The economic cost of physical inactivity in China

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A B S T R A C T

Objective. To estimate the total economic burden of physical inactivity in China.

Method. The costs of physical inactivity combine the medical and non-medical costs of five major Non Communicable Diseases (NCDs) associated with inactivity. The national data from the Chinese Behavioral Risk Factors Surveillance Surveys (2007) and the National Health Service Survey (2003) are used to compute population attributable risks (PARs) of inactivity for each major NCD. Costs specific to inactivity are obtained by multiplying each disease costs by the PAR for each NCD, by incorporating the inactivity effects through overweight and obesity.

Results. Physical inactivity contributes between 12% and 19% to the risks associated with the five major NCDs in China, namely coronary heart disease, stroke, hypertension, cancer, and type 2 diabetes. Physical inactivity is imposing a substantial economic burden on the country, as it is responsible alone for more than 15% of the medical and non-medical yearly costs of the main NCDs in the country.

Conclusions. The high economic burden of physical inactivity implies the need to develop more programs and interventions that address this modifiable behavioral risk, in order to curb the rising NCDs epidemic in China.

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Introduction

Non-Communicable Diseases (NCDs) are China’s leading cause of death, as they are estimated to account for 85% of annual deaths in the country (MOH & China CDC, 2011). Similar to other regions worldwide, NCDs in China are largely due to modifiable risk factors, namely tobacco use; unhealthy diets and excessive energy intake; and physical inactivity (Hu et al., 2011; Wang et al., 2005; Yang et al., 2011a, 2011b). While the public health burdens of the tobacco and obesity epidemics in China are somewhat well-studied (Popkin, 2008; Yang et al., 2011a), physical inactivity has remained an under-researched field in this country.

Rapid modernization and urbanization have been associated with increased sedentary lifestyles in China. Physical activity has been dropping at an alarming rate: Between 1991 and 2006, average weekly physical activity among adults fell by more than a third (Ng et al., 2009). China has recently experienced the highest rates of decline in physical activity compared to the US, the UK, Brazil and India (Ng and Popkin, 2012). In parallel, the incidence of NCDs increased substantially: For instance, between 1993 and 2003, the prevalence of cardiovascular diseases increased from 31.4 to 50.0%, and diabetes from 1.9 to 5.6% (Wang et al., 2007). The 2007 Chinese Behavioral Risk Factors Surveillance Survey (BRFSS) reported 31.1% of Chinese aged 15–69 not meeting the targets for healthy levels of physical activity of at least 30 min of moderate intensity activity on ≥5 days per week, or at least 20 min of vigorous intensity activity on ≥3 days per week (China CDC, 2010). The 2010 BRFSS reported that 11.9% of Chinese aged 18 and above reported participating in physical activity regularly, i.e., at least 3 times per week, and at least 10 min for recreational physical activities, and 83.8% reported not doing any physical activities at all (China CDC, 2011).

Recently the Chinese Government recognized the importance of healthy eating and active lifestyles in reducing NCDs, by making them integral components of the Healthy China 2020 Plan (Hu et al., 2011). Within this context, our study provides a recent scientific estimate for the economic cost of physical inactivity in China, using the latest available national data in 2007. Evaluating the economic burden of physical inactivity in this country can help policymakers further justify the importance of investments in public health initiatives promoting physical activity.

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The BRFSS measures physical activity using the validated GPAQ instruments, 16 items, which collected physical activities in three domains including work-related, leisure time, and transport-related activities.
Methods

The economic costs of physical inactivity are evaluated using the cost-of-illness approach, where the medical and non-medical costs of NCDs associated with inactivity are evaluated (Oldridge, 2008). The economic costs linked to inactivity-related NCDs include direct and indirect costs. Direct health care costs typically include hospital care expenditure, drug expenditures, physician care expenditures, and additional direct health expenditures (other professionals, public health, health research, prepayment administration, etc.). Indirect costs are defined as the value of economic output lost because of illness, injury-related work disability, or premature death before retirement. Our economic estimates are innovative and holistic, as we assess both the economic costs of NCDs directly caused by physical inactivity (Allender et al., 2007; Colditz, 1999) and those caused by physical inactivity through overweight and obesity (Popkin et al., 2006).

The method involves three steps:

1. Identification of diseases where physical inactivity is a risk factor.
2. Identification of the Population Attributable Risks (PARs) for each disease.
3. Application of these PARs to direct costs and indirect costs of these diseases, to calculate the direct costs and indirect costs due to physical inactivity.

A PAR indicates the proportion of disease that can be attributed to a particular risk factor. The PAR for each disease was calculated as \[ \frac{P(RR - 1)}{1 + P(RR - 1)} \], where \( P \) is the prevalence of physical inactivity in the population and \( RR \) is the relative risk for the disease in an inactive person (Popkin et al., 2006). The cost of physical inactivity was calculated by applying the PARs for diseases related to physical inactivity to disease-specific costs. This study used the diseases having some relationship with physical inactivity and account for the major NCDs in China, namely coronary heart disease, stroke, hypertension, cancer, and type 2 diabetes.

