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The contribution of urbanization to non-communicable diseases: Evidence from 173 countries from 1980 to 2008

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ABSTRACT

It is widely believed that the expanding burden of non-communicable diseases (NCDs) is in no small part the result of major macro-level determinants. We use a large amount of new data, to explore in particular the role played by urbanization – the process of the population shifting from rural to urban areas within countries – in affecting four important drivers of NCDs world-wide: diabetes prevalence, as well as average body mass index (BMI), total cholesterol level and systolic blood pressure. Urbanization is seen by many as a double-edged sword: while its beneficial economic effects are widely acknowledged, it is commonly alleged to produce adverse side effects for NCD-related health outcomes. In this paper we submit this hypothesis to extensive empirical scrutiny, covering a global set of countries from 1980–2008, and applying a range of estimation procedures. Our results indicate that urbanization appears to have contributed to an increase in average BMI and cholesterol levels: the implied difference in average total cholesterol between the most and the least urbanized countries is 0.40 mmol/L, while people living in the least urbanized countries are also expected to have an up to 2.3 kg/m^2 lower BMI than in the most urbanized ones. Moreover, the least urbanized countries are expected to have an up to 3.2 p.p. lower prevalence of diabetes among women. This association is also much stronger in the low and middle-income countries, and is likely to be mediated by energy intake-related variables, such as calorie and fat supply per capita.

1. Introduction

There is abundant evidence on the substantial disease burden caused by non-communicable diseases (NCDs) and risk factors (Danaei et al., 2006; Ezzati et al., 2002; Lewington et al., 2002, 2007), not only in high- but also in low- and middle-income countries (LMICs). According to recent WHO estimates, NCDs were responsible for 68% of the world's deaths in 2012, with more than 40% of those considered as 'premature', i.e. occurring before the age of 70. Almost three quarters of all NCD deaths and the vast majority (82%) of premature deaths occur in LMICs (WHO, 2014). NCDs and related risk factors, including hypertension, obesity, hypercholesterolemia and diabetes may also lead to complications impairing people's ability to live active and productive lives (Suhrcke et al., 2006).

It is widely believed that the expanding burden of NCDs is in no small part the result of major macro-level drivers (Hanefeld, 2015). In this paper we make use of a large amount of new data to explore in particular the role played by urbanization – the process of the population shifting from rural to urban areas within countries (Allender et al., 2008). Urbanization is a factor that is commonly viewed as double-edged sword: while otherwise known to promote higher living standards (Cochrane, 1983), or economic growth – at least up to a point (Henderson, 2003) – some public

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health researchers and advocates have emphasised the allegedly negative side-effects that urbanization may have in terms of enhancing the prevalence of NCD-related risk factors (Allender et al., 2011). Should these claims stand up to further empirical scrutiny – which is what we seek to provide here – then there may be a more informed case for policy to seek ways to confront the challenge of harnessing the benefits of this major macro process while at the same time avoiding its potential collateral damage.

Why might urbanization contribute to the spread of NCD-related risk factors? First, urbanization may be related to the nutritional transition towards diets high in saturated fats, sugar and calories (Popkin, 1999), thereby contributing to the spread of obesity, diabetes and high blood pressure. Such diets can also contribute to higher total blood cholesterol levels (Howell et al., 1997; Sacks and Katan, 2002; Schaefer et al., 2009). Second, urbanization may be related to the reduction in energy expenditure because of the structural economic transition from agriculture to less physically demanding service employment (Popkin, 1999). Urbanization may also lead to less energy expenditure for a number of other reasons, for example because of greater car use and lower level of physical exercise (Monda et al., 2007).

Owing to the efforts of the Global Burden of Metabolic Risk Factors of the Chronic Diseases Collaborating Group, we are now in a position to explore quantitatively how four major NCD-related risk factors – average body mass index (BMI), average total cholesterol (TC), mean systolic blood pressure (SBP) and the prevalence of diabetes – respond to urbanization in a large, global set of countries, using annual data from 1980 to 2008, separately by gender. We also explore two potential pathways through which urbanization may be linked to these risk factors.

The contribution of our paper is in bringing together several unique datasets, in order to rigorously examine, for the first time to our knowledge, the role of urbanization (defined as the proportion of people living in urban areas, as per national statistical offices), using data from 173 countries, spanning 29 years (1980–2008). Crucially, the longitudinal nature of the data makes it possible to control for country fixed effects, reinforcing the causal interpretation of our estimates.

