Contemporaneous health effects of physical activity – the role of education

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- Draft -

Abstract

Background: Physical activity has proven to be an important determinant for the prevention of numerous diseases, owing to a long-term effect of past behavior. But physical activity may also have an immediate impact on health, reflected in a temporary deviation from a given health state. As for the long-term effect, education could be considered as a crucial factor in the short-term association between physical activity and health. This study aims at analyzing the impact of physical activity on contemporaneous number of physician visits and how this impact varies with education.

Methods: Data were retrieved from waves 2016 and 2017 of the Konstanz Life-Study, a longitudinal cohort study conducted in Southern Germany. 2091 observations were grouped according to self-assessed leisure time physical activity (LTPA) into one of the three categories "high", "moderate" and "low". Education was measured by the binary variable with/without high school degree. The number of physician visits in the previous three months was regressed on physical activity and education in negative binomial and hurdle models. The role of education in the short-term relationship was identified in the interaction of physical activity with education. Further covariates like self-assessed health, age, gender, smoking, drinking or current occupation were included in the models.

Results: The negative binomial model including the interaction terms predicts a significantly higher number of physician visits for a moderately (+47%) and highly (+74%) active, average individual without high school degree compared with a low active/inactive individual without degree. Among individuals with high school degree in contrast, the number of visits was not different between the three activity categories. The estimation of the hurdle models suggest that the positive association between physical activity and the number of physician visits among individuals without degree was due an increased number of following visits after a first contact.

Conclusion: Among the participants of the Konstanz Life-Study, physical activity did not reduce the number of physician visits. Moreover, for individuals without high school degree, physical activity significantly increased the number of visits whereas among individuals without high school degree, physician visits were not affected by LTPA. The findings therefore indicate a strong role of education for the relationship between physical activity and the short-term demand for physician visits.

Keywords: Physical activity, Health care demand, Education

1. Background

Physical activity has been proven to be an important factor in the prevention of numerous chronical diseases [1-3] and the avoidance of a substantial share of healthcare cost [4]. The preventive effect of physical activity pertains to a long-term relationship in which the history of past health behaviors shapes current health status. However, physical activity also has a short-term, immediate impact on health that causes a temporary deviation from overall health status, affecting contemporary health care demand and cost. For example, increased physical activity on the one hand may reduce the risk of injuries incurred in activities of everyday life because of strengthened musculature, but on the other hand may increase the risk of incurring injuries during sports.

The empirical literature on the short-term relationship between physical activity and health care use yields a mixed picture. Using cross sectional data from a US survey, Chevan and Roberts [5] found no significant impact of physical activity on contemporaneous health care expenditures, whether controlled for health status or not. Likewise, Karl et al. [6] found no significant difference in health expenditures between individuals exerting sport and those not exerting sport if physical activity was assessed with a questionnaire. However, active individuals had lower expenditures than inactive ones when physical activity was assessed with an accelerometer. Finally, Sari [7] analyzed data from the Canadian Community Health Survey and found that inactive people used more inpatient services, nurse services, family physician visits and more other physician services compared with active individuals.

It is sometimes argued that education acts as a mediator in the relationship between physical activity and health. For the long run effect, the notion is that education increases "productive efficiency" [8, 9], i.e. increases the benefits of physical activity for a given amount of energy devoted to physical activity. For example, education may help to acquire knowledge about more goal-orientated exercising. Likewise education might have a mediating role also in the short run relationship, it may help to acquire knowledge about preventing injuries from exercising or might foster the choice of less risky sports.

While none of the studies on the short-term relationship considers the role of education, this study aims at analyzing the contemporaneous effect of physical activity on the use of health care

resources, approximated by the number of physician visits, and the impact of education on this relationship.

