Healthy Life Expectancy in People With and Without Diabetes in Latin America and the Caribbean

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Abstract

This paper estimates diabetes-free life expectancy in Latin America and the Caribbean using data from two large surveys (SABE and MHAS). It also investigates the differences in total life expectancy, disability-free life expectancy, and disabled life expectancy between diabetics and non-diabetics. Results show that elderly individuals are expected to live a large proportion of their lives with diabetes. For example, men and women at age 60 in Mexico City can expect to live about 20% of their remaining years of life with diabetes. Data from Mexico show that diabetes reduces total and active life expectancy (at age 50) in eight years. Diabetics are also more likely to live a higher percentage of their lives with functional disability – disabled life expectancy (measured by ADL) represents 17% of the remaining lives of diabetics and 12% of non-diabetics. Diabetes significantly shortens total and active life expectancy, which imposes considerable economic and social costs.

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Diabetes prevalence is increasing very fast around the world and, in some regions, it has reached epidemic levels. Little is known about the trends on diabetes incidence, but given the increase on prevalence rates, it is likely that underlying incidence rates are also on rise and mortality rates are declining for those with and without diabetes (even though, increases in prevalence rates may also be due to increase awareness of the disease). A growing body of the literature has shown evidence of decreasing age at onset of the disease. Two linked events - the increase in the prevalence of impaired glucose tolerance and the earlier onset of diabetes mellitus - are associated with the recent increase in obesity (Aguilar-Salinas et al., 2002; Goran, Ball, & Cruz, 2003; Pontiroli, 2004). The earlier onset of diabetes may be responsible for increases in the lifelong duration of diabetes and the length of diabetes-related disability and morbidity. Moreover, given the evidence that early-onset type of type2 diabetes is a more aggressive disease – increasing the myocardial infarction risk about 14 times (Hillier & Pedula, 2003) – those with early onset are expected to be even more disabled and unhealthy. Also, since diabetes increases the mortality risks, the total life expectancy (TLE) and the disability-free life expectancy (DFLE) of those with the condition are reduced (Jagger, Goyder, Clarke, Brouard, & Arthur, 2003; Laditka & Laditka, 2005).

In Latin America and the Caribbean, the rise of diabetes prevalence in has been remarkable and it is expected to increase even more – in 1995, 5.7% of the population had diabetes and prevalence rate is expected to reach 8.1% in 2025 (King, Aubert, & Herman, 1998). The prevalence of the disease among elderly is even higher. In Mexico, 17% of those aged 60 and over have diabetes, while in Mexico City and Bridgetown it reaches 22% of the elderly population.

This paper explores the general hypothesis that diabetes imposes a considerable burden on these societies and that individuals with diabetes are expected to live shorter lives and a larger proportion of their lives with disability. The first goal of this paper is to estimate the diabetes-free life expectancy using data from seven regions in Latin America and the Caribbean based on the Sullivan method. This measure will give an idea about the general burden of diabetes in terms of years lived with and without the disease. The second goal is to estimate the life expectancy for individuals with and without diabetes based data from a nationally representative panel data from Mexico conducted in 2001 and 2003. This paper also analyzes the differences in the number of years that individuals can expect to live with and without disability taking the diabetes status into consideration.

The effects of diabetes on life expectancy and healthy life expectancy

The literature about the effects of diabetes on life expectancy, and particularly on disability-free (healthy) life expectancy is recent and remains limited to the analysis of data from developed countries.

Bélanger, Martel, Berthelot, and Wilkins (2002) analyze the gender differences in disability-free life expectancy for some chronic conditions using data from the National Population Health Survey conducted in 1994 in Canada. Data included over 6,000 respondents living in private households and other 1,956 individuals aged 45 and older living in institutions. Their concept of ‘any disability’ includes disability or institutionalization. Disability is measured by moderate disability (limitations performing heavy and light household chores, shopping for groceries) and severe disability (meals preparation, personal care, mobility around the house).

