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Physical inactivity: productivity losses and healthcare costs 2002 and 2016 in Sweden

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ABSTRACT

Objectives To estimate the costs associated with physical inactivity in Sweden for the year 2016.

Methods The costs associated with insufficient physical activity was calculated employing population attributable fractions (PAFs) and register information on healthcare utilisation, mortality and disability pensions. The PAFs were calculated using information on exercise habits and morbidity-specific relative risks. The healthcare cost components were calculated based on registry data on inpatient-care, outpatient-care and primary care utilisation. Registry data on cause-specific mortality and granted disability pensions were used to calculate the productivity loss components. Costs associated with pharmaceutical utilisation were not included due lack of data.

Results Physical exercise habits improved somewhat between 2002 and 2016. Thus, the associated morbidity-specific PAFs decreased over the same time period.

Conclusions The economic costs attributable to insufficient physical activity decrease between the year 2002 and 2016. Healthcare costs attributable to insufficient physical activity as share of total healthcare expenses increased from 0.86 % in 2002 to 0.91 % in 2016.

INTRODUCTION

There is ample empirical evidence that physical activity improves (current) well-being and reduces future risks of disease. Thus, physical activity presently exerted has both an immediate welfare enhancing effect as well as a precautionary investment effect. While the immediate effect on welfare is strictly private, the reduction in risks of disease influences both private and public domains. It has been shown that physical activity improves health and promotes longevity.[1–4] Physical activity reduces the risk of (1) cardiovascular disease,[5 6] (2) hypertension and stroke,[7–9] (3) type 2 diabetes,[10–16] (4) colon cancer,[17–20] (5) breast cancer,[21–23] (6) osteoporosis[24–26] and (7) depression and anxiety.[27–30]

In spite of the large and well established health effects and general well-being effects of physical activity, a significant proportions of adult population do not exert any physical activity at all or are irregularly physically active (we will refer to this as being insufficiently physically activity). The WHO reports that 25% of the adult global population is insufficiently physically active. The proportion of the adult Swedish population that partake in physical activity regularly has risen over the last three decades, from about 30% in the early 1980s to more than 60% in the early 2010s. The proportion of women who are regularly physically active was somewhat below that of men in the early 1980s. Since then, the proportion of active women has risen more than that of men, and in the early 2010s, the proportion exceeded that of men (Survey of Living Conditions, Statistics Sweden).

The economic burden imposed on societies of physical inactivity, or insufficient physical activity, is considerable. The costs that arise due to the adverse health effects of physical inactivity have been estimated in a small number of studies.[31–41] The literature on the economic burden of physical inactivity was summarised in a recent systematic review.[42] Studies published in the peer-reviewed international literature have been performed for, inter alia, Australia, Canada, China, Japan, New Zeeland, the UK, the USA and Switzerland. In addition, Ding *et al* calculated the global economic burden of physical inactivity, divided per country, employing the prevalence approach and extrapolated healthcare unit costs.[42] Estimated proportions of national healthcare expenditures attributable to inadequate physical activity were estimated in the range 0.3%–4.6%. Estimated productivity losses varied between studies due to different methodologies.[42] To date, no study of the costs of inadequate physical activity among Swedish adults employing Swedish data has been published. This study fills in that gap by presenting such cost estimates for Sweden for the years 2002 and 2016.

Material and methods

The opportunity cost of illness is conceptually comprised of direct and indirect costs. Direct

and indirect costs are the values of the resources used and the productivity lost, respectively, due to illness. In this study, the economic costs of inadequate physical activity were estimated using the cost-of-illness methodology combined with a top-down approach and population attributable fractions (PAFs).[43 44] Direct cost components were estimated using the prevalence method, while indirect costs components were calculated, following established methodology, as the expected values from future lost production using the human capital approach with cumulative expected losses over a working life time. Direct cost components include hospital-based inpatient and outpatient care and primary care. Prescription drugs were not included. The Swedish Pharmaceutical register (the Swedish National Board of Health and Welfare), comprising information about prescribed and dispenses pharmaceuticals, does not contain any diagnostic information. In the discussion, we provide a comparison of total sales, without any estimates of the amounts attributable to insufficient physical activity, of relevant pharmaceutical for the years 2002 and 2016. Indirect cost components include market and household-based productivity losses due to mortality and work disability (early retirement).

