How does having diabetes affect ADL disability in elders?

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1 Introduction

Developing countries, particularly those in Latin America and the Caribbean, have experienced a decrease in mortality levels giving a significant raise in life expectancy (Rosero-Bixby, 1996). An immediate result was a relative increase in the number of elders in those countries. In this context, mean life expectancy at birth poses an important question in researching the effects of chronic diseases in the health of these new elders.

The prevalence of disability is high in individuals with chronic diseases (Stewart et al, 1989). Among these chronic diseases, diabetes has an important role, since it shows a considerable prevalence among the elderly. In fact, the UN supports this claim and classifies diabetes as an epidemic in a global basis. (UN Resolution, 2007). In Costa Rica according to Brenes and Rosero (2007), one of every four elders suffers from diabetes.

An important aspect of diabetes is that many of its consequences derive from complications associated with the disease. To name a few, one can mention blindness, renal and vascular insufficiency, amputations of lower extremities and hypertension. Not only do these consequences have a significant impact in terms of elevated health care costs but also, they can be thought to increase the risk of having disabilities in activities of the daily life. Indeed, studies in various countries have shown that diabetes is highly correlated to increased disability (Edge, 2004).

This paper aims to examine how the prevalence of diabetes can affect the physical disability of the elderly in Costa Rica, controlling for demographic and socioeconomic factors as well as other diseases.

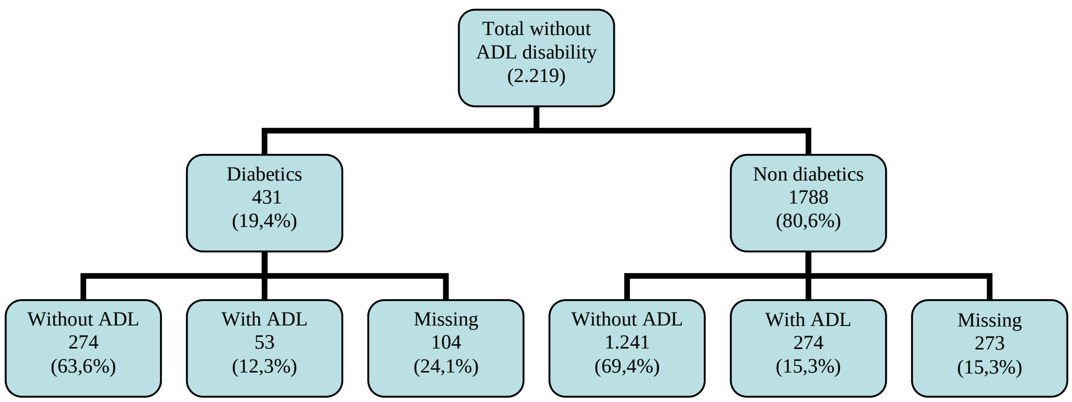
2 Methodology

In achieving the objectives of this paper, we will use the study of Healthy Aging and Longevity (CRELES, CCP University of Costa Rica) with elders of 60 years of age or more living in Costa Rica. The data were collected in two rounds, Jun-2004 and Aug-2006, and the respondents were selected by random sampling stratified by age quintile.

The method used in this research consists of a multivariate logistic regression analysis that assesses the effect of the prevalence of diabetes in the incidence of physical disability for Activities of Daily Life (ADL). The model's dependent variable is the incidence of at least one functional disability by ADL (walking, bathing, using the bathroom, eating and getting in or out of bed), coded as a dichotomous response. The presence of diabetes is our main independent variable and was self-reported; subjects were denoted as diabetic if a doctor had ever told them they had diabetes. The covariates in the model included socio-demographic variables (age, sex, family arrangement, education, marital status), health variables (body mass index - BMI, APS, cognitive ability, hand muscle strength) as well as other chronic illnesses (infarction, arthritis, osteoporosis and stroke).

In the first round, the study reports 2,219 persons out of 2,827 without limitations of ADL, among which 19.4% reported having diabetes. Therefore, the total sample of diabetics tallied 431 elders. The diagram in Figure 1 allows for a better understanding of the sampling design of this study.

