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The relationship between physical activity and out-of-pocket health care costs of the elderly in Europe

Sören Dallmeyer[1], Pamela Wicker[2], Christoph Breuer[1]

1 Department of Sport Economics and Sport Management, German Sport University Cologne, Cologne, Germany
2 Department of Sports Sciences, Bielefeld University, Bielefeld, Germany

Correspondence: Sören Dallmeyer, Department of Sport Economics and Sport Management, German Sport University Cologne, Am Sportpark Muengersdorf 6, 50933 Cologne, Germany, Tel: +49 221 4982 6094, Fax: +49 221 4982 8144, e-mail: s.dallmeyer@dshs-koeln.de

Background: Increasing health care costs represent an economic burden placed on individuals across many European countries. Against this backdrop, the aim of this study was to examine the relationship between participation in physical activity and out-of-pocket health care costs in Europe. **Methods:** Individual data from the cross-national Survey of Health, Ageing and Retirement ($n = 94\,267$) including 16 European countries were utilized. Two-part models were estimated to investigate how different levels of participation frequency in physical activity are related to out-of-pocket costs (OOPC) for people aged 50 years and older. **Results:** Only participation in physical activity more than once a week significantly decreases the probability of incurring any OOPC. However, all frequencies of physical activity significantly reduce the level of costs, with the highest savings being generated by participation once a week. The results reveal higher savings for men compared to women. **Conclusion:** Physical activity can be a useful policy instrument to reduce the economic burden of out-of-pocket health care costs for an aging population in Europe. Public officials should primarily promote physical activity interventions targeting older people who are not active at all.

Introduction

Over the last years, the share of health costs individuals have to pay out of their own pocket has increased rapidly across many European countries.[1] Higher out-of-pocket costs (OOPC) have various health and socio-economic implications because they directly affect the household budget of individuals and can, thereby, restrict access to health care or deepen poverty. With research indicating a positive relationship between age and OOPC[2] and a specific high level of OOPC in the last years of life,[3] the aging of the European population could aggravate this economic burden even more. Therefore, many European countries have started programmes in order to promote healthy behaviour for the elderly.[4]

Due to its well-documented health benefits,[5,6] physical activity represents an effective mechanism to improve health among the elderly. The WHO has declared the promotion of physical activity for older adults as one of their main priorities in their strategy for promoting physical activity in the European region.[7] Physical activity could thus help to lower the economic burden of OOPC in Europe. Previous research has found significant lower health costs for people who are physically active and, although it is difficult to compare those results across healthcare systems, those effects were fairly constant in different countries (e.g. USA, Australia, Japan).[8–10] The findings also indicate specifically higher savings for middle-aged individuals and reveal gender-specific differences.[11] Most existing studies have used aggregated measures of health costs without specifying the effect of physical activity on OOPC. However, to adequately describe the economic burden imposed on an individual, it is more accurate to focus on OOPC (as opposed to costs covered by insurances). Hence, a more detailed understanding of how physical activity can be utilized to reduce OOPC for the elderly is needed.

OOPC can be defined as 'a direct payment for healthcare goods from the household primary income or savings, where the payment is made by the user at the time of the purchase of goods or the use of the services'.[12] The imposed economic burden of OOPC can differ substantially between individuals' socio-demographic characteristics (e.g. age, income), health status (e.g. number of chronic diseases, self-reported health) and insurance characteristics.[13–15] Moreover, previous research has identified effects for obesity and smoking.[16,17] For example, An[17] found an annual increase in total OOPC of $119 for obesity and a difference of $107 between smokers and non-smokers. The role of physical inactivity has only been investigated by Chevan and Roberts[18] who investigated the relationship between levels of physical activity and short-term savings in OOPC in the USA. The authors found no significant relationship and explained the findings by reference to the small sample and the lack of differentiation between expenditure related to different health services.