2. Methods

2.1. Data Sample

We retrieved data from the Konstanz Life-Study. The Konstanz Life-Study is a longitudinal cohort study conducted in the region of Konstanz, a mid-sized city in southern Germany. The study was launched in spring 2012 as part of the EATMOTIVE project funded by the Federal Ministry of Education and Research. Participants were recruited via flyers, posters, and newspaper articles [10], data were collected at a central site (city center). The study now serves as a data hub for the SMARTACT-Project, an interdisciplinary research consortium consisting of psychologists, sport scientists, information scientist and economists aiming at studying the effects of primary prevention through the creation of evidence-based interventions using mobile technologies. Up to now the Life-Study encompasses five waves (spring and autumn 2012, spring 2013, spring 2016, spring 2017). Due to data requirements for the present analysis we used only the observations from waves 2016 and 2017 in a pooled sample, encompassing 2091 observations.

2.2. Dependent Variable

We used the number of physician visits as an indicator for health care demand [7, 11-13]. The variable was defined as the number of self-reported visits to any physician in the last three months at the date of the interview.

2.3. Explanatory Variables

Our main explanatory variables were leisure time physical activity (LTPA) and education. LTPA was measured using the GPAQ – questionnaire. The GPAQ asks for the time the participant spends on walking, moderate and vigorous physical activity during work, travel time and leisure time in the course of a usual week. Using this information MET-minutes per week were calculated for each observation. One MET (metabolic equivalent) is defined as the energy expenditure of an average person sitting and is equivalent to 1 kcal/kg/hour. According to the sum of MET minutes per week and number of days with LTPA, each observation was assigned to one of the categories “highly active”, “moderately active” or “low active” according to the criteria defined by the “GPAQ analysis framework” [14, 15]. To be “highly active” an individual must exert either vigorous activity

on at least three days and accumulating at least 1500 MET-minutes/week or must exert any combination of walking, moderate or vigorous-intensity activities accumulating at least 3000 MET-minutes/week on seven days. A "moderately active" individual exerts either vigorous activity of at least 20 minutes on three or more days per week or moderate-intensity activity and/or walking of at least 30 minutes per day on five or more days or any combination of walking, moderate-intensity or vigorous intensity activities on five or more days achieving a minimum of at least 600 MET-minutes/week. An individual categorized as "low active" does not meet any of the criteria for the "highly active" or "moderately active". We included LTPA using dummy variables for each category. Education was included as a binary variable indicating whether the individual has a high-school degree (e.g. the German "Abitur").

We define the short run effect of physical activity as its impact on contemporaneous physician visits conditional on current health status. To control for health-status we included self-assessed health status by three dummy variables indicating whether an individual rates own health as "poor/very poor", "fair" or "good/very good". In addition we included a dummy variable that indicates whether the individual was treated by a physician due to a chronical disease in the last six months. Further, we controlled for gender, age, smoking behavior, alcohol consumption, occupation, income, children in household and waist-to-hip ratio.

2.4. Data Analysis

As our dependent variable 'physician visits' is a count and since it is overdispersed in the data, we estimated negative binomial models with exponential mean function that provide a more efficient estimation than the Poisson quasi-maximum likelihood estimation if the assumption of equidispersion is violated [16].

To identify the mediating role of education in the short-term relationship between LTPA and physician visits, we interacted the LTPA-dummies with the education variable. A similar approach using interaction terms was employed by Kenkel [8] for the estimation of the impact of education on the marginal productivity of exercising for producing investment in health. In order to highlight the effect of considering the role of education, we also estimated a reduced model without the interaction terms.

We included interaction terms of the LTPA dummies with age in both version of the model to control for age specific effects of LTPA. The inclusion of further interaction terms LTPA with health status, gender and health status however did not improve the fit.

In addition we estimated a hurdle model with a Logit model as the hurdle part and a truncated negative binomial model as the count part to assess the effect of LTPA and education on the structure of demand, i.e. the effect on the probability of a first visits and on the number of the following visits. This specification also traces the notion that the process of generating physician visits is likely to be twofold: the contact decision, determining whether a first visit occurs is made by the patient, whereas the number of the following visits given a first contact is mainly determined by the physician (Winkelmann 2004).

