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Productivity losses due to premature mortality from cancer in Brazil, Russia, India, China, and South Africa (BRICS): A population-based comparison

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ABSTRACT

Background: Over two-thirds of the world's cancer deaths occur in economically developing countries; however, the societal costs of cancer have rarely been assessed in these settings. Our aim was to estimate the value of productivity lost in 2012 due to cancer-related premature mortality in the major developing economies of Brazil, the Russian Federation, India, China and South Africa (BRICS).

Methods: We applied an incidence-based method using the human capital approach. We used annual adult cancer deaths from GLOBOCAN2012 to estimate the years of productive life lost between cancer death and pensionable age in each country, valued using national and international data for wages, and workforce statistics. Sensitivity analyses examined various methodological assumptions.

Results: The total cost of lost productivity due to premature cancer mortality in the BRICS countries in 2012 was $46·3 billion, representing 0·33% of their combined gross domestic product. The largest total productivity loss was in China ($28 billion), while South Africa had the highest cost per cancer death ($101,000). Total productivity losses were greatest for lung cancer in Brazil, the Russian Federation and South Africa; liver cancer in China; and lip and oral cavity cancers in India.

Conclusion: Locally-tailored strategies are required to reduce the economic burden of cancer in developing economies. Focussing on tobacco control, vaccination programs and cancer screening, combined with access to adequate treatment, could yield significant gains for both public health and economic performance of the BRICS countries.

1. Introduction

Over two-thirds of the world's 8.2 million cancer deaths occur in low and middle income countries [1]. The high proportion of cancer mortality in developing countries is likely to increase given trends such as population ageing, changes in socioeconomic conditions and the westernisation of lifestyles [2].

The burden of cancer in developing countries has typically been described using the core indicators of incidence, mortality, and survival [2,3]. Beyond the evident public health impact, cancer also imposes economic costs on individuals and society [4]. These costs include lost productivity − where society loses the contribution of an individual to the market economy because they died prematurely from cancer. Valuing this lost production provides policy- and decision-makers with an additional perspective when identifying priorities for cancer prevention and control. This is particularly important in developing economies, where

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Table 1
Baseline demographic, cancer mortality and economic inputs for the BRICS countries.

Country	Population (millions) 2012[3]	Total cancer deaths excl. NMSC[3] (% of all deaths) [19], all ages, 2012	Life expectancy at birth/at age 65[13]	Monthly wage – local currency [16]	Monthly wage (2012 USD)[a]	Wage growth rate[b] [17]	2012 GDP (billion USD)[20]	Sex	Workforce participation (e.g. age 40–45) [12]	Un-employment rate (e.g. age 40–45)[12]	Pension age[13]
Brazil	198	224,694 (17%)	73·8/18·2	1588 (Reals 2011)	$ 1069	2·0%	2247	Male Female	93·6 71·4	2·2 4·8	65 60
Russian Federation	143	295,357 (15%)	68·0/13·9	23,693 (Ruble 2011)	$ 1340	2·4%	1990	Male Female	94·2 91·2	4·1 3·5	60 55
India	1258	682,830 (7%)	66·4/13·7	6273 (Rupee 2010)	$ 415	4·2%	1873	Male Female	98·1 37·1	1·1 1·4	60 58[c]
China	1361	2,205,946 (24%)	75·3/15·6	3045 (Yuan 2010)	$ 912	3·7%	8229	Male Female	96·5 84·8	1·9 2·6	60 50[d]
South Africa	51	47,350 (7%)	57·0/12·9	12,631 (Rand 2011)	$ 2631	2·8%	382	Male Female	85·5 67·1	15·7 17·2	60 60

BRICS: Brazil, Russian Federation, India, China, South Africa; excl.: excluding; GDP: Gross Domestic Product; NMSC: non-melanoma skin cancer; USD: United States Dollars.
[a] Adjusted to USD using Purchasing Power Parity [12], and then adjusted to 2012 dollars using USD inflation (2·1% between 2011 and 2012, and 5·3% (accumulated) between 2010 and 2012) [21].
[b] Calculated as the average projected wage growth rates from 2011 to 2060 [17].
[c] Because 5-year age groups were used in the analysis, pensionable age of 58 was rounded up to 60.
[d] Based on the pensionable age of female blue-collar workers.

workforce and productivity are key resources in ensuring sustained economic growth.

