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AGING AND DIABETES: IMPACT ON EMPLOYMENT AND RETIREMENT

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Abstract

Aging and diabetes influence employment and retirement of those older than 50.The aim of this study is to estimate the impact of diabetes on the ability to work or retire, and to investigate if the development of new job skills, for seniors aged more than 50, increase professional activity in a set of European countries. The fourth wave of the Survey of Health, Ageing and Retirement (SHARE) has been explored by using categorical models that control for age, gender, marital status, education level, new skills and country factors. Diabetes decreases the probable level of professional activity and prolongs retirement. Disparities have been found in the impact of diabetes on peoples' working situation in certain countries, which may be explained through the type of treatments of diabetes and overall by the specificities of each country's health systems. Finally, ageing only slightly increases the period of working, not enough to avoid earlier retirement globally in those European countries.

Keywords Aging, Diabetes, Employment, Retirement.

JEL: J14 Economics of the Elderly, I1 Health, J26 Retirement

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CONTENTS

INTRODUCTION

In Europe, most economies have an ageing population and a high prevalence of diabetes, which in turn, brings professional and health challenges. A set of concerns has arisen, since individuals after a certain age become inactive, unhealthy and need financial and social support that often comes from their families and mainly from social security and health programs.

A controversy has developed concerning the decreasing number of active people during the last six decades, which has diminished financial resources available through pay-as-you-go social security programs. The number of active people who, potentially, economically supports inactive people across the 27 countries of the European Union (EU-27) is dropping from eight to around two from 1950 to 2050 according to OECD (2014a). In the EU-27, the elderly population, which is defined as people aged 65 and over, has been increasing, reaching about 18% of the total population in 2014 (OECD; 2015).

Additionally, against expectations, individuals in Europe are now retiring earlier than some decades ago. The average effective age of retirement[1] for several European countries dropped between 1970 and 2012. In EU-27 the average effective age of retirement for men dropped from 68 to 62 years between 1970 and 2012 (OECD; 2015a).

The exodus of seniors from the workforce may cause both fiscal crisis and labor force scarcity. Fiscal crisis is related to the future of social security, which is often funded by

[1] The average effective age of retirement is calculated as a weighted average of (net) withdrawals from the labor market at different ages over a 5-year period for workers initially aged 40 and over.

a pay-as-you-go system, which some authors speculate could run out as a growing number of individuals retire from the labor force.

Labor force scarcity increases difficulties since there are several weaknesses that older individuals face in wage and salary employment that discourage later retirement. Among them are actual age discrimination, mobility restrictions and health status.

Faced with these challenges concerning age, a set of policies have been discussed, and their implementation has been encouraged in several countries. Those policies tend to increase the legal age of retirement and encourage the participation of seniors in the labor force. Others prefer to motivate the immigrant population. Nevertheless, poor health may diminish productivity and motivation for working.

In an ageing society with the burden in terms of health, there are multiple challenges to achieving a better performance inside enterprises and other organizations. Days of work lost due to the disease may mean less productivity inside companies.