3. Results

3.1. Descriptive Analysis

Table 1 provides the descriptive statistics of all variables used. The mean of physician visits in the sample is 1.45, the share of observations with at least one visit is 66%. The share of inactive/low active individuals in the sample is at 14%, the shares of moderate and high active individuals are at 43% both. 73% of the participants have a high-school degree. Table 2 shows the unconditional means of physician visits by physical activity and education. Without subdividing the sample according to high school degree, the mean number of physician visits is not very different between the three LTPA groups (first row). Separating observations according to high school degree reveals different patterns for the different levels of education. Among individuals without degree, the mean number of visits increases with physical activity, whereas among individuals with degree, the mean the number of visits is highest in the low active group as compared with moderate or high active individuals.

Table 1: Sample description, means or frequencies (standard deviations or percentages)

Variable	
N	2091
No. physician visits	1.45 (1.90)
Physician visits > 0 y/n	1371 (0.66)
Leisure time physical activity	
high	900 (0.43)
moderate	906 (0.43)
low/inactive	285 (0.14)
High school degree	1529 (0.73)
Female	1328 (0.64)
Age	41.02 (17.14)
Current occupation	
Employed/Self-employed	1133 (0.54)
Student/Vocational training	627 (0.30)
Unemployed	35 (0.02)
Retired	261 (0.12)
Homemaker	35 (0.02)
Income	
<1000 EUR / Month	489 (0.23)
1000 - 2000 EUR / Month	424 (0.20)
2000 - 3000 EUR / Month	402 (0.19)
3000 - 5000 EUR / Month	477 (0.23)
> 5000 EUR / Month	299 (0.14)
Kids < 14	262 (0.13)
Self assessed health	
Poor/very poor	94 (0.04)
Fair	385 (0.18)
Good/very good	1612 (0.77)
Phys. visits due to chronical disease y/n	356 (0.17)
Waist-to-hip ratio	100.68 (7.45)
Cigarettes/Week	5.13 (20.96)
Alcohol consumption	
<100 g/week	1665 (0.80)
100 - 200 g/week	251 (0.12)
200 - 350 g/week	132 (0.06)
2 > 350 g/week	43 (0.02)

Table 2: Mean physician visits by physical activity and education (standard deviation)

High school degree/LTPA	Total	*Low/inactive*	*Moderate*	*High*
Total	1.45 (1.90)	1.45 (1.86)	1.42 (1.67)	1.49 (2.11)
No	1.49 (1.67)	1.12 (1.21)	1.50 (1.59)	1.61 (1.85)
Yes	1.44 (1.97)	1.61 (2.09)	1.40 (1.70)	1.44 (2.20)

