The Costs of Physical Inactivity in the Czech Republic in 2008

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Background: Several scientific studies estimate the burden of physical inactivity in different countries, yet in the Czech Republic, this kind of research is still missing. This paper represents one of the first attempts to quantify the costs of physical inactivity in the Czech Republic for 2008. Methods: The analysis, based on scientific literature review, uses the comparative risk assessment methodology and applies it on data available in the Czech Republic. Results: In 2008, the financial cost of physical inactivity to public health insurance companies was almost 700 million Kč, or 0.4%, of total healthcare costs. Furthermore, physical inactivity caused 2442, or 2.3%, of all deaths in 2008 and 18,065, or 1.2%, of all disability-adjusted life years in 2004. Conclusions: The costs of physical inactivity in the Czech Republic are considerable, yet slightly smaller than in other comparable studies. The obtained results could be used as an argument for policymakers when conceiving public or private health policy.

Keywords: physical activity, economic burden, cost-of-illness methodology

According to the World Health Organization (WHO) Global Strategy on Diet, Physical Activity, and Health,1 cardiovascular diseases made up 29.2% of total global deaths in 2003. In the Czech Republic, this share reached 50.2% in 2010.2 Furthermore, cancers represented 26% of all deaths in the Czech Republic in 2010.2 Together, these 2 groups caused more than three-quarters of deaths in the country, compared with the average 63% in the EU-15.3

It has been already well documented that physical inactivity is an important modifiable risk factor to many noncommunicable diseases. Warburton et al4 state in their literature review from 2006 that physical activity is associated with greater than 50% reduction in the risk of all-cause and cardiovascular-related death, 20%–30% reduction in the relative risk of female breast cancer, and 30%–40% reduction in the relative risk of colon cancer.

The Czech population is relatively physically active compared with other developed nations. Still, almost one-fifth of adults do not fulfill the WHO Global Recommendations on Physical Activity for Health guidelines from 2010.5 Furthermore, Czech children are becoming less and less active,6 so the prospects are not very favorable.

Lastly, health prevention has not gained a firm place in the Czech society and public policy yet. The preventive programs of government or public health insurance companies are oriented rather on vaccination and screening. Public or private programs that are focused on modification of health behaviors, especially an increase in individual physical activity, are rare. The quantification of costs of physical inactivity in the Czech Republic could therefore enhance the adoption and implementation of such programs.

In this study, we apply the comparative risk assessment methodology to estimate the economic burden of physical inactivity in the Czech Republic in 2008.

Methods

In our analysis, we focus on 3 types of costs:

- Economic costs of treating diseases associated with physical inactivity
- Number of deaths due to diseases associated with physical inactivity
- Burden of disease attributable to physical inactivity measured by disability-adjusted life years (DALYs).

To quantify these costs, we use the prevalence-based comparative risk assessment methodology developed by the WHO.7 To estimate the costs attributable to physical inactivity the current population exposure is compared with the counterfactual distribution. The counterfactual distribution relates to the theoretical minimum distribution within a population. We derive the counterfactual distribution for physical inactivity from the WHO study,7 where the minimum means that everyone within the population is sufficiently physically active.

The application of the comparative risk assessment methodology is divided into 5 steps:

- Determination of diseases associated with physical inactivity and their relative risks
• Determination of the prevalence of physical inactivity in the Czech Republic in 2008
• Determination of the economic costs to the public health system in the Czech Republic in 2008 for treating these diseases, the number of deaths due to these diseases, and the DALYs for these diseases
• Calculation of population-attributable fractions (PAFs) for each disease
• Application of the PAFs to economic costs, number of deaths, and DALYs data to calculate the overall burden of physical inactivity.

There is an extensive scientific discussion about which diseases are associated—and to what extent—with physical inactivity. In our study, we adopt the health outcomes from the WHO study. These diseases are listed in Table 1, together with the relative risks for each health outcome taken from the same study.

Considering the WHO 2010 Global Recommendations on Physical Activity for Health and the International Physical Activity Questionnaire methodology, we understand physical inactivity as a variable with 3 categories:

• Level 1—Inactive: doing no physical activity
• Level 2—Insufficiently active: doing some physical activity, but less than 75 minutes of vigorous activity a week, or 150 minutes of moderate activity a week, or 180 minutes of walking a week, or any combination resulting in the total of 600 MET minutes a week on at least 3 days per week
• Level 3—Sufficiently active (unexposed): doing at least 75 minutes of vigorous activity a week, or 150 minutes of moderate activity a week, or 180 minutes of walking a week, or any combination resulting in the total of 600 MET minutes a week on at least 3 days per week.

To identify the economic costs of physical inactivity to the healthcare system, we use the data from health insurance companies, which cover approximately 75% of all healthcare expenditures in the Czech Republic.