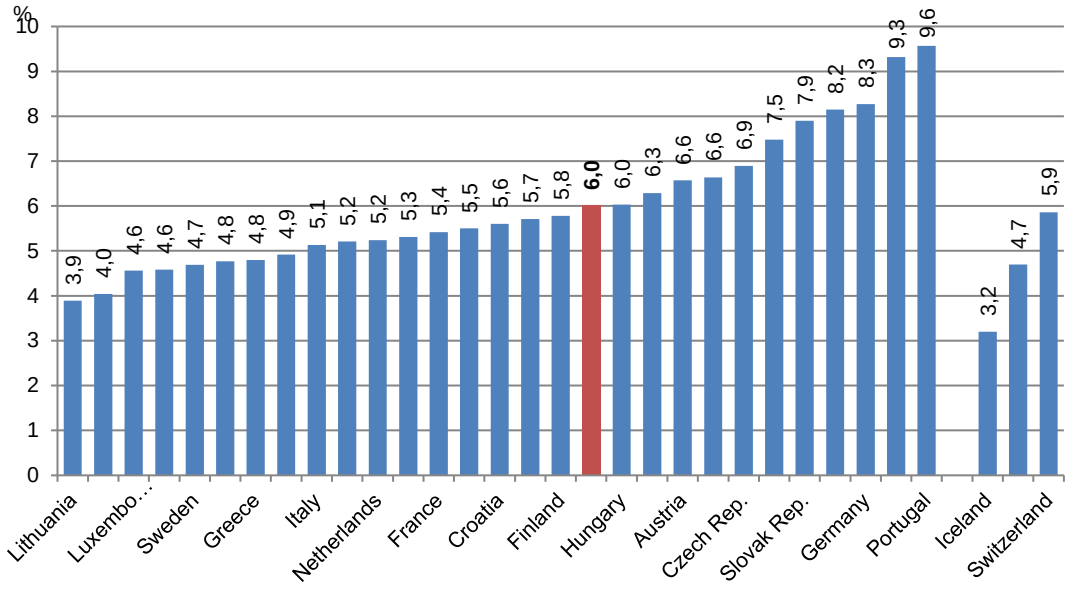
More years of life probably implies an increase of health problems, which can be more or less acute depending on the progress of science and medicine. It is a consensus that when age increases, individual health problems are expected to rise.

Among several diseases and in particular among chronic diseases[2], diabetes is one that is increasing in Europe and worldwide. This sickness is an example of a major risk that affects individuals. According to the OECD (2014), diabetes is one of the main causes of death in

[2] The disease is characterized by high levels of glucose in the blood. Diabetes cases are classified into two types. Type-1 diabetes is when the pancreas stops producing the hormone insulin and type-2 diabetes is a combination of the pancreas having reduced ability to produce insulin and the body being resistant to its action.

Europe. Approximately 271,300 people were estimated to have died from diabetes-related diseases in 2013. In 2013, an estimated 32 million adults aged 20-79 had diabetes in the European Union, according to the International Diabetes Federation (IDF). This figure represents 6% of the population in this age group and is often named the national prevalence of diabetes[3] (see Figure 1). It is expected that in Europe, 38 million adults will have diabetes in 2035.

Figure 1. Prevalence estimates of diabetes, adults aged 20-79 years



Note: The data are age-standardized to the World Standard Population.
Data of 2013.
Source: IDF (2013)

[3] This is a percentage of the number of adults (20 – 79 years) who have diabetes in the given year, which is calculated by dividing the number of cases in adults by the total population in adults. To compare countries, the comparative prevalence is often used, in order to adjust for the distribution of the population in different age groups.

In a European study, a substantial proportion of the population is not monitored at the recommended frequency for important predictors of costly diabetic complications (Liebl, *et al*; 2002). There are recommendations for hemoglobin A_{1c}, total cholesterol, high and low density lipoprotein and triglyceride values from the European Diabetes Policy Group. The target values for control are far from being optimal in a set of European Countries[4].

On average, people with diabetes are three times more likely to be hospitalized than non-diabetic individuals (Björk; 2001). In Europe, 50% of people with diabetes die of cardiovascular disease and another 10-20% die of kidney failure, according to IDF (2013).The risk of leg amputation is 15–40 times higher for people with diabetes, and the risk for heart disease and stroke is two to four times higher, compared with people without diabetes.

In the presence of chronic diseases, such as diabetes, life and the health status of individuals are more difficult than for healthy individuals. Several factors are driving the diabetes epidemic. The most significant factors are those associated with type 2 diabetes, such as to hypertension and dyslipidemia, which are linked to increases in life expectancy, poor diet and a sedentary lifestyle with less physical activity. Often, the indicator of QALY, which relates each additional year of individual life with the quality of life expected in a certain year (Becker, *et al.*, 2005), is used to give a measure of how those factors are expected to affect individuals' well-being. There are other risk factors related with social, economic, and cultural status, literacy, access to health system and adherence to disease treatment (Saydah, *et al*, 2013).