The purpose of this study is to shed further light on the relationship between physical activity and OOPC by specifically focusing on the age group of the elderly in Europe using a rich dataset from 16 European countries. The sample is of considerably larger size compared to data harnessed in previous research and, thus, addresses one major shortcoming of previous research in this context: 'the lack of sufficient sample sizes to reliably measure small effect sizes'.[11] Additionally, it enables us to include numerous socio-demographic control variables in the empirical models and to deal with the potential endogenous health status. With physical activity and OOPC both likely being influenced by health conditions, detailed information about individuals' health is required to minimize the potential bias for the physical activity estimates. Separate models for men and women allow identifying gender-specific differences.

Methods

Data source and variables

The study uses data from the Survey of Health, Ageing and Retirement (SHARE) in Europe, a multidisciplinary, cross-national, longitudinal study of people aged 50 years and older from 27 European countries and Israel. The survey covers the period from 2004 to 2015. More information about the data collection and survey design of SHARE can be found elsewhere.[19] From the six existing waves only wave 5 and 6 were used as information for the

variables of interest (i.e. physical activity, OOPC) and important covariates (i.e. insurance information) was only available in these waves. Hence, the total sample consists of pooled data from the years 2013 and 2015. Individuals with severe physical limitations were excluded from the analysis since those health problems are likely to significantly affect physical activity and health care costs simultaneously ($n = 30\,072$). The relevant data on physical activity and OOPC were available for 16 countries. The total sample includes $n = 94\,267$ observations (table 1).

The outcome of interest is OOPC. In the survey, respondents were asked to indicate how much they have paid (without getting reimbursed by health insurance, national health system or a third-party payer) for inpatient care, outpatient care, drugs or homecare out of their own pocket in the last 12 months. This information is comprised in a variable measuring the annual total OOPC. The long recall period of 12 months can potentially bias the results, but it allows capturing infrequent spending. While previous studies have used similar time frames,[14–16] a potential recall bias has to be kept mind when interpreting the results. Based on country-specific weights provided by the dataset, all costs are adjusted for purchasing power parity (ppp) and inflation relative to the level of Germany in the year 2006.

The explanatory variable of interest is physical activity. Respondents were asked how much they have engaged in vigorous-intensity activities such as sports, heavy housework (e.g. carrying boxes) or a job that involves physical labour (e.g. crafts). The variable was measured on a four-point scale: more than once a week, once a week, one to three times a month and hardly ever or never. Dummy variables for each category were created, with 'never active' representing the reference category.

Based on previous research, numerous control variables are included.[13–15] In addition to the common factors age, gender, income, education, marital status, employment and immigration status, a few variables taking into account the specific age structure of the sample were considered, such as whether the person is retired. Moreover, variables measuring the number of children, and the household size are included, reflecting potential cost-sharing among family members.

Evidentially, the health status of the individual and the level of physical activity create an endogeneity problem when estimating the relationship between physical activity and OOPC: healthier individuals are likely to be more physically active and have lower OOPC. Hence, the parameter estimates of physical activity would be upward biased if unobserved health conditions are not considered in the model. The usual econometric strategy to deal with endogeneity in this context would be to employ an instrumental variable approach. Unfortunately, the used dataset does not include any valid and reliable instruments. Hence, in order to minimize the bias, a number of variables capturing observed health dimensions are considered. Specifically, variables reflecting if the individual's self-perceived health is described as poor (on a scale from poor, fair, good, very good and excellent) and if the individual has medium physical limitations are included in the analysis.[13,20] Moreover, dummy variables controlling if an individual has been diagnosed in the past with different chronic diseases are used.[15] The list of considered chronic diseases is based on a report by the WHO[21] describing the most prominent chronic diseases worldwide, including stroke, heart attack, diabetes, respiratory diseases, cancer, Parkinson, cataracts, Alzheimer, osteoarthritis, stomach ulcer and rheumatoid. Also, the two risk factors if the person has smoked daily and is considered obese (body mass index > 30) are included, as both were found to be associated with higher health care costs in earlier studies.[16,17] Finally, the analysis encompasses two variables measuring if the person has a supplementary private health insurance and an additional private long-term care insurance.[22]

However, even with those controls, a potential bias due to unobserved health effects has to be considered when interpreting the results. In order to identify if including the endogenous control variables (e.g. health status and insurance) causes a bias of the physical activity coefficients as well, the empirical models were estimated without the health status and insurance variables.