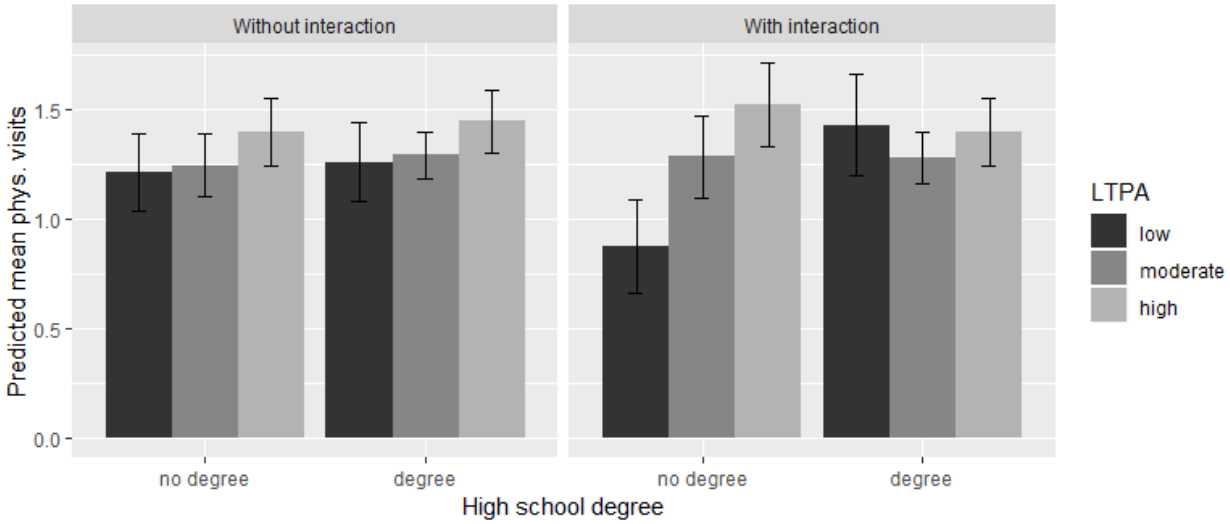
3.2. Negative Binomial Models

The coefficient estimates of the negative binomial models with and without interaction terms of the LTPA dummies with the high school dummy are displayed in Table 3. In the reduced model without interaction terms, the LTPA dummies capture the age independent effect of LTPA averaged over both education levels. Both dummies are positive, but only the dummy for high LTPA is significant. For the total effect of LTPA on physician visits also the negative interaction terms of the LTPA dummies with age must be considered. The level effect of education – the coefficient of the high school dummy - is small and insignificant.

In the model including the interaction of LTPA with education, the interaction terms are highly significant and negative, indicating a clear impact of education on the relation between LTPA and physician visits. The LTPA dummies, which now capture the age independent effect of LTPA for individuals without high-school degree, are both positive and significant. Compared with the model without interaction terms, the age dependent effect of LTPA (interaction LTPA with age) is more salient and the high-school dummy is significantly positive.

Figure 1 shows the predicted mean visits for the activity and education levels for an otherwise average individual of the sample derived from both models. Obviously LTPA has no significant effect for both levels of education in the reduced model (left panel of figure 1). Without the interaction terms, the model predicts 2.5% ($\approx +0.03$, 95% CI $\pm$ 0.19) more visits for the moderately active and 14.9% ($\approx +$ 0.18, 95% CI $\pm$ 0.21) more visits for the highly active individual with or without degree compared with the low active individual. The mean visits are 3.8% ($\approx + 0.05$) higher with high-school degree for each activity group.

Figure 1: Predicted mean physician visits (+/- 95% CI) for an average individual in the sample by LTPA and high school degree from the NegBin models. Panel left: model without interaction between the LTPA dummies with the high school dummy, panel right: model with the interaction terms.



The right panel of figure 1 shows the predicted means for the model with interaction. Without degree, the predicted visits are significantly higher for both the moderate and the high LTPA category compared with the low active category. The mean number of visits for the moderately active individual is 47% (+0.41, 95% CI ± 0.28) above the predicted mean for the low active individual, which has the lowest mean value of all subgroups (0.87, 95% CI ± 0.21). The highly active individual had 74% (+0.65, 95% CI ± 0.29) more visits than the inactive individual. In contrast, with high school degree the mean visits for the moderately and highly active individual are not statistically different from the visits for the inactive/low active individual (moderate vs. low active/inactive: -0.15, 95% CI ± 0.26, high vs. low active/inactive -0.03, 95% CI ± 0.28).

The other coefficient estimates in table 3 are not very different between the models. The male dummy is strongly significant and indicates that men have fewer visits than women. Furthermore the dummies for self-assessed health and the dummy for visits due to a chronical disease are significant with the expected signs, whereas smoking increases physician visits.

Table 3: Estimation results negative binomial models with and without interaction between the LTPA dummies with the high school dummy. Dependent variable: number of physician visits