[4] Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom.

When combined with the natural aging process and other age-related conditions, diabetes contributes to poorer outcomes in older people compared to those without diabetes (IDF, 2013). In this context, the aging process and the upward trends in diabetes prevalence are a challenge not only for society, but also for the economy in terms of work in companies and organizations and in terms of economic burden on health systems.

Theoretically, a possible solution to the imminent labor force shortage and fiscal crisis might be senior entrepreneurship. Elderly entrepreneurship would mean a process of recognizing seniors' human capital, which would diminish discrimination towards seniors, elevate social respect, and eventually enhance seniors' life satisfaction.

Additionally, some authors argue that the spirit of entrepreneurship is higher among seniors than in young groups. This might be a valid evidence when individuals hold a satisfactory health profile. Furthermore, in the US, senior entrepreneurs are found to be relevant players in regional economic growth (Zhang, 2008).

The author mentioned before argues that seniors are well-positioned to continue working as entrepreneurs well beyond their retirement years in the knowledge economy, since occupations are more related with processing of information, creative tasks and communication rather than repetitive tasks linked with the Fordist economy. Advanced technologies are reducing the problems of mobility in the sequence of Internet developments and therefore facilitate working remotely, as well as augment productivity (Song, 2015).

On the other hand, further activity might even improve the health status of individuals. Professional experience, maturity, accumulation of knowledge and development

of new job skills might improve the ability to work for seniors. By relying on the development of new job skills, enterprises may increase productivity and performance.

In Europe, the impact of active labor policies for seniors have been less evident and effective than expected when they are formalized. The statistics for whole European Union show that the share of self-employment among 55 and 64 over total employment has a decreasing trend[5] since it dropped from 25,8% to 21,7% in the period 2003-2013 (See Table 1).

Table 1. Incidence of self-employment, for 55-64 years old, in Europe (% of total employment)

	2003	2007	2013
Estonia	9.3	9.7	8.5
Norway	10.7	11.1	10.0
Luxembourg	17.6	0.5	10.1
Denmark	14.9	12.9	11.2
Sweden	13.8	14.0	13.5
Germany	18.3	16.7	14.4
Austria	22.4	18.9	15.7
France	23.1	19.6	17.1
Finland	21.8	17.4	17.2
Hungary	18.7	18.7	17.6
Belgium	20.7	18.3	18.0
United Kingdom	18.9	18.6	19.5
Netherlands	20.9	20.3	21.1
Ireland	21.8	20.5	21.3
EU	25.8	22.7	21.7
Spain	33.4	28.0	24.7
Poland	42.3	36.4	28.8
Italy	43.3	33.8	28.9
Portugal	46.1	42.3	32.1
Greece	63.8	56.4	58.3

Source: OECD, Older workers scoreboard 2014

[5] The incidence decreased from 46.1% in 2003 to 32.1% in 2013 in the case of Portugal. However, the trend in incidence of self-employment of individuals aged between 55 and 64 over total employment within the same cohorts in Portugal and the EU in 2003, 2007 and 2013 shows a high incidence in the case of Portugal compared to whole countries of the European Union.

However, with an unsatisfactory health profile with chronic diseases such as diabetes, individuals face professional challenges in a knowledge economy in a context of ageing. In this context it's worth value to study how the development of new job skills occurs for seniors and study the impact of holding the disease on the ability to work.

This study link empirically health problem caused by diabetes and employment for seniors for a set of European countries. The study is organized in six parts. After this introduction, the literature review about the economic burden of diabetes precedes, the method and data follows, the results and discussion are then explained and at the end the conclusion is presented.