These data are monitored by the Czech Statistical Office (CZSO) and updated yearly, but they are available for main groups of diseases in ICD-10 (ie, the 10th revision of the WHO’s International Statistical Classification of Diseases and Related Health Problems) classification only. To find out the costs for our specific diagnoses, we undertook an extensive scientific literature review and contacted directly all public Czech health insurance companies:

• The Leal et al study provides data for cardiovascular, coronary heart, and cerebrovascular diseases for the Czech Republic in 2003. We calculate the percentage of coronary heart diseases within the cardiovascular diseases group and use it on data from CZSO for 2008
• We take the percentage of ischemic stroke within the cardiovascular diseases group for the General Health Insurance Company (VZP CR) and use it on data from CZSO for 2008
• To establish the costs of breast and colon cancer, we adopt the methodology from Katzmarzyk and Janssen study and use the actual incidence of these 2 cancers relative to all newly diagnosed cancers in the Czech Republic in 2008
• For diabetes mellitus type 2, we use its percentage within the endocrine diseases group for another Czech health insurance company, Metal-Aliance, convert it with the help of incidence rates of diabetes mellitus type 2 among Metal-Aliance clients and overall Czech population, and use it on data from CZSO for 2008.

Data for specific mortality in 2008 are available from CZSO. On the other hand, data for specific DALYs are not monitored annually, so we take the most recent estimates made by the WHO Global Burden of Disease study.

For calculation of population attributable fractions by each disease, we use the WHO formula with different levels of risk exposure:

<table>
<thead>
<tr>
<th>Health outcome (ICD-10 code)</th>
<th>Inactive level</th>
<th>Insufficiently active level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15–69</td>
<td>70–79</td>
</tr>
<tr>
<td>Ischemic heart disease (I20-I25)</td>
<td>1.71</td>
<td>1.50</td>
</tr>
<tr>
<td>Ischemic stroke (I63)</td>
<td>1.53</td>
<td>1.38</td>
</tr>
<tr>
<td>Diabetes mellitus type 2 (E11)</td>
<td>1.45</td>
<td>1.32</td>
</tr>
<tr>
<td>Female breast cancer (C50)</td>
<td>1.34</td>
<td>1.25*</td>
</tr>
<tr>
<td>Colon cancer (C18)</td>
<td>1.68</td>
<td>1.48</td>
</tr>
</tbody>
</table>

Physical Inactivity in Czech Republic

PAF = \frac{\sum_{i=1}^{n} P_i (RR_i - 1)}{\sum_{i=1}^{n} P_i (RR_i - 1) + 1}

where \( P_i \) is the prevalence of the exposure level \( i \), \( RR_i \) is the relative risk of disease in exposure \( i \), and \( n \) is the total number of exposure levels.

Results

The level of physical activity was determined from the 2008 Czech Republic European Health Interview Survey, which uses the International Physical Activity Questionnaire, asking respondents about their individual physical activity during the last 7 days in 4 domains (leisure time, transport, work, and house work). The prevalence of physical inactivity is represented in Table 2 by age and level of inactivity. The exposure to physical inactivity naturally rises with age; with the exception of the oldest age group, the prevalence of physical inactivity is smaller than the prevalence of insufficient physical activity. The overall percentage of population who are inactive or insufficiently active (18%) is smaller than is the average in developed countries.

Data for healthcare costs, specific mortality, and DALYs of each disease are summarized in Table 3. Diseases associated with physical inactivity represented 7.4% of the total costs of the public health insurance companies in the Czech Republic in 2008, which is comparable to other empirical studies. Specific mortality associated with physical inactivity represented 43% of all-causes mortality, as ischemic heart disease is by far the most frequent cause of death in the Czech Republic. DALYs lost due to diseases associated with physical inactivity represented 24% of all those in 2004.

Table 4 summarizes individual components of the burden of physical inactivity in the Czech Republic in

<table>
<thead>
<tr>
<th>Disease</th>
<th>Healthcare costs 2008</th>
<th>Mortality 2008</th>
<th>DALYs 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart disease</td>
<td>4903</td>
<td>25,844</td>
<td>172,000</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>3262</td>
<td>11,685</td>
<td>89,000</td>
</tr>
<tr>
<td>Diabetes mellitus type 2</td>
<td>3735</td>
<td>1979</td>
<td>27,000</td>
</tr>
<tr>
<td>Female breast cancer</td>
<td>1198</td>
<td>1674</td>
<td>21,000</td>
</tr>
<tr>
<td>Colon cancer</td>
<td>1539</td>
<td>3915</td>
<td>41,000</td>
</tr>
<tr>
<td>Total physical inactivity</td>
<td>14,637</td>
<td>45,097</td>
<td>350,000</td>
</tr>
<tr>
<td>Total</td>
<td>197,280</td>
<td>104,948</td>
<td>1,461,000</td>
</tr>
</tbody>
</table>