Our methodology maps the impact of physical inactivity on chronic diseases through three channels: a direct one (inactivity to NCDs); and two indirect channels (inactivity through overweight, and inactivity through obesity). Note that the independent epidemiological relationship between physical activity levels and disease risk is well established in the literature, as most empirical studies have included obesity-related indicators as covariates in their analysis (Katzmarzyk, 2010; Katzmarzyk and Janssen, 2004). In our model we therefore need epidemiological statistics on the relative risks of NCDs due to inactivity, overweight and obesity; and the relative risks of overweight and obesity due to inactivity. To compute the above two statistics, we rely on data from the Chinese 2002 National Nutrition and Health Survey, which was used by Ma et al. (2007) to study the linkages between physical activity and overweight and obesity. Ma et al. divided their data into four groups according to the level of physical activity (sedentary, low active, active, very active) and computed the rates of overweight and obesity as compared to the incidence of normal weight among these groups. We have grouped for the sake of our analysis the data into sedentary or low active (physically inactive), and active or very active (active), and found that the rate of overweight and obesity in the inactive group was 28.1% vs. 21.3% in the active group, and the rate of normal weight in the inactive group was 72% vs. 78.7%. The RR statistic on the linkage between obesity and inactivity (sedentary vs. physically active) is therefore RR = 1.44. As for the other RR statistics, Katzmarzyk et al. (2000) obtained the RRs of NCDs attributable to physical inactivity from large prospective epidemiologic studies for coronary heart disease, stroke, hypertension, type 2 diabetes and cancer. They pooled the RR estimates from each chronic disease group using a general variance-based method of meta-analysis based on the estimate of RR and the 95% confidence interval (CI) reported in each study. As for the RR of NCDs due to overweight and obesity, they are available in the 2007 Chinese Behavioral Risk Factors Surveillance report, in addition to estimates of the economic burden of NCDs available in the 2003 National Health Service Survey. In order to match the two sources of data we have updated the cost estimates in the 2003 survey using inflation between 2003 and 2007.

Results

Table 1 summarizes the main relative risk statistics and the corresponding Population Attributable Risk indicators for each chronic disease, using recent prevalence data: The 2007 Chinese Behavioral Risk Factors Surveillance reported that the prevalence of physical inactivity among adults was 31.1%; while the prevalence of overweight was 25.8% and the prevalence of obesity was 7.6% (China CDC, 2010). PARs show for instance that inactivity is directly responsible for 16% of stroke cases in China, while overweight contributes 21% and obesity is 7%.

Using the fact that inactivity contributes to overweight and obesity through a relative risk of 1.44, we find that the prevalence of overweight and obesity due to inactivity was 12% in 2007. This allows the computation of the risks attributable to inactivity, both direct and indirect through overweight and obesity. Table 2 summarizes the results of these PARs. The overall risk of inactivity as a contributor to the main NCDs analyzed varies between 12% and 19%.

The last step in the analysis consists of multiplying the PARs from the previous table with the direct and indirect costs of NCDs. We use the estimates of Hu et al. (2007) which rely on the 2003 National Health Service Survey (Table 3), which reported that the economic burden of all the NCDs in China was 858 billion Yuan in 2003 (about 103.7 billion USD). Coronary heart disease, stroke, hypertension, cancer, and diabetes accounted for 31% of direct (medical) costs of all the NCDs, and 23% of the direct (medical) costs of all diseases. We have updated the 2003 cost estimates to match the epidemiological data of 2007, by incorporating inflation between 2003 and 2007. Table 4 summarizes the main direct (medical) and indirect (non-medical) costs linked to the major NCDs used in this study. By applying the PARs computed previously in Table 2, we are able to deduce estimates for the cost of each chronic illness due to physical inactivity.

The results show that physical inactivity was responsible for the 6.7 billion USD in total economic costs in 2007. This constituted 15.2% of the total costs of the major NCDs analyzed, while direct health costs due to inactivity reached 15.7% of the total direct costs of the selected NCDs.

Table 1

<table>
<thead>
<tr>
<th>Relative Risks (RRs) (95% CI)</th>
<th>Inactivity</th>
<th>Overweight (BMI 24–28)</th>
<th>Obesity (BMI &gt;28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary heart disease</td>
<td>1.45 (1.38–1.54)</td>
<td>1.31 (0.97–1.82)</td>
<td>1.74 (1.08–2.83)</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.60 (1.42–1.80)</td>
<td>2.01 (1.65–2.52)</td>
<td>1.98 (1.40–2.79)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.30 (1.16–1.46)</td>
<td>2.35 (2.22–2.40)</td>
<td>5.22 (4.81–5.66)</td>
</tr>
<tr>
<td>Cancer</td>
<td>1.41 (1.31–1.53)</td>
<td>1.20 (0.87–1.46)</td>
<td>1.50 (1.06–2.17)</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>1.50 (1.37–1.63)</td>
<td>2.37 (2.00–2.81)</td>
<td>3.90 (3.28–4.84)</td>
</tr>
</tbody>
</table>

Notes: RRs are adjusted for demographic factors and other health risk factors. BMI, body mass index; CI, confidence intervals. The cancer category mainly includes colon and breast cancer, as no information is available on other types of cancer.