Total numbers of hospitalisations and hospital visits, in Sweden, by disease category were collected from the national register administrated by the Swedish National Board of Health and Welfare. No national registry exists for primary care. Instead, the total number of primary-care visits was estimated using data collected from the administrative registry in the region of Västra Götaland (VGR) (about 1.7 million inhabitants out of a total of 10 million; the figures for VGR were multiplied by 5.9). The estimates of the number of life years and working years lost due to mortality and permanent disability were based on data on mortality and newly granted early retirement by medical condition, age and sex (National Board of Health and Welfare, Causes of Death Register; Försäkringskassan, government agency administrating social security) and life tables for the years 2002 and 2016 (Statistics Sweden).

Unit costs for hospitalisations, per medical condition, were collected from the cost-per-patient database administrated by the Swedish Association of Local Authorities and Regions, while unit costs for hospital visits and visits to primary care were collected from the VGR county council. The number of lost working years was converted into monetary units by multiplying by average annual wages (Statistics Sweden), including the employer contribution to social insurance. Further, a monetary value was estimated for lost household production, based on survey information on household time use patterns (Statistics Sweden). We assumed that permanent disability prevented the retirees from performing any household work. Present values of future market and household production were discounted at 5%.

Available information about physical activity among Swedish adults permits us to calculate PAFs separately for physical inactivity, PAF_{ia}, and physical irregular activity, PAF_{ira}, using the formulas:

$$PAF_{ia} = \frac{s_{ia}(rr_{ia}-1)}{1+s_{ia}(rr_{ia}-1)+s_{ira}(rr_{ira}-1)}$$

$$PAF_{ira} = \frac{s_{ira}(rr_{ia}-1)}{1s_{ia}(rr_{ia}-1)s_{ira}(rr_{ira}-1)}$$

where s_{ia} and s_{ira} are the shares inactive and irregularly active in the population, rr_{ia} and rr_{ira} are the (unadjusted) relative risks of disease among inactive and irregularly active. The shares of physically inactive and irregularly active in the Swedish population are collected from the Survey of Living Conditions (Statistics Sweden). We used the relative risks for disease reported by Garrett *et al*, which are calculated for an adult population (aged >18), together with physical exercise habits for the Swedish population aged 16–64 in 1996/1996 and 2008/2009 in order to calculated population attributable proportions for 2002 and 2016 (there is no reporting for the age group 18–64).[34] The attributable proportions calculated in this way are likely to be lower than the 'true' proportions, since the relative risks reported by Garrett *et al* are valid for those aged >18 years of age, and since the relative morbidity risk associated with insufficient physical activity is lower among those above 64 years of age (the absolute risk of illness is increasing with age). The following medical conditions were included: ischaemic heart disease, hypertension, stroke, depression and anxiety, breast cancer, colon cancer, osteoporosis and diabetes type 2. Table 1 summarises exercise habits and the corresponding PAFs for each included disease.

The Survey of Living Conditions (SLC) comprises information as to the intensity and regularity of the respondents' physical activity on a five-point scale: 1 corresponds to *no physical exercise at all*; 2 corresponds to *physical exercise now and then*; 3 corresponds to *physical exercise regularly at least once a week*; 4 corresponds to *physical exercise regularly about twice a week* and 5 corresponds to *high intensive physical exercise at least twice a week*. The relative mortality risks reported by Garrett et al. (2004)[34] are computed for three levels of physical exercise regularity: inactive, irregularly active and regularly active. In order to align the Survey-of-Living-Conditions information with the information provided by Garrett *et al*, we assumed that the five levels in the SLC correspond to the levels in Garrett *et al* as follows: level 1 in the SLC corresponds to inactive; levels 2 and 3 correspond to irregularly active and levels 4 and 5 correspond to regularly active.

RESULTS

The number of hospitalisation, visits to a hospital clinic, primary care visits, the number of deaths and the number of early retirements attributable to insufficient physical activity are summarised, per medical condition and separately for the years 2002 and 2016, in table 2. The number of lost working years and lost life years

Table 1 Physical exercise habits and population attributable proportions (2002 and 2016; men and women)

		PAF (%) corresponding to insufficient physical activity			
		2016		2002	
Disease	ICD-10 codes	Men	Women	Men	Women
Colon cancer	C18	21.0	17.0	25.0	23.0
Breast cancer	C50	11.7	9.3	14.0	13.0
Hypertension	I10–I15	11.7	9.3	14.0	13.0
Angina	I20	21.0	17.0	25.0	23.0
Ischaemic heart disease	I21–I25	21.0	17.0	25.0	23.0
Stroke	I61, I63	21.0	17,0	25.0	23,0
Depression and anxiety	F30–F43, F53	6.9	5.4	8.0	8.0
Diabetes	E11	11.7	9.3	14.0	13.0
Osteoporosis	M80–M82	21.0	17.0	25.0	23.0