LITERATURE REVIEW

The literature about the impact of ageing and diabetes on professional activity in Europe is almost inexistent. The main discussion in the literature has been about the economics burden of diabetes in terms of its impact on the national healthcare systems. Diabetes imposes a large economic burden on the national healthcare system in most European countries, which might be due to aging and the longevity phenomenon (Robine, *et al*, 2005; Maynard, 2006).

The monetary burden (economic costs) of diabetes is the sum of direct and indirect costs. Diabetes' direct costs are the value of resources such as personal health care, hospital

care, physicians' services, nursing home care, other professional services, and drugs that could be allocated to other uses in the absence of disease. (Colditz, 1992).

Indirect costs are the value of lost output due to cessation or reduction of productivity caused by morbidity and mortality. While morbidity costs are wages lost by people who are unable to work due to the disease, mortality costs are the present value of future earnings lost by people who die prematurely. (González *et al*, 2009)

Some studies base their conclusions on a sample, others focus on the prevalence of diabetes, by using a "bottom-up" approach, which means they still study a representative portion of the population, but they extrapolate for the whole population of a country. (Henriksson and Jönsson, 1998).

The estimated average yearly cost of Type II diabetes per patient for a set of European countries was already EUR 2834 in 1999 (Jönsson, 2002). The expenditures on diabetes care are not evenly distributed across age and gender groups (IDF, 2009). More than three-quarters of global expenditure in 2010 was for persons between 50 and 80 years of age. Women spent more on diabetes care than men.

A French study from about 1850 000 selected patients in order to study the cost differential which could be attributed to diabetes (calculated by determining the difference between costs generated by diabetic patients and those generated by the rest of the population of the same age). The main conclusions point out that between 1998 and 2000, the amount which can be attributed to diabetes alone increased, being estimated at 2.414 billion euros in 2000 compared to 2.021 billion euros in 1998 (Ricordeau *et al*; 2003).

In Sweden the direct costs of diabetes are estimated at 2455 million Swedish Kroner (MSEK) and constitute about 43% of the total cost. The indirect costs (production loss due to morbidity and premature mortality) were the dominant costs and amounted to 3291 MSEK, or 57% of total cost. In this country, the distribution of costs between management/control of the disease and complications has been similar between 1978 and 1994, being similar to the cost structure presented in other American studies. In Sweden in 1994, three times more resources were spent on treating complications compared to what was spent on control of the disease (Björk, 2001). According to this author, diagnosing more individuals with diabetes earlier and introducing and improving_treatment would lead to increased health status and quality-adjuster life years among the population, which would optimise the usage of resources in national health care budgets.

In Germany a study of which the main objective is to identify health care costs of diabetes by age, gender and type of diabetes treatment points out that, the direct costs per person are estimated at 5,262 euros and constitute about 51% of the total cost of disease, representing 14.2% of total health care diabetes-related costs in 2001 (Köster *et al*, 2006). The indirect costs per person (production loss due to morbidity and premature mortality) are 49% of the total cost (5,019 euros).

METHODOLOGY AND STRUCTURE

This study firstly investigates the impact of the development of new job skills on the ability to work for seniors (people aged more than 50) and then how diabetes affect the probability of working or retiring among the selected European countries.

The data is from the 4th wave of the Survey of Health, Ageing and Retirement in Europe (SHARE, 2013)[6], which is a very rich survey. The data accounts for 60,000 interviews in 20 European countries[7] (Börsch-Supan, *et al*, 2013; Malter *et al*, 2013, Börsch-Supan, 2013a).