With country-specific differences of cost-sharing and health coverages in mind, we used a typology from Reibling et al.[23] based on OECD data from 2016 to control for differences in health care systems. The five types are supply- and choice-oriented, performance- and primary care-oriented and regulation-oriented public systems, low-supply and performance mixed systems and supply- and performance-oriented private systems. Moreover, unemployment rate, inflation and GDP growth were included to control for further country-specific differences.[24]

Table 1 OOPC by country (in € ppp)

Country	Health system type	Observations	OOPC	
			Average OOPC	OOPC > 0
Austria	SC—public system	5989	345.89	522.10
Belgium	SC—public system	8819	329.06	399.95
Czech Republic	SC—public system	7943	143.46	161.63
Denmark	R—public system	6797	118.51	160.33
Estonia	LSLP—mixed system	7619	191.08	233.80
France	SC—public system	6554	131.40	225.74
Germany	SC—public system	7878	174.64	218.01
Italy	R—public system	7705	317.32	445.92
Luxembourg	SC—public system	2466	251.16	347.56
The Netherlands	R—public system	3067	92.85	241.55
Poland	LSLP—mixed system	1257	325.82	424.40
Portugal	PPC—public system	1191	578.65	685.75
Slovenia	SC—public system	5683	67.66	143.95
Spain	R—public system	9369	156.36	297.03
Sweden	PPC—public system	6916	156.68	179.11
Switzerland	SP—private system	5014	395.06	670.33

Note: Health system types based on Reibling et al.[23]: supply- and choice-oriented public system (SC—public system), performance- and primary care-oriented public system (PPC—public system), regulation-oriented public system (R—public system), low-supply and low performance mixed system (LSLP—mixed system), and supply- and performance-oriented private system (SP—private system).

Empirical analysis

The effect of physical activity on OOPC is estimated with two-part models. A two-part model is often calculated to predict health care costs because of a highly skewed distribution of the underlying data.[25–27] A large number of non-users of health services results in a high proportion of zeros, while a small number of users have high health care costs. This zero-inflation is also present in our data as 29.3% of respondents indicated no OOPC at all. Two-part models separately calculate first the probability of having positive (i.e. larger than zero) OOPC and second, in the case of positive OOPC, the determinants of the amount of OOPC.

The first part of the model is specified as a binary logit regression model and the second part as a generalized linear model (GLM). GLMs are frequently used estimators for modelling health care costs in the presence of heteroscedasticity through the choice of a link and a distribution function. They use the raw cost scale which avoids the need of retransforming the data after.[26,27] Regarding the link function, the log-transformation of the OOPC variable yielded a kurtosis close to 3, confirming the applicability of a log-link. Concerning the distribution function, a Park test[26] revealed that the gamma distribution best fits the underlying data. Both the log-link and the gamma distribution are the most common GLM specifications in the context of modelling health care costs.[25] To identify the magnitude of cost differences, unconditional incremental effects (IE) for the different binary physical activity variables are estimated. Therefore, the results of the model for both outcomes of the binary physical activity

variables are estimated and then the difference is taken. In two-part models, the unconditional IE account for both parts of the model.

Results

Table 1 shows the descriptive statistics of the OOPC measures and the explanatory variables. In total, 70.7% of respondents report positive OOPC in the last year. On average, the annual economic burden of OOPC is at around €211.88. When focusing only on those incurring positive OOPC, respondents have paid on average €299.57 in the last 12 months. Table 1 displays the OOPC by country. The highest annual amount can be observed in Portugal (€578.65), followed by Switzerland (€395.06). The OOPCs are lowest in Slovenia (€67.66) and the Netherlands (€104.17).

