Extended Abstract

Title: The relationship between population aging and macroeconomic changes to the growth in global diabetes prevalence between 1990 and 2008.

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Introduction

The burden of diabetes has grown tremendously in the past 30 years due to more people developing the disease and surviving to older ages (Amos, McCarty, & Zimmet, 1997). Globally, studies estimate that 194 million people developed diabetes between 1980 and 2008 (Danaei et al., 2011) and an additional 150-200 million people will develop diabetes by the year 2030 (King, Aubert, & Herman, 1998; Shaw, Sicree, & Zimmet, 2010; Whiting, Guariguata, Weil, & Shaw, 2011; Wild, Roglic, Green, Sicree, & King, 2004). The global prevalence of diabetes increased from 4% in 1995 to 6% in 2010. The projected prevalence in the year 2030 is estimated to be between 4-8% (King et al., 1998; Shaw et al., 2010; Wild et al., 2004).

Diabetes has significant health consequences globally. In 2010, almost 4 million global deaths could be attributed to diabetes—making diabetes responsible for 7% of global all-age mortality (Roglic & Unwin, 2010). Diabetes is the 17th leading cause of DALYs, however, diabetes increases the risk of both ischemic heart disease and cerebrovascular disease, which are the 2nd and 3rd cause of DALYs (Murray, Jamison, Lopez, Ezzati, & Mathers, 2006). Diabetes is also one of the three greatest contributors to years lived with disability (Vos et al., 2013).

The influence of macroeconomic factors and population aging on diabetes prevalence is poorly understood. The impact of economic development and greater national investment in health on life expectancy and mortality rates has been extensively studied (Babones, 2008; Basu, Yoffe, Hills, & Lustig, 2013; Due & Damsgaard, 2009; Ruhm, 2004) but this research has not been extended to diabetes. Although many studies link rising rates of diabetes and other chronic non-communicable diseases to the processes of globalization, urbanization, and economic development, very little empirical evidence exists on the relationship between macroeconomic changes and country level diabetes prevalence. Furthermore, few studies quantify the growth in diabetes attributable to population aging, and these studies all have significant limitations (Boyle et al., 2001; Danaei et al., 2011; Leibson, O'Brien, Atkinson, Palumbo, & Melton, 1997).

The primary aim of this paper was to quantify the growth in the global prevalence of diabetes between 1990 and 2008 for people aged 20 to 100, and identify population factors associated with this growth. This was accomplished by first using decomposition analysis to estimate the percentage of the growth in global diabetes prevalence attributable to age and gender composition changes between 1990 and 2008; then, removing the effect of age and gender compositional changes by standardizing diabetes prevalence across countries, performing multivariable regression analysis to identify macroeconomic factors that might explain the growth in diabetes prevalence not attributable to demographic changes.

Data and Methods

We used published data on age and sex-specific counts of people with diabetes, world population estimates and projections, and macroeconomic variables to quantify the contribution of aging and macroeconomic changes to diabetes growth. To ensure comparability and consistency across years and countries, counts of the number of people aged 20-100 with diabetes by 10-year age and sex groups for 193 countries were taken from recent data published by Danei et al, 2011. Age-specific population estimates were collected from the United Nations

World Population Prospects, 2010 report. Estimates of macroeconomic variables for each country were taken from the World Bank World Development Indicator database.

Decomposition analysis was performed to assess the contribution of aging to the growth in diabetes prevalence. The decomposition equation consists of two parts: (1) the growth in diabetes attributable to age-composition changes and (2) the growth in diabetes attributable to age-specific prevalence changes. The difference in crude diabetes prevalence between 1990 and 2008 was split into the growth in diabetes prevalence attributable to changes in the age and gender composition of the global population and the growth in diabetes prevalence attributable to changes in the age and gender specific prevalence of diabetes. This analysis was then repeated among the high-income and low to middle-income countries separately.

Despite limited research on the relationship between diabetes prevalence and macro-level variables, the relationship between mortality and macroeconomic changes is rich—key variables were identified based on this literature, including, gross national income per capita, female labor force participation, unemployment rate, health expenditure per capita, foreign direct investment, and percent of the population residing in urban areas. To control for differences in demographic compositions between countries prior to conducting regression analysis, diabetes prevalence was age and gender standardized across all countries and years using the year 2000 global population distribution as a standard.

The relationship between each key variable and diabetes prevalence was examined cross-sectionally and longitudinally using linear regression models in different specifications: bivariate cross-sectional, longitudinal year fixed effects, longitudinal global region and year fixed effects, and longitudinal country and year fixed effects. Year fixed effects models control for unobserved processes related to specific years, such as recessions and the introduction of new technologies, while region and country fixed effects models additionally control for unexamined time-invariant differences between global regions and countries.

Results

Diabetes prevalence has grown by 1.95% points globally between 1990 and 2008, with a 2.69% point growth in high-income countries and a 1.77% point growth in LMICs (Table 1). Globally, 19.17% of the growth in diabetes between 1990 and 2008 is attributable to age-composition changes, with 80.83% of the growth attributable to increases in the age-specific prevalence of diabetes. The effect of aging is smaller for LMICs with only 17.7% of diabetes prevalence growth attributable to age-composition changes. In high-income countries, 28.89% of the growth of diabetes prevalence between 1990 and 2008 can be attributed to changes in the age-composition.

After removing the effect of population aging, a number of variables appeared to be correlated with diabetes prevalence. Based on preliminary regression results (Table 2), we found evidence that GNI per capita, female labor force participation, foreign direct investment, and health expenditure per capita have an impact on diabetes prevalence. Labor force participation could be associated with reduced diabetes prevalence by both increasing income and mediating diet and activity levels. Furthermore, health expenditure per capita could impact diabetes prevalence through returns on investment in health in the form of better preventive and curative care. Foreign direct investment net inflows could represent the influence of globalization through changing dietary patterns, greater reliance on automobile transport, and increased sedentary behaviors.

Conclusion and Next Steps

Understanding the determinants of diabetes growth is essential for planning the prevention and management of the global diabetes epidemic. With populations across the world living longer and growing older, quantifying the contribution of population aging to diabetes growth is key to setting funding priorities and preparing health systems for aging populations. Furthermore, quantifying the relationships between macro-level factors and diabetes prevalence is critical to policy formulation by revealing how manipulations to macroeconomic factors through policy might impact diabetes prevalence. Based on our analysis, population aging is only responsible for a small percentage of the growth in diabetes prevalence between 1990 and 2008. GNI per capita, female labor force participation, foreign direct investment, and health expenditure per capita might all be responsible for the portion of diabetes growth not attributable to population aging.

Our next steps are to refine the regression results through sensitivity analyses, diagnostics, and alternative model specifications. In addition to using standardized diabetes prevalence as an outcome, we plan to look at the effect of the main variables on age and gender specific diabetes prevalence to develop a clearer picture of the age and gender pattern of diabetes.