The method used to estimate those impacts is based on the binary choice models (Greene, 2003). These models allows the estimation of different regressions in order to study the impacts of diabetes and age on work or retirement. The general model can be written has:

$$Y = \begin{cases} 1, & if\ g(X, \varepsilon, ß) > 0 \quad working\ (or\ retirement) \\ 0 & otherwise \end{cases} \qquad (1)$$

[6] "This paper uses data from SHARE Wave 4 released 1.1.1, as of March 28th 2013 (DOI: 10.6103/SHARE.w4.111). The SHARE data collection has been primarily funded by the European Commission through the 5th Framework Programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th Framework Programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5- CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th Framework Programme (SHARE-PREP, N° 211909, SHARE-LEAP, N° 227822 and SHARE M4, N° 261982). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11 and OGHA 04-064) and the German Ministry of Education and Research as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions)." The 4th wave is from 2010-2011.

[7] Estonia, Hungary, Luxembourg and Portugal, Austria, Belgium, Denmark, Spain, France, Germany, Greece, Italy, The Netherlands, Sweden, Switzerland, the Czech Republic, Ireland, Israel and Poland, Slovenia.

Let *Y* be the discrete dependent variable, *X* the vector of explanatory variables, *ß* the vector of the parameters, *g(.)* a generic function and ε the vector of the error terms.

In a binary choice estimation, the objective is to estimate the unobservable variable $Y^* = X\beta + \varepsilon$, that explains the observable binary outcome 0 or 1 of the (observable) dependent variable.

The dependent variables describe the state of the activity that explain either the state of "working" or "not working" and the state of "retired" or "not retired". Therefore, in each model those variables are binary variables that take the value 1 when the individual is in a given situation and 0, if otherwise, respectively.

The vector *X* is composed of a set of factors believed to affect the participation of an individual in the labor market such as age, education, country and the presence of diabetes as mentioned by Chu *et al* (2001).

For each model, the independent variables are:

- gender (variable male, binary variable, were 1 represents male);
- age (variable age as linear, age^2 age squared, age^3 as cubic and age^4 as the fourth power);
- country (20 selected countries; base category: Portugal);
- degree of education (variable education; base category: No education);
- diabetes (variable diabetes as binary variable, were 1 represents having the disease);
- opportunity to develop new skills in main job (variable newskills as a binary variable).

For the variables related to age, the models were tested with age as a numerical variable in linear, squared, cubic and fourth power. Age to the fourth power fully accounts for age's effects, since the prevalence of diabetes increases with seniority (Dall *et al*, 2008).

Following the estimation, the criteria adopted to compare models are the Akaike Information Criteria (AIC) and the Adjusted McFadden"s R^2.

The AIC Akaike's information criterion is a measure to compares different samples or non-nested models. The best model is the one with the lower AIC:

$$AIC = \{-2Ln\ \hat{L}(M_k) + 2P|N\} \quad (2)$$

$\hat{L}(M_k)$ is considered as the likelihood of the model, P as the number of parameters and K as the number of regressors.

The Adjusted McFadden's R^2 with just the intercept to a model with all parameters. The best-fitting model is the one with higher Adjusted McFadden's R^2:

$$\overline{R}^2_{McF} = 1 - \frac{ln\hat{L}(M_{Full}) - P}{Ln\hat{L}(M_{Intercept})} \quad (3)$$

To control for misspecification, regressions are estimated using robust standard errors, also known as White standard errors (Long *et al*, 2014).

RESULTS

Several tests were performed. The test to observe whether all the coefficients in each model are different than zero gives us a satisfactory result for the model, since Prob > chi2 < 0.05. Two-tail p-values test the hypothesis that each coefficient is different from 0. To reject this hypothesis, the p-value has to be lower than 0.05. If such is the case, then the variable has a significant influence on the dependent variable (y).