PAF, population attributable fraction.

attributable to insufficient physical activity are reported in table 3. We have also calculated the relations between lost life years and the number of deaths and total lost life years (for all illness). Total monetary costs associated with the healthcare utilisation and productivity losses, attributable to insufficient physical activity, are reported in table 4 (the costs calculated for 2002 were inflated to 2016 prices using the Swedish Consumer Price Index). In table 5, we report the direct and indirect costs attributable to insufficient physical activity in relation to total direct and indirect cost, for the years 2002 and 2016. Specific result and remarks follow below.

First, the number of hospitalisations due to insufficient physical activity has decreased, between 2002 and 2016,

Table 2 Healthcare utilisation, mortality and early retirements due to insufficient physical activity

	Number of hospitalisations (inpatient care)		Number of hospital visits (outpatient care)		Number of visits in primary care		Number of deaths (16–64 years of age)		Number of early retirements (16–64 years of age)	
	2002	2016	2002	2016	2002	2016	2002	2016	2002	2016
Men										
Colon cancer	749	653	1717	2100	Missing	1368	44	31	5	1
Breast cancer	7	6	62	46	47	32	1	0	0	–
Hypertension	334	177	2546	2370	53 785	130 292	4	8	39	1
Angina	6459	2068	4541	2859	24 066	8214	1	1	93	2
Ischaemic heart disease	5077	4662	5738	7129	9548	46 912	350	179	146	9
Stroke	3964	3062	1472	1571	Missing	20 737	61	26	99	28
Depression and anxiety	771	1243	3367	11 531	32 883	53 847	0	0	273	83
Diabetes	494	414	4848	6054	22 268	79 275	2	4	16	4
Osteoporosis	57	17	284	374	3283	3187	–	–	5	–
Total	*17 913*	*12 302*	*24 574*	*34 035*	*145 880*	*343 864*	*463*	*248*	*677*	*128*
Women										
Colon cancer	616	473	669	488	Missing	166	34.4	23.0	3	1
Breast cancer	658	323	7483	2348	1422	1370	67.4	35.1	42	4
Hypertension	256	158	1008	640	27 183	32 431	1.3	1,3	36	1
Angina	2695	519	903	311	3992	734	1.2	0,2	40	0
Ischaemic heart disease	3218	1551	959	526	1571	2759	91.5	39.2	38	1
Stroke	3204	1885	348	366	Missing	3626	31.4	10.7	42	11
Depression and anxiety	312	233	3414	14 799	42 166	85 506	0.2	0.1	419	104
Diabetes	308	132	1202	996	8744	14 770	0.8	1.4	9	1
Osteoporosis	305	101	571	458	6503	2249	0.0	0.0	15	1
Total	*11 570*	*5375*	*16 557*	*20 931*	*91 581*	*143 612*	*228*	*111*	*645*	*124*

Table 3 Lost working years and lost life years due to insufficient physical activity, and lost life years due to insufficient physical activity in relation to the number of death and in relation to lost life years for illnesses

	Lost working years (mortality)		Lost working years (early retirement)		Lost life years		Lost life years/ number of deaths		Lost life years/lost life years for all illness	
	2002	2016	2002	2016	2002	2016	2002	2016	2002	2016
Men										
Colon cancer	363	295	35	5	1728	1502	10	11	0.94%	0.48%
Breast cancer	8	2	0	–	22	12	17	12	0.01%	0.00%
Hypertension	34	61	224	7	220	403	7	8	0.12%	0.13%
Angina	10	2	522	7	126	45	6	8	0.07%	0.01%
Ischaemic heart disease	2531	1387	823	54	15 468	8 177	8	10	8.38%	2.60%
Stroke	469	239	653	189	2845	1281	8	9	1.54%	0.41%
Depression and anxiety	2	0	3137	1403	9	7	7	7	0.01%	0.00%
Diabetes	12	27	99	25	141	221	6	9	0.08%	0.07%
Osteoporosis	–	–	40	–	1	2	3	4	0.00%	0.00%
Total	*3430*	*2012*	*5533*	*1689*	*20 560*	*11 650*	*72*	*78*		
Women										
Colon cancer	284	214	17	5	1651	1112	10	11	0.71%	0.30%
Breast cancer	705	379	318	–	2363	1405	15	15	1.02%	0.38%
Hypertension	12	5	220	7	166	170	6	6	0.07%	0.05%
Angina	6	0	244	7	94	21	6	6	0.04%	0.01%
Ischaemic heart disease	664	283	239	54	6861	2510	7	8	2.95%	0.67%
Stroke	256	81	363	189	2171	749	7	8	0.93%	0.20%
Depression and anxiety	1	0	4547	1403	9	8	5	7	0.00%	0.00%
Diabetes	4	7	76	25	90	93	7	8	0.04%	0.02%
Osteoporosis	–	–	74	–	10	6	3	0	0.00%	0.00%
	1932	*971*	*6098*	*1689*	*13 414*	*6072*	*66*	*68*		

