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Large-scale societal factors and noncommunicable diseases: Urbanization, poverty and mortality spatial patterns in Argentina

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ABSTRACT

Introduction: In developing countries, the rapid increase in noncommunicable diseases burden has been accompanied by socio-demographic changes, such as rapid urbanization, with persistence of considerable socio-economic gaps between populations. In Argentina, cardiovascular diseases (CVD) and cancer are leading causes of death. The aim of this study was to identify geographic clustering of mortality rates related to both diseases in Argentina and to assess their association with two large-scale societal factors, urbanization and poverty contexts.
Materials and methods: We performed an ecological study in Argentina (n = 525 counties), 2009–2011 period. Using spatial analysis techniques we identified and mapped spatial clusters of high and low values for age-standardized mortality rates (ASMR) of cancer or CVD and for selected urbanization and poverty indicators. We estimated incidence-rate ratios using two-level *Poisson* regression models, which accounted for rates distribution spatial variability.
Results: Cancer and CVD mortality rates distribution were spatially dependent. Population growth showed an inverse association with ASMR from these causes, for both sexes. We detected an additive interaction of effects between urban scale and poverty level, being the "rural poverty" associated with an increasing risk of mortality by cancer (in both sexes) or by CVD (only men), compared to contexts with high urban scale and low poverty level. Counties with an intermediate urban scale seem to present the most favorable context, even when their socio-economic conditions are more unfavorable than those with higher urbanization levels.
Conclusions: Geographical differences in urban and socioeconomic contextual conditions can explain spatial variation in NCD mortality burden in Argentina.

1. Introduction

Noncommunicable diseases (NCD) are the leading mortality cause of death worldwide, with the majority of death occurring in low- and middle-income countries. In Argentina, NCD account for 81% of total deaths, being cardiovascular diseases (CVD) and cancer responsible for almost half of all deaths (World Health Organization, 2014a).

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While common behavioral or metabolic/physiological risk factors for NCD are well established at the individual level, currently researchers are looking at the role of large-scale societal forces that drive NCD, including ageing, the globalization of unhealthy lifestyles, and rapid urbanization (World Health Organization, 2014b). Nevertheless, pathways underlying these "upstream" determinants of NCD are not completely understood, especially in low- and middle-income countries (Ebrahim et al., 2013).

Although the growing epidemic of NCD has been described as a global phenomenon, the spatial distribution of their burden indicators varies greatly both between and within countries. Based on the idea that people's lifestyles and the conditions in which they live strongly influence their health (Wilkinson and Marmot, 2003), the Spatial Epidemiology assumes that geography defines the spatial context and character in which health risks occur (Beale, Abellan, Hodgson, & Jarup, 2008). Thus, it may be thought that behind the spatial patterns of diseases burden often underlie some health inequities, reflecting, in turn, inequitable distribution of its determinants.

Particularly, the Social Determinants of Health (SDH) approach puts its interest in those conditions in which individuals live, work and age, and the wider set of forces and systems shaping the conditions of daily life (World Health Organization), as main determinants of health outcomes in populations. From this perspective, models have been proposed which, in general, identify constituents ranging from the most distal factors at societal-level to a set of individual-level influences (behavioral/physiological) (Graham, 2004). It is remarkable that the conception of nested and correlated data structures that underlie the conceptual model of SDH is the basis of multilevel analytical approach (Kawachi, Subramanian, & Almeida-Filho, 2002). Accordingly, our study focused on two large-scale societal factors, urbanization and poverty, addressed from the multilevel modeling framework and mapping.

The influence of urbanization on health is complex, context-specific and closely related to socioeconomic determinants. In fact, if we assume that it is linked to economic growth and development, we would expect a favorable impact on health due to its potential to minimize socioeconomic disadvantages. However, urban life has also been associated with environmental risk exposures (i.e., air pollution and occupational hazards) (Gong et al., 2012) and risks conferred by behavioral changes such as unhealthy diet and sedentary life (Angkurawaranon, Jiraporncharoen, Chenthanakij, Doyle, & Nitsch, 2014a, Angkurawaranon, Jiraporncharoen, Chenthanakij, Doyle, & Nitsch, 2014b; Gong et al., 2012; Leon, 2008). In addition, it should be noted that, although there is strong evidence that poverty has traditionally been deeper in rural areas than in cities, nowadays, the growing concentration of harsh poverty within cities, especially in developing countries (UNFPA, 2007), reinforces the importance of disentangling the complex linkage between urbanization, poverty and health.