	Without interaction		With interaction	
Variable	Coefficient	p-Value	Coefficient	p-Value
Leisure time physical activity (Reference "low")				
moderate LTPA	0.286	0.185	0.829	0.007
high LTPA	0.497	0.028	1.138	0.000
High school degree	0.037	0.533	0.493	0.002
Moderate LTPA * high school degree			-0.496	0.006
High LTPA * high school degree			-0.579	0.001
Male	-0.386	0.000	-0.386	0.000
Age	0.005	0.261	0.009	0.050
Moderate LTPA * Age	-0.006	0.201	-0.011	0.042
High LTPA * Age	-0.009	0.082	-0.014	0.007
Current occupation (Reference "Employed/Self-employed")				
Student/Vocational training	0.101	0.370	0.104	0.357
Unemployed	0.195	0.280	0.211	0.244
Retired	0.033	0.746	0.031	0.756
Homemaker	-0.208	0.233	-0.227	0.185
Income (Reference "<1000 EUR / Month")				
1000 - 2000 EUR / Month	0.048	0.583	0.054	0.538
2000 - 3000 EUR / Month	0.031	0.769	0.029	0.784
3000 - 5000 EUR / Month	0.105	0.299	0.097	0.339
> 5000 EUR / Month	0.036	0.744	0.031	0.781
Kids < 14	-0.078	0.329	-0.081	0.312
Self-assessed health (Reference "Poor/Very poor")				
Fair	-0.355	0.003	-0.358	0.002
Good/very good	-0.714	0.000	-0.714	0.000
Phys. visits due to chronical disease y/n	0.589	0.000	0.577	0.000
Waist-to-hip ratio	5.395	0.262	4.247	0.385
(Waist-to-hip ratio)2	-2.761	0.227	-2.198	0.346
Cigarettes/Week	0.002	0.050	0.002	0.057
Alcohol consumption (Reference "<100g/week")				
100 - 200 g/week	0.109	0.155	0.118	0.123
200 - 350 g/week	0.166	0.162	0.169	0.155
2 > 350 g/week	-0.087	0.592	-0.087	0.589
Wave 2016	-0.036	0.519	-0.030	0.580
n	2091		2091	
Log Lik	-3306.7		-3301.2	
AIC	6669.5		6662.5	

We estimated the negative binomial model also for different subsamples. To check the potential impact of outliers we excluded observations with ten or more visits and found that the estimates for LTPA and interaction terms dummies reduced in magnitude but precision remained high (Table A1 in the Appendix). Separate estimations by gender reveal only slight differences for the LTPA related coefficients between men and women (Table A2). Not surprisingly, the coefficient estimates are more salient among individuals with fair or poor health state compared with those for individuals with a "good" or "very good" health state but the coefficient signs remain the same for all subsamples (Table A3).

Table 4 shows the results of the hurdle model. All LTPA associated coefficients have the same signs as in the basic negative binomial model. However, only in the count part of the hurdle model the coefficients are significant, suggesting that LTPA in combination with education and age affects mainly the number of following visits. Somewhat surprisingly, individuals with a fair health status have the same probability for a first visit. Also the number of cigarettes smoked only increases the number of following visits, but not the probability of a first visit.

Table 4: Estimation results for the hurdle model. Dependent variable: probability and number of physician visits

	Hurdle		Count	
Variable	Coefficient	p-Value	Coefficient	p-Value
Leisure time physical activity (Reference "low")				
moderate LTPA	0.596	0.310	1.120	0.010
high LTPA	0.750	0.198	1.660	0.000
High school degree	0.331	0.283	0.716	0.003
Moderate LTPA * high school degree	-0.502	0.167	-0.623	0.022
High LTPA * high school degree	-0.555	0.120	-0.771	0.004
Male	-0.800	0.000	-0.214	0.014
Age	0.008	0.409	0.011	0.106
Moderate LTPA * Age	-0.005	0.624	-0.015	0.039
High LTPA * Age	-0.006	0.563	-0.022	0.002
Current occupation (Reference "Employed/Self-employed")				
Student/Vocational training	0.281	0.113	0.015	0.920
Unemployed	0.243	0.523	0.246	0.307
Retired	-0.268	0.218	0.191	0.198
Homemaker	-0.592	0.102	-0.154	0.516
Income (Reference "<1000 EUR / Month")				
1000 - 2000 EUR / Month	0.216	0.190	-0.026	0.837
2000 - 3000 EUR / Month	0.187	0.306	-0.083	0.554
3000 - 5000 EUR / Month	0.238	0.202	0.050	0.721
> 5000 EUR / Month	0.111	0.578	-0.010	0.947
Kids < 14	-0.124	0.416	-0.073	0.524
Self assessed health (Reference "Poor/Very poor")				
Fair	-0.074	0.807	-0.525	0.000
Good/very good	-0.722	0.011	-0.841	0.000
Phys. visits due to chron. disease y/n	1.210	0.000	0.503	0.000
Waist-to-hip ratio	-9.275	0.430	9.705	0.170
$(\text{Waist-to-hip ratio})^2$	4.657	0.414	-4.985	0.140
Cigarettes/Week	0.0003	0.899	0.003	0.015
Alcohol consumption (Reference "<100g/week")				
100 - 200 g/week	0.165	0.283	0.139	0.202
200 - 350 g/week	0.206	0.341	0.183	0.278
2 > 350 g/week	0.156	0.652	-0.293	0.259
Wave 2016	-0.014	0.887	-0.053	0.524
n		2091		
Log Lik		-3268.0		
AIC		6654.1		