Table 4 Total costs, healthcare utilisation, mortality and early retirements due to insufficient physical activity (millions SEK)

	Hospitalisations (inpatient care)		Hospital visits (outpatient care)		Visits in primary care		Deaths (16–64 years of age)		Early retirements (16–64 years of age)	
Men and women	**2002**	**2016**	**2002**	**2016**	**2002**	**2016**	**2002**	**2016**	**2002**	**2016**
Colon cancer	56	129	19	19	Missing	1	226	210	20	3
Breast cancer	55	31	65	19	0.04	0.03	222	150	113	13
Hypertension	11	10	111	12	45	116	16	29	173	4
Angina	166	153	61	11	20	7	6	1	307	4
Ischaemic heart disease	361	359	42	36	8	42	1197	751	432	29
Stroke	210	357	5	14	Missing	18	260	141	386	128
Depression and anxiety	44	85	86	89	28	48	1	0	2619	1014
Diabetes	13	28	51	35	19	71	6	16	67	15
Osteoporosis	28	7	27	7	3	3	–	–	45	13
Total cost	*943*	*1159*	*467*	*242*	*122*	*306*	*1933*	*1298*	*4161*	*1223*
Total cost per year										
2002	*7627*									
2016	*4228*									

Table 5 Healthcare costs and productivity losses due to insufficient physical activity in relation to healthcare costs and productivity losses for all illness (0–64 years of age)

	Costs due to insufficient physical activity (current prices; millions SEK)		Total costs (for all illness) (current prices; billions SEK)		Costs due to insufficient activity/costs for all illness	
	2002	2016	2002	2016	2002	2016
Healthcare (excluding pharmaceuticals)	1198	2178	140	240	0.86%	0.91%
Mortality	1667	1298	24	60	7.04%	2.16%
Early retirement	3587	1223	154	21	2.32%	5.85%

by more than 50% for women. For men, the decrease is a more moderate 31%. During the same time period the other healthcare components underwent a corresponding increase. Men increased their number of visits to a hospital clinic by 38% and women by 26%. The increase in the number of visits in primary care due to insufficient physical activity is even more pronounced: 136% for men and 57% for women. The number of patients receiving inpatient or outpatient care increased from about 29 500 in 2002 to about 35 400 in 2016. During the same time period, the number of deaths attributable to insufficient physical activity decreased with about 50% for both men and women. In monetary terms, these developments translate into total healthcare costs, attributable to insufficient physical activity, at about 1.5 billion SEK in 2002 and 1.7 billion SEK in 2016.

Second, among men, the number of lost life years due to insufficient physical activity declined from 20 560 in 2002 to 11 650 in 2016. The development between the 2 years of the share of lost life years for all illness that is attributable to insufficient physical activity declined reflected this development. For instance, men who died because of ischaemic heart disease attributable to insufficient physical activity declined from about 8.4% in 2002 to about 2.6% in 2016. Similar developments were found among women.

Third, healthcare costs due to morbidities attributable to insufficient physical activity represented 0.86% of total healthcare expenditures in 2002 and 0.91% in 2016. The corresponding figures for mortality were 7.04% and 2.16%.