Table 1. Regression models for measuring the impact of diabetes diseases on working and retirement

	M1—working	M2-working	M3 – retired
	Coeff.	Coeff.	Coeff.
diabetes	-.637***	-.322***	.178***
age	1.492	-.154	-7.441
age2	-.016	.018	.195
age3	-.000074	-.0004**	-.002
age4	1.19e-06	2.62e-06*	7.70e-06
male	.494***	.183**	.336***
married	.059**	.136*	-.082**
education	.093***	.035*	.012***
newskills		-.149***	
cons	-31.643	1.305	89.215
McFadden's Adj R2:	0.391	0.222	0.440
AIC*n:	28359.500	6237.988	29059.186

*significant at 0,1, ** significant at 0,05; *** significant at 0,01

The logit model has odds ratios to infer on the impact a change in a variable has on two different dependent variables that are the probability of being working or the probability of being retired.

The odds ratio represent the odds of Y=1 when X increases by 1 unit. These are the exp(logit coeff). If the OR > 1 then the odds of Y=1 increases. If the OR < 1 then the odds of Y=1 decreases.

The variable of most interest, diabetes, is statistically significant in all models (regressions) for the estimation of being working or retired. In Model M1, M2 and M3, the sign of the coefficient suggests that the presence of the disease increases more the probability of being retired than the probability of being working, which is in harmony with the expectation. When, country dummies variables are introduced, the odds ratio of diabetes in model M4 increase slightly the probability of being retired comparing to M3.

Table 2. Odds Ratio of models

	M1—working	M2-working	M3 – retired	M4 – retired
	Odds Ratio	Odds Ratio	Odds Ratio	Odds Ratio
Diabetes	.529	.725	1.195	1.205
Age	4.447	.857	.0005	1.249
age2	.984	1.019	1.215	
age3	.999	.999	.998	
age4	1.000001	1.000003	1.000008	
Male	1.639	1.201	1.399	1.475
Married	1.061	1.146	.921	1.143
Education	1.097	1.035	1.012	.995
Newskills		.861		
Austria				1.664
Germany				.765
Sweden				.651
Netherlands				.364
Spain				.161
Italy				.435
France				1.245
Switzerland				.475
Denmark				.124
Belgium				.661

	M4 - retired
Czechia	2.476
Poland	1.459
Hungary	2.120
Slovenia	2.325
Estonia	.698

An individual's age effect (age^4) is significant in model M2 to explain the outcome of being employed. Gender and marital status variables are significant in all models. These variables are significant and the odds ratios present at the table above show (>1) that an increase of odds of being employed or retired is expected.

The level of education holds a positive effect on its probability, which is significant in explaining the state. Furthermore, the variable male is also significant, suggesting that the inequality in the distribution of retirement between men and women is still present. Here, the positive sign for the male category (male=1) indicates that being a man increases expressively an individual's probability of being employed and retired. The odds ratio of developing new job skills is less than 1 in both type of models for working and retirement.

The development of new job skills variable is significant but does not hold a positive effect on the probability of being working as could be expected.

A specific country where the individual lives has some explanatory power over their working or retirement situation. A Wald test was performed for the set of dummies that characterize each country. The results proved to be statistically significant for the majority of countries in the models explaining the impact of diabetes on the working situation. The geographical surroundings of the individual have some effect on the outcome of being employed, except for Germany, Netherlands and Italy since the Prob >chi2>0,05.

For Austria, France, Portugal, Czechia (Czech Republic), Poland, Hungary, and Slovenia, the Odd Ration is higher than 1, and the probability of being retired increases (Table 3. Model M5). The inverse exists for the other countries.