In Latin America and the Caribbean, the most urbanized region in the world, rapid urban growth in the last decades has been highlighted as a megatrend that affects people's well-being (PAHO, 2012). In turn, Argentina is among the countries with a long-standing process of urbanization and with a highly urban population (UN & CELADE, 2009). Even when census results indicate that 91% of population is living in urban areas, there is a notable heterogeneity in the country, which has been related to quality of life in this population (Velázquez, 2010). Besides, the last national census reports that over a million households have at least one basic need unsatisfied, 83.5% of which belong to urban areas.

Socio-demographic scenario in the Latin American region has been widely studied. However, little is still known about large-scale societal factors underlying the spatial distribution of NCD burden statistics in developing countries. Therefore, our aims were: a) to identify geographic clustering of mortality rates of cancer and CVD in Argentina (2009–2011), and b) to assess their association with two larger-scale societal factors, urbanization and poverty contexts.

2. Materials and methods

2.1. Study design and data

We performed an ecological study, including two hierarchical administrative divisions of Argentina: 525 counties (510 departments and 15 communes in Buenos Aires City), nested into 24 provinces (23 plus the Autonomous City of Buenos Aires, excluding Argentine Antarctica and the South Atlantic Islands). We calculated sex-specific and age-standardized mortality rates (ASMR, *per* 100,000 persons/year) by direct method (national population of 2010 census as standard) for selected causes (ICD-10th revision codes: C00-C97 for cancers and I00-I99 for CVD) and for each geographical unity (county). The average of 2009–2011 ASMR was used to control the influence of small-area estimation, which is expected in counties with small population size.

Beyond the simplified notion of urbanization as the proportion of people living in areas defined as urban, this phenomenon represents a complex demographic process that involves several aspects, such as the population distribution on the urban-rural space, the speed and scale of urban growth, and the organization of the urban system. Thus, our convention for "urbanization" encompasses two main features: the speed of population growth (as *proxy* of urban population growth) and the organization of the urban system measured by county urban scale. We include the following indicators: a) average annual population growth (defined by the National Institute of Statistics and Censuses -INDEC- as the average annual change of population size during the 2001–2010 period, *per* thousand inhabitants) and b) urban scale (category based on the largest urban agglomeration within each administrative division in 2010). We define urban scale variables taking into account the six category scale proposed by Velázquez et al. (2016). For interpretation, we transformed this scale as follows: a) big cities and large middle-sized cities (of 400,000 or more inhabitants); b) intermediate middle-sized cities (399,999-50,000 inhabitants); c) small cities and villages (49,999-2000 inhabitants); and d) towns and rural population (less than 2000 inhabitants).

We chose the percentage of households with Unsatisfied Basic Needs (UBN) as poverty indicator for each sampling unit. This indicator is extensively used as a structural poverty index in Latin American counties. From the basic needs approach, poverty was defined on the basis of socially determined needs that an individual, and hence her households, must satisfy in order to participate fully in society (ECLAC & UNICEF, 2005). Thus, if the access of previously established basic needs, such as housing, sanitation facilities, attendance to school and livelihood, are not met by households, they are considered poor.

No ethical review was required as it involved anonymized records and datasets existing in the public domain.

2.2. Data sources

In order to calculate ASMRs, we used the number of certified deaths provided by the National Health Ministry and estimated the population size by exponential interpolation of 2001 and 2010 population census data, published by the INDEC. Population growth information was obtained through the INDEC Report of the 2010 National Population, Household and Housing Census final results. Poverty indicator was obtained by processing of this official census database using REDATAM software (Redatam + SP, ECLAC/United