2. Study data and methods

2.1. Data source and measures

We combine data from several sources, for the period 1980–2008, over which our outcome variables of interest are available. Data on NCD risk factors are taken from the Global Burden of Metabolic Risk Factors Project of the Chronic Diseases Collaborating Group at Imperial College London (2014). In particular we use age-standardized country-level average BMI, TC and SBP levels and diabetes prevalence, for adults aged 20 years and older. Briefly, the data have been estimated on the basis of a large number of surveys, articles and epidemiological studies (Danaei et al., 2011a,b; Finucane et al., 2011). Although as much effort as possible was made to obtain the actual estimates from the epidemiological literature, in a minority of cases the data was unavailable. Such missing data was modelled as a function of time-varying, country-level economic, demographic and epidemiological characteristics. Furthermore, in order to reduce the impact of short-term fluctuations in the predictor variables over time, their weighted averages were used, with decreasing weights for observation more distant in the past. The prediction Bayesian models were fit using Markov Chain Monte Carlo algorithm.

This dataset was recently used to study, for example, the association between market deregulation, fast food consumption and BMI (De Vogli et al., 2014b), and to estimate the "ideal" GDP per capita level at which the economic activity is sustainable in terms of CO_2 emissions, and healthy BMI levels (Egger et al., 2012). Similar data was also recently used to estimate population-level associations between nutrient intake and average BMI, glucose and cholesterol levels (Dave et al., 2016). Using these data, Doytch et al. (2016) found that both caloric intake and physical inactivity can partly explain the impact of GDP per capita and labour force participation on average BMI.

Data on the proportion of people living in urban areas (i.e. the urbanization rate) are from the World Bank's World Development Indicators (WDI).[1] This data is originally collected by the national statistical offices, but is further smoothed by the United Nations Populations Division. Specifically, "percentages urban are the numbers of persons residing in an area defined as "urban" per 100 total population".[2] Additional control variables are from the WDI (population growth rate (annual, %); population density (per square km of land area); services value added (as a % of GDP); logarithm of the GDP per capita (constant 2005 US$); proportion of the population aged 16–64 years; proportion of the population who are female), FAOSTAT[3] (food supply, kcal/capita/day; fat supply, g/capita/day).

2.2. Analytic methods

In our empirical analysis we include control variables that account for countries' differential propensities to urbanize, and which also influence NCD risk factors and conditions. First, we control for both the population growth rate and population density, as they may be associated with both urbanization (Canning, 2011) and average population health (Hinrichsen and Robey, 2000). We also control for two other potential correlates of urbanization – proportion of population who are female, as well as proportion of population of working age (aged 15–64 years). We also control for the level of economic development, either by splitting countries into income groups (as described below), or by controlling for the gross domestic product (GDP) per capita in the pooled models. In addition, following Glaeser (2014), we control for agricultural productivity measured as cereal yield in kilograms per hectare times hectares per capita, as this was shown to be a driver of urbanization, both theoretically and empirically (Glaeser, 2014). Second, we account for all relevant time-invariant, country-level factors that may affect both NCDs and urbanization, such as – among others – geographical and institutional characteristics, by controlling for country fixed effects. Third, we include a general time trend, as well as ten region-specific[4] time trends to control for any common regional factors that may be changing over time. Forth, to account for the possibility that the outcome variable may simultaneously affect the independent variable of interest, we lag urbanization by one period in all specifications.

More formally, our main equation is as follows:

$$Y_{it}^{j} = \alpha + \beta_1 X_{it-1} + \mathbf{Z}'_{it}\beta_2 + \alpha_i + \epsilon_{it} \quad (1)$$

where Y_{it}^{j} is one of the four outcome variables j associated with country i at time t; X_{it-1} is lagged urbanization; $\mathbf{Z}_{it}$ is the vector of control variables as described above, including general and region-specific time trends, with the associated parameter vector β_2; α_i are country fixed effects, possibly correlated with X and $\mathbf{Z}$, and ε_{it} is an error term. Due to the fact that ε_{it} might exhibit serial correlation, even conditional on time trends, we estimate cluster-robust standard errors (clustered at the country level).

[1] http://data.worldbank.org/data-catalog/world-development-indicators.
[2] http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS.
[3] http://faostat.fao.org/.
[4] The regions are: Sub-Saharan Africa; Latin America and Caribbean; East Asia; Mediterranean and North Africa; Eastern and Southern Europe; Former Soviet Union; North America; Pacific; South Asia; Western Europe.