Sources: Czech Statistical Office, World Health Organization.
2008. About 7% of ischemic heart disease and 4% of diabetes mellitus type 2 and colon cancer are attributed to physical inactivity. Furthermore, physical inactivity was associated with 3% of ischemic stroke and female breast cancer. These fractions are much lower than in other studies, which is mainly a consequence of the lower exposure to the risk factor in the Czech Republic than in other countries mentioned. With lower PAFs, all 3 components of the burden of physical inactivity in the Czech Republic in 2008 are, in general, smaller than in other surveys. Overall, physical inactivity is associated with about 0.4% of healthcare costs of public health insurance companies, 2.3% of all deaths, and 1.2% of all DALYs. Ischemic heart disease represents the biggest share of this burden: 50% of attributable costs, 74% of attributable deaths, and 67% of attributable DALYs. Diabetes mellitus type 2 represents the second highest share in attributable costs (23%), and ischemic stroke represents the second biggest part of attributable deaths (14%) and DALYs (14%).

**Discussion**

Our study quantifies the costs of physical inactivity in the Czech Republic expressed in financial costs to the public healthcare system, number of deaths, and DALYs. The analysis shows that in 2008, physical inactivity contributed nearly 700 million Kč (about €29 million), or 0.4% of total healthcare costs to public health insurance companies costs. Regarding mortality and morbidity, sedentary lifestyle was responsible the same year for 2442 of total deaths and 18,065 DALYs in the Czech Republic. A number of studies attempted to quantify the burden of ill health attributable to physical inactivity, yet most of these studies do not include in their analysis all 3 components appearing in our study.

As for the healthcare costs attributable to physical inactivity, the estimates using the cost-of-illness methodology range from 1.2–2.6% of the total healthcare costs. Scarborough et al use in both of their studies for 2002–2003 and 2006–2007 the PAFs calculated for the WHO EUR-A region, apply them on UK healthcare costs, and estimate the extent of attributable costs to 1.5% and 1.2%, respectively. Katzmarzyk et al include in both of their studies for 1999 and 2001 more health outcomes of physical inactivity than are included in the WHO Global Burden of Disease project and find that physical inactivity was responsible in Canada for, respectively, 2.5% and 2.6% of healthcare costs. Colditz also includes other conditions such as depression, anxiety, and osteoporosis as related to inactivity and estimates

### Table 4 Burden of Physical Inactivity in the Czech Republic in 2008

<table>
<thead>
<tr>
<th>Disease</th>
<th>PAF (%)</th>
<th>Healthcare costs (millions CZK)</th>
<th>Mortality (number of deaths)</th>
<th>DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart disease</td>
<td>7.0</td>
<td>343.21</td>
<td>1809</td>
<td>12 040</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>2.9</td>
<td>94.60</td>
<td>339</td>
<td>2581</td>
</tr>
<tr>
<td>Diabetes mellitus type 2</td>
<td>4.2</td>
<td>156.87</td>
<td>83</td>
<td>1134</td>
</tr>
<tr>
<td>Female breast cancer</td>
<td>2.8</td>
<td>33.54</td>
<td>47</td>
<td>588</td>
</tr>
<tr>
<td>Colon cancer</td>
<td>4.2</td>
<td>64.64</td>
<td>164</td>
<td>1722</td>
</tr>
<tr>
<td>Total physical inactivity</td>
<td>692.86</td>
<td>2442</td>
<td>18 065</td>
<td></td>
</tr>
<tr>
<td>% of total</td>
<td>0.35%</td>
<td>2.33%</td>
<td>1.24%</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5 Burden of Physical Inactivity in Different Studies (% of Total)

<table>
<thead>
<tr>
<th>Country</th>
<th>Physical inactivity</th>
<th>Healthcare costs</th>
<th>Mortality</th>
<th>DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czech Republic (2008)</td>
<td>5</td>
<td>0.4</td>
<td>2.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Canada (1999)</td>
<td>62</td>
<td>2.5</td>
<td>10.3b</td>
<td>–</td>
</tr>
<tr>
<td>Canada (2001)</td>
<td>54</td>
<td>2.6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>South Africa (2000)</td>
<td>46c</td>
<td>–</td>
<td>3.3</td>
<td>1.1</td>
</tr>
<tr>
<td>UK (2002–2003)</td>
<td>17d</td>
<td>1.5</td>
<td>3.1</td>
<td>3d</td>
</tr>
<tr>
<td>UK (2006–2007)</td>
<td>17d</td>
<td>1.2</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>USA (1995)</td>
<td>29</td>
<td>2.4</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>World (2004)</td>
<td>17</td>
<td>–</td>
<td>5.5</td>
<td>2.1</td>
</tr>
</tbody>
</table>

*Prevalence of population doing no or very little physical activity; b data for 1995; c unweighted average of male and female prevalence; d data for the WHO EUR-A region in 2002.*
the economic costs to 2.4% of total costs in the United States in 1995.

