we give a brief overview of each dataset and the key variables used in our analysis.