DISCUSSION

In this study, we have derived estimates of the societal costs attributable to insufficient physical activity in Sweden for the years 2002 and 2016. We used an epidemiological approach employing PAFs based relative risks derived by Garrett *et al*[34] and exercise habits among adult swedes in 1996/1997 and 2008/2009.[34] To the best of our knowledge, this is the first study of the costs of insufficient physical activity performed for Sweden. The overall conclusion emerging from our calculations is that the adverse health effects associated with physical inactivity causes large economic costs. The costs attributable to insufficient physical activity are of the same order of magnitude as the costs attributable to smoking, which is, arguably, the life style factor that has the most serious health consequences.[42 43] Bolin and Lindgren estimated the societal costs of smoking using the same methodology as adopted in this study and arrived at a total cost of 8.3 billion for the year 2002, compared with our estimate of the costs in 2002 for insufficient physical activity, 6.6 billion (in 2002 prices; excluding pharmaceuticals).[43] Insufficient physical activity was estimated to account for 0.86% and 0.91% of total healthcare expenditures in Sweden in 2002 and 2016. The corresponding 2001 figure for smoking is 1.3%. Compared with earlier studies performed with similar methodological approaches for other countries the shares estimated in this study are considerably lower. For instance, Colditz estimated that 2.4% of total US healthcare expenditures in 1995 were attributed to physical inactivity, and Katzmarzyk *et al* found that the corresponding figure in Canada in 1999 was 2.5%.[32 33] Our results, however, fall within the range of shares of total healthcare expenditures, for a variety of countries, accounted for by insufficient physical activity reported by Ding *et al* in their recent review.[42] Further, although 13 of the studies included in the Ding *et al* review incorporated indirect costs, there are methodological differences and reporting uncertainties that make comparisons with our results difficult, if not futile. Ding *et al* calculated direct and indirect per-country costs for 2013.[42] For Sweden, their mortality-related productivity losses amounted to about 50% of the direct costs. We estimated the value of productivity losses for deaths occurring in 2016 at about 72% of the healthcare costs, which is in the same order of magnitude as the Ding *et al* measure.

Information about drug prescriptions and associated diagnoses is not systematically collected in Sweden. Information about total pharmaceutical sales per ATC code is available at the Swedish ehealth Agency, since 2014. The total cost for prescribed pharmaceuticals in 2016, for appropriate ATC codes (see box 1), amounted to about 6.4 billion SEK. The corresponding figure for 2002 was 4.7 billion SEK (in 2016 prices). Ignoring the complication that several pharmaceuticals have multiple indications and employing the average population attributable proportions (arithmetic averages over the included diseases) for the 2 years, yields the following estimates of the pharmaceutical costs attributable to insufficient physical activity for the years 2002 and 2016, 940 million SEK and 880 million SEK.

Box 1. ATC codes for the pharmaceuticals included in the calculation provided in the discussion

A12A
B01A
C01A
C01D
C03A
C03C
C03D
C03E
C07A
C08
C09
C09A
C09B
C09C
C09D
C10
G03C
G03D
G03F
L02B
M05B
N02A
N05A
N05B
N05C
N06A

A number of caveats should be addressed. *First*, we have not made any attempts at estimating the monetary value of reduced quality of life among those struck by illness. Obviously, these intangible costs are potentially considerable. *Second*, we have assumed that the population attributable proportions are applicable to the Swedish populations that we studied, although using relative morbidity/mortality risks estimated for a different population. The relative risks associated with physical inactivity are conditional on given life style habits in the specific population used for obtaining estimates. Any change in health-related life style habits other than physical activity in that population will change the relative risks associated with physical inactivity. For example, consider the thought experiment in which every smoker quitted smoking at a given point in time. Over time, the incidence of ischaemic heart disease will decline, ceteris paribus. However, the cases of ischaemic heart disease that still occur will not be caused by smoking, and, hence, the relative risk for ischaemic heart disease associated with physical inactivity will increase as a consequence of the smoke stop. *Third*, we did not include the productivity losses due to temporary illness caused by the diseases included, which is probably the most serious limitation. The reason for this is that there is no systematic collection of sickness absenteeism from work per diagnosis in Sweden. The Swedish Social Insurance Agency do collect information about sickness absenteeism per diagnosis, but only for days reimbursed beyond the 14th day of sickness for each case of work absenteeism.

The findings are summarised in the box 2.

Box 2. What are the new findings and what are the implications for clinical practice?

- Physical exercise habits improved somewhat between 2002 and 2016, causing a decrease in the proportions of the economic costs that can be attributed to insufficient physical activity.
- Healthcare utilisation, hospital and primary care visits, due to the conditions associated with insufficient physical activity increased over the period.
- Total healthcare costs attributable to insufficient physical activity increased as a share of total healthcare expenditures between 2002 and 2016.
- Improvements in physical exercise habits curb future healthcare expenses and initiatives aiming at achieving such improvements are likely to be cost effective or even cost saving.

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