4. Discussion

In this study we analyzed the effect of LTPA on short-term demand for physician visits and the role that education plays for this association. The models with and without the identification of the role of education indicate that among the participants of the Konstanz Life Study physical activity does not decrease short-term demand for physician services.

The model including the interaction terms moreover suggests a clear impact of education on the association between LTPA and physician visits. Among individuals without high school degree, physician visits are lowest for low active individuals and significantly higher for moderately and highly active individuals. In contrast, among individuals with high-school degree, LTPA has no significant effect on the number of physician visits. The negative interaction between LTPA and age further indicates that the increasing effect of LTPA on physician visits is present mainly among younger individuals.

In addition, as judged by significance, the estimation of the hurdle model suggests that LTPA and education mainly affect the number of visits following a first contact. Assuming that the first contact of a treatment period is initiated by the patient whereas the number of the following visits is determined by the doctor in response to the established diagnosis, this result gives support to the hypothesis that low active individuals without high school degree rather differ in the reason for visiting a doctor from physically active individuals than in their propensity to see a doctor. As we do not have further information on the diagnosis or the kind of treatment, we must leave deeper analysis of this question to future research.

As no other study could be found where the role of education is analyzed, we cannot compare our results in this particular respect with the findings of other researchers. However, overall our results do not support the hypothesis that physical activity reduces short term demand for physician visits. This is in contrast to the results reported by Sari [7]. Sari estimated a Zero-Inflated Negative Binomial model with data from Canada and found on average 5.5% more family visits and 13.4% more consultations of other physicians among inactive compared with active individuals. In the study by Sari "physically inactive" was defined as having a total daily energy expenditure of less than 3 kcal per kg of body weight, corresponding more or less to the "low" category in our study.

However, our results are compatible with those reported in a study by Winkelmann [11], the only study available that uses German data to estimate the number of physician visits and that includes

physical activity as an explanatory variable. Winkelmann estimated different econometrical models to assess the effect of a reform in the German health care system on doctoral visits using data from the German Socio-Economic Panel (GSOEP), a representative survey for the German population. The definition of physician visits is identical to the definition in our study (number of visits in the last three months), whereas the definition of physical activity is captured only in a dummy ("Participation in active sports at least once a week"). In most models estimated by Winkelmann [11], physical activity was positive and insignificant except for a Probit-Poisson-log-normal model (probability of a first visit, positive and significant) and a Poisson model with fixed effects (total visits, negative and insignificant). In a Poisson model with cluster robust standard errors, most comparable to our negative binomial model, Winkelmann reports an insignificant 4.6% increase in visits for active people.

Concerning the analysis of contemporary health care demand, there might be worries about reversed causality, that is, reduced LTPA may also be the result and not a determinant of physician visits. This issue certainly would be relevant, if the instrument used to assess physical activity were the IPAQ-questionnaire, where the participants are asked for their physical activity in the *last* seven days, or with accelerometer devices worn in the last three months. Of course, any sickness within the last three months (which led to physician visits) might have had an impact on the possibility to be physically active in the same period. In contrast, the definition of LTPA in the GPAQ – leisure time physical activity in a *normal* week – provides safeguard against this issue since it excludes the assessment of LTPA in extraordinary situations of a temporary nature.

We are aware of two limitations for our study. First, education could be correlated with unobservable factors that are also correlated with physician visits causing biased estimations. An example is medical knowledge. Although medical knowledge is more likely to be acquired by individuals with higher education, it also can be acquired through occupation, i.e. nursing [12], or parental background. The identification of the unbiased effect of education would require valid instruments for education. But since we did not find a credible source of exogenous variation for education in the data, we cannot exclude that the coefficients do not exactly indicate the true effect of education.