2 The cost-of-illness (CoI) methodology uses a simple, widely used and easy to understand framework to compute the aggregate economic burden of chronic illnesses linked to physical inactivity. It can capture the morbidity impacts of the measured chronic diseases linked to physical inactivity, by accounting for the drop in economic performance due to morbidity. The CoI methodology however does not account for the complex dynamic interactions at the individual and societal levels brought by physical inactivity prevalence, as the costs developed should be seen as a snapshot at a specific point in time.
Discussion

Our analysis has shown that physical inactivity currently contributes between 12% and 19% to the risks associated with the five major NCDs in China, namely coronary heart disease, stroke, hypertension, cancer, and type 2 diabetes. As a result, physical inactivity is imposing a substantial economic burden on the country, as it is responsible for almost one sixth of direct (medical) and indirect (non-medical) yearly costs of the main NCDs in the country. This ratio is close to the direct medical costs attributable to obesity and overweight: Zhao et al. (2008) reported that 25.5% of the direct costs of hypertension, diabetes, coronary heart disease and strokes were attributable to overweight and obesity. The direct costs of physical inactivity are more than half than those caused by smoking: 6.2 billion USD (43 billion Yuan) was the direct medical bill linked to smoking in 2008 in China (Yang et al., 2011a), compared to our estimate of direct costs of physical inactivity of 3.5 billion USD. Using a similar methodology to the one used in this paper, Popkin et al. (2006) had found that in 2000 the direct medical costs attributable to physical inactivity in China reached 1. billion USD (Popkin et al., Table 6 page 286). Even though our results are not directly comparable to those of Popkin et al., the dramatic rise in physical inactivity has undeniably left an economic consequence, as the estimated medical costs of major illnesses caused by physical inactivity seem to have more than doubled in less than a decade.

This study has also shed light on the mechanisms through which physical inactivity causes NCDs through overweight and obesity. In China, 12% of overweight and obesity cases could be prevented if people participate in sufficient physical activity. Moreover, our findings showed that 4% of the economic costs of the five major NCDs are attributable to physical inactivity through overweight and obesity. Although the prevalence of obesity in China is not comparable to that in developed countries, the prevalence of overweight is as high as 25.8%, and the prevalence of overweight and obesity reached 33.4% in 2007. These rates are quite alarming for a country going through rapid nutritional and lifestyle transitions. Our findings for China also echo recent global evidence on the physical inactivity pandemic (Das and Horton, 2012; Lee et al., 2012), and stress the need for national as well as global interventions targeting this modifiable risk factor. Lee et al. (2012) in fact show that if physical inactivity was to be eliminated in China, then life expectancy there would increase by 0.61 years.

Promoting adequate levels of physical activity can be a cost-effective approach to save lives and reduce the economic burden of diseases. It should be one of the top priorities of NCDs prevention and control programs. The Chinese government started recently implementing the Physical Activity Regulation issued by the State Council of the People’s Republic of China, in addition to the Sunny Sport initiative which requires schools to provide at least 1 h of physical activity per day for students. The Ministry of Health also initiated the National Healthy Lifestyle for All Initiative to promote physical activity among the public.

Despite this positive progress, additional measures should be taken to ensure the adoption and implementation of these policies and interventions, in addition to the development of a surveillance system to measure the extent of implementation of the various policies and programs.

Although dramatic increases were observed in China, a higher rate of overweight and obesity was observed in urban areas compared to rural areas, and in the economically developed eastern regions compared to others. More efforts, including the National Healthy Lifestyle for All Initiative to promote physical activity among the public.

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Strengths and limitations

This study only considers the five major NCDs, rather than all the diseases. This is due to the fact that limited information exists on the relative risks of inactivity, overweight and obesity as they link to other diseases, especially for the Chinese population.

Moreover, psychological costs due to pain, suffering, loss of friends and support network, are also omitted from the human capital model. The Col physical inactivity indirect cost estimates should therefore be seen as a lower bound to the true burden imposed on society; especially that physical inactivity has been shown to contribute to depressive and anxiety symptoms (Cao et al., 2011).

Nevertheless, the costs estimated through the Col method provide an accurate snapshot of the macroeconomic financial burden of diseases at a given point in time. The economic burden estimates provide an up-to-date evidence-based analysis of the direct financial cost of physical inactivity to the Chinese society, which can be used by policymakers, health professionals and other stakeholders to lobby for the adoption of more programs and interventions which tackle this modifiable behavioral risk.

Conflict of interest statement

The authors declare that there are no conflicts of interest.
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