Figure 1: Sample design for the study



3 Preliminary Results

Table 1. Descriptive characteristics of the sample at baseline for people with diabetes (n=2219)

EXPLANATORY VARIABLES	TOTAL N	D N (%)	ND N (%)
Total	2219	431 (19.4)	1788 (80,6)
Age, average ± Stdv *	74.1 ± 8.8	72.4 ± 7.6	74.6 ± 9.0
Sex (male)	1057 (47.6)	160 (15.1)	897 (84.9)
Family arrangment (living alone)	279 (12.6)	40 (14.3)	239 (85.6)
Education (6 years or more)	737 (33.2)	137 (18.6)	599 (81.4)
IBM. average± stdv *	26.4 ± 5.1	28.5 ± 4.6	25.8 ± 5.1
Self report health (bad health)	1057 (47.6)	264 (25.0)	793 (75.0)
Cognitive deterioration (no deterioration)	602 (27.1)	113 (18.8)	489 (81.2)
Grip strenght (Kg), average± Stdv	25.7 ± 8.6	26.0 ± 8.7	24.5 ± 8.3
Heart attack	102 (4.6)	31 (30,4)	71 (69.6)
Arthritis	322 (14.5)	67 (20,8)	255 (79.2)
Osteoporosis	191 (8.6)	46 (24,1)	145 (75.9)
Stroke	67 (3.0)	15 (22,4)	52 (77.6)

Table 1 presents baseline characteristics of the sample. The mean age of sample subject was 74.1. On average, diabetics had a BMI of 28.5, 2.1 points above the overall average. In regards to cognitive deterioration, almost 20% of diabetics had moderate or severe deterioration. Moreover, prevalence of some diseases oscillates between 20% and 30% among diabetics, heart attack being the most prevalent (30.4%) followed by osteoporosis (24.1%), stroke (22.4%) and arthritis (20.8%).

Overall, preliminary results point to a correlation between diabetes and functional disability in at least one ADL. This association is partly mediated by demographic, socioeconomic and health factors.

Table 2 shows the odds ratio for each explanatory variable and the level of significance in 4 models. The first model utilizes diabetes as the only explanatory variable and shows a significant relation between diabetes and the incidence of at least one ADL (*p=0.000*). The other models gradually add the other co-variables to see how they alter the relation between diabetes and the incidence of ADLs.

The results show that, once you control for socio-demographic before controlling for other health variables, having diabetes increases by 92% the odds of developing at least one ADL disability. On model 4, once controlling both socio-demographics and health variables and other chronic diseases, having diabetes still increases by almost 65% the odds of developing at least one ADL disability. In other words, having diabetes in the first round increases the odds of having an ADL disability in the second round by 1.63 times.

Table 2: Logistic Regression of the effect of diabetes in the incidence of ADL disability

	Modelo 1		Modelo 2		Modelo 3		Modelo 4	
Explanotory Variables	Odds	P>|z|	Odds	P>|z|	Odds	P>|z|	Odds	P>|z|
Diabetes**	1.82	0.000	1.92	0.000	1.65	0.008	1.63	0.010
Age 70-79 (ref 60-69)**			2.62	0.000	2.19	0.000	2.11	0.000
Age 80 or more (ref 60-69)**			6.48	0.000	3.84	0.000	3.69	0.000
Living alone			1.10	0.696	1.19	0.466	1.20	0.452
Male sex**			0.69	0.021	1.71	0.019	1.87	0.007
Years of education			0.81	0.185	1.16	0.421	1.19	0.333
Grip strenght 2nd quartile (ref 1st)**					4.90	0.000	4.63	0.000
Grip strenght 3nd quartile (ref 1st)**					3.20	0.000	3.14	0.000
Grip strenght 4nd quartile (ref 1st)					1.05	0.858	1.04	0.887
Moderate cognitive deterioration (No deterioration)					1.18	0.430	1.19	0.396
Severe cognitive deterioration (No deterioration)**					3.22	0.000	3.45	0.000
Bad self-report health					1.46	0.023	1.38	0.057
BMI 2nd quartile (ref 1st)					0.56	0.113	0.55	0.108
BMI 3rd quartile (ref 1st)					0.63	0.187	0.62	0.189
BMI 4th quartile (ref 1st)					1.09	0.816	1.06	0.884
Arthritis*							1.63	0.021
Stroke*							1.95	0.076
Osteoporosis							1.60	0.076
Heart Attack							1.14	0.737

Source: Costa Rica Study of Longevity and Healthy Aging (CRELES), 2004-2006.
*Significative at 5% level
**Significative at 1% level

Table 3 shows the final model in more detail with 95% confidence interval. When assessing goodness of fit, according to Pearson´s Chi-Square test ($X^2=1147.82$) we do not reject the hypothesis that there is a good fit *(p=0.4626)* and conclude that the model estimated fits well with the data. Its pseudo R^2=0.1603 states that the model manages to explain 16% of the variance of the data. Moreover in table 3, one can see that among the health-related variables, grip strength, severe cognitive deterioration and arthritis affects one's incidence of ADLs by elevating the odds of having an ADL if one of these is present. For example, having a severe cognitive deterioration in the first round, increases the odds of developing an ADL on the second round by 3.45 times.