Second, as the Life-Study is not designed as being representative for the German population, our results may suffer from selection bias and limited external validity. These concerns in particular arise since the Life-Study is likely to attract individuals with a distinct interest in health and healthy

lifestyle. This gives rise to concerns that participation was not completely random. However the comparison of the results from our negative binomial model without interaction terms with the results from the Poisson model of Winkelmann [11] suggests that our estimates are compatible with those that would have resulted within a more representative population.

5. Conclusion

Among the participants of the Konstanz Life-Study, physical activity does not reduce the number of physician visits. Moreover, education plays a role in the relationship between physical activity and the short-term demand for physician visits. For individuals without high school degree, physical activity significantly increases the number of visits whereas among individuals with high school degree, physician visits are not affected by LTPA.

From the estimation of the hurdle model, it can be concluded that low active individuals without high-school degree rather differ from active individuals in the reasons for doctoral treatment than in the propensity for contacting the physician. For future research it would be interesting to analyze data entailing information on the reasons for the visits to learn about the way education impacts the association between physical activity and short-term demand for physician services.

6. Appendix: Further Tables

Table A1: Estimation results negative binomial models without observations with 10 or more physician visits. Dependent variable: number of physician visits

Variable	Coefficient	p-Value
Leisure time physical activity (Reference "low")		
moderate LTPA	0.665	0.009
high LTPA	0.735	0.003
High school degree	0.356	0.010
Moderate LTPA * high school degree	-0.429	0.008
High LTPA * high school degree	-0.503	0.002
Male	-0.381	0.000
Age	0.005	0.181
Moderate LTPA * Age	-0.008	0.067
High LTPA * Age	-0.007	0.109
Current occupation (Reference "Employed/Self-employed")		
Student/Vocational training	0.135	0.132
Unemployed	0.145	0.418
Retired	0.027	0.771
Homemaker	-0.261	0.121
Income (Reference "<1000 EUR / Month")		
1000 - 2000 EUR / Month	0.034	0.660
2000 - 3000 EUR / Month	0.000	1.000
3000 - 5000 EUR / Month	0.063	0.481
> 5000 EUR / Month	0.043	0.669
Kids < 14	-0.043	0.572
Self assessed health (Reference "Poor/Very poor")		
Fair	-0.210	0.029
Good/very good	-0.527	0.000
Phys. visits due to chronical disease y/n	0.556	0.000
Waist-to-hip ratio	0.330	0.937
(Waist-to-hip ratio)2	-0.208	0.916
Cigarettes/Week	0.002	0.028
Alcohol consumption (Reference "<100g/week")		
100 - 200 g/week	0.117	0.108
200 - 350 g/week	0.101	0.286
2 > 350 g/week	-0.052	0.742
Wave 2016	-0.088	0.053
n	2069	
Log Lik	-3114.1	
AIC	6288.3	

Table A2: Estimation results negative binomial models by gender. Dependent variable: number of physician visits