Turning to the level of physical activity, 38.2% of respondents are physically active more than once a week, 15.2% once a week, 9.2% one to three times a month and 37.5% are never or almost never physically active. Regarding the general socio-demographics, respondents are on average 66.50 years old, with a maximum age of 103. Altogether, 54.8% of respondents are female, 70.0% married, 24.2% have a tertiary education and 29.4% are employed. Respondents have 2.13 children on average and 9.6% are immigrants. The average annual net income is at around €28 330 and 57.6% of respondents are retired. Regarding health, only 4.0% perceive their own health as poor, but 36.5% indicate to have medium physical limitations for certain activities (table 2).

Table 3 summarizes the results of the two-part model. Since this article focuses on the relationship between physical activity and OOPC, the discussion of results concentrates on these variables. In the full sample, physical activity of more than once a week significantly decreases the probability of incurring positive OOPC. This effect remains in the male subsample, but not the female subsample. Regarding the magnitude of OOPC, all physical activity measures have a significant negative relationship with the amount of OOPC in the full sample and the two subsamples. The effect is highest for physical activity once a week, followed by physical activity more than once a week and physical activity less than once a week.

Table 4 presents the unconditional IE accounting for both parts of the model. If a person is physically active once a week, annual OOPCs are reduced by 17.7% (€37.40) compared to someone who is never active. For physical activity more than once a week, this effect decreases to 15.3% (€32.41). For physical activity less than once a week, it is reduced to 12.7% (€26.81). The effects of all three physical activity measures are considerably higher for males compared to females. Supplementary table A1 shows the results of all two-part models without the potential endogenous variables of health status and insurance. The estimated coefficients are considerably higher, but overall the results are consistent.

Table 2 Overview of variables and summary statistics ($n = 94\,267$)

	Mean	SD	Min	Max
Dependent variables				
Positive OOPC	0.707	–	0	1
Total OOPC (in € ppp)	211.88	925.73	0	175 451
Total OOPC (>0)	299.57	1088.76	0.062	175 451
Physical activity				
More than once a week	0.382	–	0	1
Once a week	0.152	–	0	1
Less than once a week	0.092	–	0	1
Never	0.375	–	0	1
Socio-demographics				
Age	66.50	9.44	50	103
Age^2	4511.40	1296.89	2500	10 609
Female	0.548	–	0	1
Married	0.700	–	0	1
Tertiary education	0.242	–	0	1
Employed	0.294	–	0	1
Retired	0.576	–	0	1
Household income (in €1000 ppp)	28.33	50.09	0.001	7821.00
Immigrant	0.096	–	0	1
No. of children	2.13	1.28	0	19
Household size	2.14	0.947	1	12
Poor health	0.040	–	0	1
Medium physical limitation	0.365	–	0	1
Insurance				
Supplementary insurance	0.397	–	0	1
Additional private insurance	0.064	–	0	1
Risk factors				
Ever daily smoked	0.457	–	0	1
Obese	0.200	–	0	1
Chronic diseases				
Stroke	0.023	–	0	1
Heart attack	0.088	–	0	1
Diabetes	0.112	–	0	1
Respiratory disease	0.049	–	0	1
Cancer	0.043	–	0	1
Parkinson	0.004	–	0	1
Cataracts	0.070	–	0	1
Alzheimer	0.008	–	0	1
Osteoarthritis	0.168	–	0	1
Stomach ulcer	0.032	–	0	1
Health system types				
SC—public system	0.481	–	0	1
PPC—public system	0.086	–	0	1
R—public system	0.286	–	0	1
LSLP—mixed system	0.094	–	0	1
SP—private system	0.053	–	0	1
Macroeconomic indicators				
Inflation	0.70	0.943	−1.14	2.78
Unemployment rate	9.33	5.41	4.62	26.09
GDP growth	1.28	1.72	−1.73	5.31

Discussion

Discussion of results and implications

The descriptive results show that the level of OOPC varies between the different European countries. In the empirical analysis, the effects of the control variables (e.g. socio-demographics, health and insurance) are mostly in line with previous research,[13–16] indicating that the results can be considered credible.