Age and sex are also related with the incidence on ADL disability. As age increases, the odds of getting an ADL disability rise. Subjects with 70-79 years of age in comparison to having 60-69 have 2 times higher odds of getting at least one ADL disability. Moreover, elders of 80 years or more have 3.7 times the odds of those 60-69 years of developing an ADL disability. Additionally, men show higher possibilities of getting an ADL disability on the second round than women do, almost twice the odds of women. As for education, table 3 shows that education does not have a significant relationship with ADL disability *(p=0.333)*.

Table 3: Logistic Regression of the effect of diabetes in the incidence of ADL disability

Incidence of ADL disability	Odds Ratio	Std. Err.	P>|z|	[95% Conf	Interval]
Diabetes**	1.63	0.31	0.010	1.13	2.36
Age 70-79 (ref 60-69)**	2.11	0.40	0.000	1.45	3.06
Age 80 or more (ref 60-69)**	3.69	0.87	0.000	2.32	5.86
Living alone	1.20	0.30	0.452	0.74	1.95
Male sex**	1.87	0.44	0.007	1.19	2.96
Years of education	1.19	0.22	0.333	0.83	1.70
Grip strenght 2nd quartile (ref 1st)**	4.63	1.38	0.000	2.58	8.31
Grip strenght 3nd quartile (ref 1st)**	3.14	0.86	0.000	1.84	5.36
Grip strenght 4nd quartile (ref 1st)	1.04	0.29	0.887	0.60	1.79
Moderate cognitive deterioration (No deterioration)	1.19	0.24	0.396	0.80	1.78
Severe cognitive deterioration (No deterioration)**	3.45	0.93	0.000	2.03	5.84
Bad self-report health	1.38	0.23	0.057	0.99	1.91
BMI 2nd quartile (ref 1st)	0.55	0.20	0.108	0.27	1.14
BMI 3rd quartile (ref 1st)	0.62	0.22	0.189	0.31	1.26
BMI 4th quartile (ref 1st)	1.06	0.39	0.884	0.51	2.17
Arthritis*	1.63	0.34	0.021	1.08	2.46
Stroke*	1.95	0.73	0.076	0.93	4.06
Osteoporosis	1.60	0.42	0.076	0.95	2.69
Heart Attack	1.14	0.43	0.737	0.54	2.40

Source: Costa Rica Study of Longevity and Healthy Aging (CRELES), 2004-2006.
*Significative at 5% level
**Significative at 1% level

In summary, the study shows that there is a higher risk of developing ADL disabilities for diabetics that ranges from 1.63 and 1.82 the odds of a non-diabetic, depending on the controlling variables.

4. Discussion

The positive correlation between diabetes and disability in the adjusted model can be explained by the fact that diabetes causes, among other complications, neuropathies. These neuropathies cause motor and sensory changes, as well as micro-vascular injury which, in turn, cause a reduction of blood flow and muscle strength and diminish the person's ability to undergo their daily activities.

We believe that the outcome of this investigation contributes, from a public health standpoint, important insight for the decision making processes on the development of preventive campaigns to reduce the factors that increase the prevalence of diabetes in the population.

This model was fitted (results not shown) using the missing data in two opposite scenarios. The purpose for this was to guarantee that the missing information between rounds did not affect the results. In the best case scenario, the missing values referred to people that had ADL disabilities and in the worst case scenario the missing values where considered as people without ADL disabilities. We concluded that the models used are consistent since the differences considering the best and worst case scenarios were negligible.

4.1 Limitations

It is worth acknowledging some of the limitations of this study. The ADL disabilities and the presence of diseases were self-reported and hence not diagnosed by a health physician. Furthermore, the study of CRELES is, as of yet, only two rounds, which hampers an analysis of the incidence of diabetes on the incidence of functional disability, since a two year lag between rounds can be too short a period of time to observe an effect of newly diagnosed diabetics on new cases of ADL disabilities. Future research considering the incidence of diabetes is called for, as the study of CRELES expands to a third round.

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