	Women		Men	
Variable	Coefficient	p-Value	Coefficient	p-Value
Leisure time physical activity (Reference "low")				
moderate LTPA	0.634	0.063	0.899	0.088
high LTPA	1.099	0.001	0.951	0.071
High school degree	0.330	0.070	0.728	0.007
Moderate LTPA * high school degree	-0.359	0.087	-0.628	0.039
High LTPA * high school degree	-0.518	0.011	-0.703	0.023
Age	0.008	0.164	0.008	0.311
Moderate LTPA * Age	-0.009	0.140	-0.009	0.290
High LTPA * Age	-0.015	0.009	-0.008	0.340
Current occupation (Reference "Employed/Self-employed")				
Student/Vocational training	-0.048	0.710	0.400	0.055
Unemployed	0.337	0.138	0.134	0.654
Retired	-0.166	0.188	0.219	0.243
Homemaker	-0.245	0.196	-0.122	0.767
Income (Reference "<1000 EUR / Month")				
1000 - 2000 EUR / Month	0.026	0.789	0.070	0.697
2000 - 3000 EUR / Month	-0.131	0.226	0.189	0.423
3000 - 5000 EUR / Month	0.055	0.622	0.112	0.617
> 5000 EUR / Month	0.087	0.482	-0.148	0.525
Kids < 14	-0.086	0.377	-0.001	0.996
Self assessed health (Reference "Poor/Very poor")				
Fair	-0.288	0.028	-0.498	0.019
Good/very good	-0.644	0.000	-0.823	0.000
Phys. visits due to chronical disease y/n	0.470	0.000	0.749	0.000
Waist-to-hip ratio	4.957	0.307	-2.782	0.879
(Waist-to-hip ratio)2	-2.444	0.290	1.104	0.900
Cigarettes/Week	0.004	0.002	-0.001	0.681
Alcohol consumption (Reference "<100g/week")				
100 - 200 g/week	0.029	0.760	0.264	0.035
200 - 350 g/week	0.150	0.228	0.160	0.433
2 > 350 g/week	-0.138	0.590	-0.103	0.625
Wave 2016	-0.046	0.476	-0.038	0.703
n	1328		763	
Log Lik	-2197.0		-1078.0	
AIC	4452.1		2213.9	

Table A3: Estimation results negative binomial models by health status. Dependent variable: number of physician visits

	Health states "fair" or "good/very good"		Health state" "good/very good"		Health states "poor/very poor" or "fair"	
Variable	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
Leisure time physical activity (Reference "low")						
moderate LTPA	0.811	0.014	0.474	0.235	1.275	0.004
high LTPA	1.135	0.000	0.871	0.024	1.436	0.003
High school degree	0.456	0.007	0.321	0.133	0.658	0.004
Moderate LTPA * high school degree	-0.478	0.013	-0.295	0.215	-0.722	0.007
High LTPA * high school degree	-0.560	0.003	-0.392	0.087	-0.763	0.008
Male	-0.396	0.000	-0.443	0.000	-0.288	0.002
Age	0.010	0.062	0.007	0.323	0.012	0.072
Moderate LTPA * Age	-0.011	0.055	-0.006	0.360	-0.016	0.032
High LTPA * Age	-0.015	0.006	-0.012	0.090	-0.016	0.037
Current occupation (Reference "Employed/Self-employed")						
Student/Vocational training	0.080	0.490	0.044	0.746	0.263	0.133
Unemployed	0.076	0.718	0.257	0.262	0.268	0.376
Retired	0.061	0.555	0.101	0.418	-0.063	0.686
Homemaker	-0.280	0.100	-0.344	0.091	-0.118	0.675
Income (Reference "<1000 EUR / Month")						
1000 - 2000 EUR / Month	0.052	0.571	0.095	0.386	-0.100	0.460
2000 - 3000 EUR / Month	-0.012	0.907	-0.025	0.842	0.088	0.615
3000 - 5000 EUR / Month	0.085	0.417	0.112	0.375	0.065	0.697
> 5000 EUR / Month	0.000	0.999	0.017	0.902	0.002	0.992
Kids < 14	-0.096	0.239	-0.075	0.423	-0.041	0.792
Health status fair					-0.352	0.002
Health status good/very good	-0.347	0.000				
Phys. visits due to chronical disease y/n	0.556	0.000	0.503	0.000	0.687	0.000
Waist-to-hip ratio	2.794	0.608	0.834	0.896	-4.490	0.585
(Waist-to-hip ratio)2	-1.487	0.571	-0.256	0.934	1.404	0.714
Cigarettes/Week	0.003	0.025	0.003	0.105	0.001	0.317
Alcohol consumption (Reference "<100g/week")						
100 - 200 g/week	0.120	0.123	0.144	0.123	0.080	0.521
200 - 350 g/week	0.189	0.117	0.334	0.035	-0.093	0.487
2 > 350 g/week	-0.020	0.899	-0.186	0.364	0.074	0.787
Wave 2016	-0.030	0.600	-0.013	0.843	-0.085	0.339
n	1997		1612		479	
Log Lik	-3097.1		-2408.4		-876.1	
AIC	6252.1		4872.7		1810.3	

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