The effect of physical activity on OOPC is 2-fold. The probability of incurring OOPC is only significantly lower if someone is physically active more than once a week whereas all levels of physical activity frequency are associated with a lower amount of OOPC compared to someone who is never active. The differentiation by gender reveals that the first effect can mainly be attributed to men.

For the second effect on the amount of OOPC, the dose–response relationship between physical activity and OOPC is non-linear: The highest effect occurs for a participation frequency level of once a week followed by participation of more than once a week and less than once a week. Likewise, previous studies identified diminishing returns of physical activity frequency and intensity for health outcomes and health care utilization.[28,29] With the present sample exclusively considering individuals aged 50 years and older, a higher frequency of more than once a week might exceed the physical abilities of some people, whereas a participation frequency of less than once a week does not maximize the potential benefits of physical activity. These findings are in line with different guidelines regarding physical activity, which usually recommend that, from a certain age onwards, people should determine their intensity and frequency of their physical activity based on their physical fitness.[30,31]

The estimated monetary savings from a physically active person compared to a non-active person vary between 17.7% (once a week) and 12.7% (less than once a week) of annual OOPC. These savings from physical activity are higher compared to OOPC savings from the prevention of health risks such as smoking (10.3%)[17] and overweight (11.4%),[16] but lower than OOPC savings from the

Table 3 Summary of two-part models for total OOPC

	Full sample		Female		Male	
	Prob. (logit)	Cond. (GLM)	Prob. (logit)	Cond. (GLM)	Prob. (logit)	Cond. (GLM)
Physical activity						
More than once a week	−0.045*	−0.140***	−0.022	−0.100***	−0.064***	−0.187***
Once a week	0.023	−0.181***	0.029	−0.116***	0.014	−0.270***
Less than once a week	0.044	−0.137***	0.060	−0.097***	0.019	−0.182***
Socio-demographics						
Age	0.062***	−0.128***	0.050***	−0.131***	0.090***	−0.103***
Age^2	−0.000***	0.001***	−0.000***	0.001***	−0.001***	0.001***
Female	0.236***	0.090***	–	–	–	–
Married	−0.062***	−0.135***	−0.093***	−0.097***	−0.055	−0.228***
Tertiary education	0.198***	0.238***	0.147***	0.240***	0.230***	0.233***
Employed	0.102***	−0.205***	0.061	−0.217***	0.132***	−0.134***
Retired	0.106***	−0.145***	0.067***	−0.139***	0.086	−0.123
Household income	0.151***	0.138***	0.143***	0.139***	0.160***	0.128***
Immigrant	−0.159***	−0.035	−0.165***	0.032	−0.152***	−0.105***
No. of children	−0.022***	−0.051***	−0.034***	−0.048***	−0.009	−0.057***
Household size	−0.026***	0.028***	−0.035***	0.048***	−0.018	0.010
Poor health	−0.070	0.276***	−0.016	0.336***	−0.116	0.172***
Medium physical limitation	0.389***	0.334***	0.382***	0.391***	0.407***	0.275***
Insurance						
Supplementary	−0.355***	0.098***	−0.390***	0.112***	−0.313***	0.073***
Additional private insurance	0.002	0.123***	−0.058	0.119***	0.062	0.140***
Risk factors	Yes	Yes	Yes	Yes	Yes	Yes
Chronic diseases	Yes	Yes	Yes	Yes	Yes	Yes
Health system types	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic indicators	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.322***	9.553***	−1.406***	9.567***	−3.525***	8.862***
Observations	94 267	66 672	51 695	37 654	42 572	29 018

Note: Displayed are the coefficients; all models are estimated with robust standard errors;***: $P<0.001$,**: $P<0.01$,*: $P<0.05$.Reference categories are never (physical activity), supply- and performance-oriented private systems (health system types).