They show that diabetes has a great impact reducing disability-free life expectancy for both men and women. Disability-free life expectancy at age 45 is 14.1 years lower for women with diabetes than for those without the disease. Among men, diabetes reduces disability-free life expectancy in 10.7 years. Diabetes also had a strong effect reducing total life expectancy of women in Canada – total life expectancy at age 45 is reduced in 13 years among women. However, the effects are much smaller among men – diabetics have total life expectancy of 27.7 years, while non-diabetics are expected to live 33.3 years, on average. The authors conclude that diabetes imposes a bigger burden on total life expectancy among women, but diabetes-related disabilities are probably similar among both sexes.

Jagger et al. (2003) use data from five rounds of a routine health assessment of individuals aged 75 and older in Leicestershire, United Kingdom. The final sample is composed by 2,474 individuals. Jagger and colleagues show diabetics have lower total life expectancy than those without diabetes – life expectancy at age 75 reaches 10.3 among non-diabetics and 7.2 among diabetics. Results also show that disability-free life expectancy of diabetics is reduced in 2.4 years – disability-free life expectancy of diabetics aged 75 is 4.7 years, while non-diabetics are expected to live, on average, 7.1 years without any losses on autonomy.

Laditka and Laditka (2005) use data from the United States nationally representative1984-1990 Longitudinal Study of Aging. The baseline survey sample is composed by 7,527 non-institutionalized individuals aged 70 and over. Those who entered nursing homes in the follow-up interviews were included in the final sample. Disability was defined when individuals had difficulties performing at least one activity of daily living (bathing, eating, dressing, transferring and using the toilet), while the unimpaired status was defined if the individual didn't have any limitation on activities of daily living (ADL). Their results confirm that individuals with diabetes live shorter lives with more disability. More specifically, their results show diabetes reduces the total life expectancy by 4.1 years among white, highly educated women aged 70 (the average remaining years of live among diabetics reach 13.9 in this category and 9.8 among non-diabetics). These white highly educated women are expected to live almost 40% of their remaining lives with some sort of impairment if they are diabetic at age 70, compared with 28% among their non-diabetic counterparts. Among white highly educated men, life expectancy is reduced in 2.8 years, on average, among diabetics. Diabetic highly educated white men are also expected to live a larger percentage of their lives with some impairment compared with non-diabetics, 26.5% and 19.1%, respectively. Results indicate that the diabetic toll in terms of total life expectancy and unimpaired life expectancy is higher for women. Also, as expected, having lower education and/or being non-white reduce the total life expectancy and increases the number (and percentage) of years expected to be lived with impairment for both diabetics and non-diabetics. The authors conclude that since many covariates were not included in the model the estimates should be taken as suggestive of the burden of diabetes on the total and disability-free life expectancies.

Methods, data and measures

Data

Data on self-reported diabetes prevalence in Latin America and the Caribbean come from SABE (Salud, Bienestar y Envejecimiento en América Latina y el Caribe Proyecto) and MHAS (Mexican Health and Aging Study). MHAS also provides the necessary panel data that will be used to generate multistate life tables. Additional mortality data was obtained from a variety of sources and they are described below.

- **Salud, Bienestar y Envejecimiento en América Latina y el Caribe Proyecto (SABE)**

SABE is a multicenter survey that investigates the health and well being of older people (aged 60 and over) and, in some cases, of their surviving spouse in seven capital/major cities in countries of Latin America and the Caribbean. The cities investigated were: Buenos Aires (Argentina); Bridgetown (Barbados); São Paulo (Brazil); Santiago (Chile); Havana (Cuba); Mexico City (Mexico); Montevideo (Uruguay) (Peláez et al., 2003). The general survey was funded and supported by the Pan American Health Organization (PAHO/WHO), Center for Demography and Ecology, University of Wisconsin-Madison and National Institute on Aging. In each country, international and national institutions contributed for the project.