Studies estimating the number of deaths and DALY’s attributable to physical inactivity mostly use the WHO Global Burden of Disease methodology. The world average for the attributable mortality in 2004 was 5.5% of total deaths and 2.1% for attributable DALY’s. Joubert et al. use the same health outcomes and relative risks as WHO and our study and estimate the burden of disease in South Africa in 2000 to be 3.3% of total mortality and 1.1% of total DALY’s. Katzmarzyk et al. estimate the mortality due to physical inactivity in Canada in 1995 to be 10.3%, but they make their calculations with much higher physical inactivity prevalence rate: 62%.

All these previous estimates are summarized in Table 5, together with our own findings. The second column shows the prevalence rate of physical inactivity, which was used to calculate the 3 components of costs. We have to point out that not all studies use the same definition for physical inactivity, hence another source of differences in obtained results.

Our study is innovative in many ways. First of all, to our knowledge, there is no other study quantifying the economic burden of physical inactivity in the Czech Republic from any perspective. Furthermore, the analysis is one of a few using 3 components of physical inactivity costs. In addition, compared with other studies calculating the financial costs to healthcare systems, we use our own PAFs, calculated with the help of the physical inactivity prevalence rate determined from a Czech health survey and relative risks adopted from elsewhere.

Still, the study has some limitations. The biggest issue concerns the calculation of healthcare costs for specific diagnoses. For ischemic heart disease, we use data for 2003. If the structure of different diseases within the cardiovascular disease group has changed meanwhile, our results can be biased in either way. As for the ischemic stroke, we apply the structure of the costs of cardiovascular diseases of the biggest Czech health insurance company on the total costs of cardiovascular disease care. Again, if these structures differ, our results are inaccurate. In addition, for colon and breast cancers, we use the actual incidence of these cancers relative to all newly diagnosed cancers to establish their share within the neoplasms category, which assumes that the treatment of different cancers is equally expensive; this does not have to be the case. Finally, there are some limitations in the methodology used: we calculated the PAFs for the age group 15–69 years, as the relative risks for our selected diseases are only available for this age group. Yet, this age group is quite heterogeneous regarding the physical activity level or the financial burden to public resources—thus, another source of possible underestimates of the overall economic burden of physical inactivity.

The presented study is one of the first attempts to quantify the economic burden of physical inactivity in the Czech Republic. It uses methodology developed in other studies and applies it to the Czech context. The obtained results are comparable with those found elsewhere, though the estimated burden is slightly smaller than in other reviewed studies. Still, the burden of inactivity is quite considerable, especially in the case of morbidity and DALYs, and the results could be used as an argument for policymakers to focus more on the health policy on modifiable health behaviors.

Acknowledgments

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Notes

1. When the research was underway, there were 8 public health insurance companies in the Czech Republic. All of them were asked to provide data on costs of treating specific diagnoses. Six of them stated they did not collect such information, which left us with data for only 2 of them: the General Health Insurance Company (VZP CR), insuring 60% of the overall Czech population, and Metal-Aliance Insurance Company, insuring 4% of the population. In addition to the costs of specific diagnoses, Metal-Aliance provided data on the incidence rate of these diagnoses among its clients.
2. There is no data on the incidence rate of coronary heart disease or ischemic stroke within the overall Czech population, so we cannot convert the data obtained from Metal-Aliance to the national level. For coronary heart disease, we use the percentage obtained from another study instead. For ischemic stroke, we use the percentage from the General Health Insurance Company, which insures the majority of the Czech population.
3. The EHIS 2008 Survey uses age groups of 10 years, distinguishing also the gender of individuals. However, as the WHO study defines the relative risks for selected diseases for the age groups 15–69 years, 70–79 years, and 80 + years, and the relative risks are the same for males and females. We calculated the physical activity level for the same age groups as WHO, not distinguishing the gender of individuals.
4. For example, the EHIS 2008 Survey showed that the level of inactivity or insufficient activity for men is 5.4% in the age group 15–24 years and 18.1% in the age group 55–64 years. For women, the lowest level 8.9% is in the age group 25–34 years, and in the age group 55–64 years, it is 19.9%.
5. For example, according to the CZSO, in 2008, 2.5% of the overall public health insurance expenses were used on men in the age group 15–24 years and 10.7% in the age group 55–64 years; 3.1% of these expenses were used on women in the age group 15–24 years and 9.9% in the age group 55–64 years.

References