Table 4 Unconditional IE of the two-part models for physical activity

Physical	Full sample		Female		Male	
Activity	IE	%	IE	%	IE	%
More than once a week	−32.41***	−15.3	−23.64***	−10.6	−40.87***	−20.5
	−42.96, −21.86		−36.69, −10.66		−56.45, −25.29	
Once a week	−37.40***	−17.7	−24.31**	−10.9	−53.52***	−26.9
	−48.79, −26.01		−38.59, −10.04		−70.86, −36.19	
Less than once a week	−26.81**	−12.7	−18.50	−8.3	−35.49**	−17.8
	−42.23, −11.36		−38.46, 1.47		−58.01, −12.97	

*Note:****: $P<0.001$,**: $P<0.01$,*: $P<0.05$. Reference category: never (physical activity).

prevention of obesity (26.1%).[16] However, on average, the magnitude of the effects in comparison to the total health care expenditure is rather small. Nevertheless, for countries where the health systems rely more heavily on OOPC (e.g. Poland, Portugal, Switzerland), the results can be economically significant.

The findings have implications for public health policies. First of all, the importance of initiatives such as the 'Physical activity strategy for the WHO European Region' by the WHO[7] to promote physical activity across all age groups finds evidence in the results. The potential health benefits of physical activity could translate into a lower health costs-related economic burden on the elderly's household budgets. Furthermore, the varying effects of physical activity on OOPC emphasize the need for initiatives considering the specific characteristics of the elderly. Policymakers have to be aware that the diminished physical capacity of older adults determines the recommended frequency of physical activity at which the aforementioned economic benefits can be maximized. Hence, policy interventions should be primarily designed to get people from being physically inactive to be active with some frequency. Also, interventions focusing specifically on men appear to be most promising in this context as the results indicate considerably higher OOPC savings for men than women. Because of the diminishing effects of participation frequency, for both, males and females, a physical activity frequency of once a week should be targeted. Finally, the estimated monetary savings can serve as potential incentives to reduce physical inactivity, since existing research has shown that financial incentives make for an effective mechanism to increase both frequency and duration of physical activity participation, especially among the elderly.[32] For example, policy interventions could inform older people by using mass media campaigns about the potential economic savings of being physically active just once a week.

Conclusion

This study has examined the relationship between physical activity and OOPC using individual data from 16 European countries. The findings indicate the pivotal role of physical activity for preventing high health care costs and for lowering the economic burden of OOPC in Europe. The study contributes to the existing body of research by adding physical activity to the list of factors investigated in the context of OOPC and by using a larger sample size, which allows controlling for important health confounders.

Some limitations must be pointed out that future research may take on. First of all, physical activity and OOPC were self-reported. For physical activity, a more objective measure (e.g. accelerometry data) might provide additional insights into the studied relationship. For OOPC, more data with shorter recall periods could be beneficial. Second, the present empirical analysis might suffer from endogeneity due to the endogenous health status. Future research should apply an instrumental variable approach or matching methods to eliminate this potential upward bias. Finally, the study could only be conducted across 16 countries due to the limited sample size on the individual country level. A country-specific analysis would enable researcher to confirm the findings in selected countries where OOPC have higher economic significance.

Supplementary data

Supplementary data are available at *EURPUB* online.

Conflicts of interest: None declared.

Key points

- This study investigates the relationship between different frequencies of physical activity and OOPC with a focus on the elderly.
- The results show a negative effect on OOPC for different physical activity frequencies compared to being not active.
- OOPC can be reduced by 17.7% through participating in physical activity once a week.

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