Previous work estimating lost productivity due to cancer has focussed on Europe and the United States (US) [5]. The impact on low and middle income economies has been less well studied – only Iran has estimates of cancer-related lost productivity [6,7]. Developing economies and those 'in transition' [8] (hereafter referred to collectively as developing economies) often have different demography, exposure to cancer risk factors, and economic environments than developed countries; all of which could modify the economic impact of cancer. For example, developing countries have younger populations and lower life expectancy [3], higher rates of communicable diseases and infection-related cancers [2], and lower workforce participation among women [4].

The aim of this study was to estimate – for the first time – the value of productivity lost due to cancer-related premature mortality in Brazil, the Russian Federation, India, China, and South Africa (collectively known as the BRICS countries) in 2012. We elected to focus on the BRICS countries, as they are diverse in terms of wealth, health indicators and health care systems, yet have all have had particularly rapid demographic and economic growth. Currently the five countries combined comprise over 40% of the world's population [9], 25% of global gross domestic product (GDP) [9], and 42% of the world's cancer deaths [2].

2. Methods

2.1. Approach

This study was a population-based cross-country cost analysis to estimate productivity losses from cancer deaths in persons of working age (15 to pensionable age) in 2012. An incidence-based method was used, to account for the productivity lost throughout the lifetime of those who died from cancer in the year 2012 [5].

The study took the Human Capital Approach, but also provided results for the years of life lost to allow the equivalent Friction Cost Approach estimates to be derived by readers if desired (and if the other required data are available). The Human Capital Approach is the traditional approach to calculating lost productivity, and calculates the present value of potential time in the workforce (the measure of productivity) using market wages [10]. In response to criticisms of the Human Capital Approach, the Friction Cost Approach has been developed to measure actual rather than potential productivity loss [11]. It calculates losses only for the period it takes to replace a worker in the workplace, known as the friction period [11]. However, this requires data on the length of the friction period, the elasticity of labour supply and other details of macroeconomic conditions, which are often not known [5], and particularly uncertain in rapidly developing countries such as those included in this study. Two other approaches have also been proposed – the Washington Panel Approach and the willingness to pay approach, however currently neither of these are recommended by pharmacoeconomic guidelines [5].

2.2. Data sources

The GLOBOCAN project uses country specific data and methods to estimate cancer incidence, mortality and prevalence for 168 countries worldwide. The most recent available GLOBOCAN data for the BRICS countries were used to derive 2012 cancer mortality rates for all invasive cancers (except non-melanoma skin cancer) and 28 cancer types by country, sex and age group (15–39, 40–44, 45–49, …, 60–64 years) [3]. Economic data on workforce participation and unemployment rates in 2012 were obtained from the Organisation for Economic Co-operation and Development (OECD), by sex and age-group (15–19, 20–24, …, 60–64 years) [12]. Pensionable ages for each country by sex in 2012 were taken from the OECD [13]. Standardised life tables were used to calculate country- and sex-specific life expectancy to pension age [14,15]. Average wages for each country were used [16], with future wage growth based on average projected GDP growth from 2010 to 2060 [17]. The recommended discount rate of 3% was applied [18]. Unable to identify high quality BRICS data for unpaid productivity losses, or losses incurred prior to death, we excluded these from our analysis. Table 1 shows the data inputs for each country.

2.3. Data analysis

For each cancer death in working age persons, years of productive life lost (YPLL) were calculated as the difference between pensionable age and age at death from cancer (based on the age group mid-point),