Table 3. Model M5

retired	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
diabetes	1.300129	.0548764	6.22	0.000	1.196902	1.412259
age4	1	3.43e-09	50.50	0.000	1	1
male	1.458037	.0363652	15.12	0.000	1.388476	1.531082
married	1.127919	.0326644	4.16	0.000	1.065681	1.193792
education	.9891544	.003332	-3.24	0.001	.9826453	.9957065
Austria	1.552916	.10476	6.52	0.000	1.360585	1.772434
Germany	.8216134	.290936	-0.55	0.579	.4104443	1.644678
Sweden	.7804348	.189683	-1.02	0.308	.4846787	1.256664
Netherlands	.3912547	.0442191	-8.30	0.000	.3135146	.4882715
Spain	.1733794	.0199915	-15.20	0.000	.1383087	.2173428
Italy	.464675	.0454859	-7.83	0.000	.3835546	.5629521
France	1.146777	.0804255	1.95	0.051	.9994998	1.315756
Switzerland	.4990087	.0362388	-9.57	0.000	.4328052	.575339
Denmark	.0879695	.0296492	-7.21	0.000	.0454405	.1703023
Belgium	.6343126	.049054	-5.89	0.000	.5451003	.7381257
Czechia	2.249603	.1476927	12.35	0.000	1.977981	2.558525
Poland	1.442851	.4698866	1.13	0.260	.762105	2.731671
Hungary	1.990586	.137201	9.99	0.000	1.739049	2.278504
Slovenia	2.093423	.1585138	9.76	0.000	1.804696	2.428342
Estonia	.7616767	.0498468	-4.16	0.000	.669985	.8659169

Note: Logistic regression;Number of obs=37555; Wald chi2(20)=4834.25;
Prob>chi2=0.0000; Pseudo R2=0.3624

DISCUSSION

The aim of this study is to measure how diabetes constrains the ability to work or retire and whether seniors (>50 years old) develop new job skills that increase the probability of working.

In all models for the complete sample that does not individualize each country, the results are consistent with diabetes as a disease that decreases the probability of working

since the odds ratios of it in the models M1 to M2 are below the unity. The probability of being retired clearly increases because the odds ratio of diabetes is greater than one.

The introduction of countries variables to control for geography differences among the European countries related with population health characteristics, shows that the impact of diabetes on professional activity is different from country to country. Therefore, there are disparities among the selected countries which may be explained through the health systems' characteristics and treatments implemented.

The model M2 confirms that there are an individual's age effects, which mean that ageing increases the outcome of being employed, but very slightly, because the odds ratio is only close to one. This reveals that in the selected countries of Europe, the active policies are not substantially increasing the effective age of retirement. Earlier retirement persists among the countries, as mentioned before.

It was found that in seven European countries having diabetes, the probability of working is decreasing and the probability of being retired is increasing. This result is in line with the fact that the existence of social security programs in those countries, but against with the expected results of active labor policies for seniors.

Additionally, the result points out that the development of new job skills do not cause the probabilities of working to grow. Regarding that now occupations are more related with processing of information, creative tasks, communication, by using advanced technologies, this result means that the development of new job skills for seniors need more investment in order to improve seniors professional activity.

Finally, less discrimination in terms of age, further investment in knowledge management for seniors through the active labor policies for seniors, simultaneously with diabetes prevention and care are measures that in practice would not only benefit health systems' budgets, but also competitiveness and productivity of companies in the economy.

CONCLUSIONS

Individuals face professional challenges in a knowledge economy in a context of ageing and diabetes. This study join the subjects of aging, diabetes and professional activity for seniors by using data from a set of European countries included in the Share inquiry. This study provides new evidence that diabetes significantly decreases the probability of employment while increasing the retirement period in some European countries, such as Austria, France, Portugal, Czechia, Poland, Hungary and Slovenia. Additionally, it shows that diabetes is one relevant disease that need to be better diagnosticated, treated, controlled and managed to improve active aging.

The impact of diabetes on professional activity is negative in a set of European Countries included in the inquiry without considering the specific effects of each country. Health problems related with diabetes are causing great economic challenges not only in companies but also in the economy overall. Further investments in education for development new skills and appropriate health treatments of diabetes enhance professional activity. Therefore, those investments are key steps to promote conditions towards active aging and entrepreneurship in senior age.

Regarding that now occupations are more related with processing of information, creative tasks, communication, by using advanced technologies, this result means that the development of new job skills for seniors need more investment in order to improve seniors professional activity, while health fragilities could arrive due to aging.

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