The questionnaire design was intentionally geared toward the production of information that could be comparable with that retrieved in other countries. In particular, the aim was to include modules and sections modeled after the Health and Retirement Study (HRS) in the U.S. A standardized questionnaire was used to collect detailed information during face-to-face interviews. Samples were drawn using multistage clustered sample with stratification of the units at the highest levels of aggregation. Detailed information on sample selection is presented elsewhere (Palloni & Peláez, 2002).

The sample is composed by 10,602 individuals aged 60 and over. Among those, 8,782 were not previously diagnosed with diabetes, while 1,763 reported a previous diagnosis of diabetes. Other 57 individuals did not answer the question (0.54% of the sample) and were excluded from the analysis. There were no age or sex differences between those who answered or not the question regarding a previous diagnosis of diabetes. Five individuals had missing values on the sample weight variable and were excluded from the analysis. The final sample is composed by 10,540 individuals. The mean age of the sample is 70.2 years (weighted estimates) and most of the sample (59.7%) is composed by women. Among diabetics, mean age reaches 70 years and 59.3% are females. Among non-diabetics, mean age is 70.2 years and 59.8% are women.

- **Mexican Health and Aging Study (MHAS)**

MHAS is a prospective two-wave panel study of a nationally representative cohort of Mexicans born prior to 1951 (50 and older). The survey has national and urban/rural representation. Surviving spouses regardless of their age were also interviewed. The baseline interview was conducted in 2001 and the second wave during 2003. Data collection was done in collaboration with The National Institute of Statistics. The study was designed field protocol and content similar to HRS. Detailed information is presented elsewhere (Palloni, Soldo, & Wong, 2002).

In the first wave, a total of 15,144 complete interviews were obtained (response rate 94.2% at the household level). There are13,022 individuals aged 50 and over with complete information on age, sex and diabetic status. From the initial 15,144 individuals, there are 1,718 with less than 50 years of age, and they were excluded from the analysis. Other 404 individuals without diabetic status at baseline were also excluded. There were no age differences among those with complete or missing information on diabetic status, but more men lacked this information than women. Among the 13,022 cases with complete information on age, sex and diabetic status, the mean age reaches 62.7 (weighted estimate) and 53.8% are women. Among diabetics, the mean age reaches 63.4 years and 60.3% are women. Among non-diabetics, the mean age reaches 62.6 years and 52.7% are women. For the analysis of ADL limitations, the final sample is restricted to 12,050 individuals with complete information in both waves. For instrumental activities of daily living (IADL), 12,065 individuals had full information and for

Nagi limitations (Nagi, 1976), 12,056 individuals were analyzed. Those with missing data on disability and mobility measures in the first wave were older ($p<0.0001$) and more likely to be men ($p=0.0001$). However, there were no differences by diabetic status. There were 546 deaths between waves, 518 of them among those with complete information on age, sex, diabetic and disability statuses.

- **Mortality data**

Mortality data for Buenos Aires was obtained in the “Anuario Estadistico” for the years 2000 and 2001. Deaths of both years were averaged. Population estimates for Buenos Aires were obtained at INDEC based on the census data (Censo Nacional de Población, Hogares y Viviendas 2001). Data were not available for Bridgetown. Therefore, the life table produced by World Health Organization (WHO) for Barbados is being used for Bridgetown instead. The life table refers to the year 2000. The use of the Barbadian life table is reasonable because 37% of the total population lives in Bridgetown according to PAHO (Pan American Health Organization). Population of the São Paulo metropolitan area was obtained with the Brazilian Census Bureau (IBGE), mortality data was obtained in the SEADE foundation that analyzes relevant social, demographic and economic data in the São Paulo state. Santiago life table refers to the period 2001-2002 and it was published by the Chilean population bureau (Instituto Nacional de Estadísticas). The publication “Chile: Tablas Abreviadas de Mortalidad, por sexo. País y Regiones, 2001-2002” contains the life tables for disaggregated by sex and regions. Life tables for Havana were created by Esther María León Díaz from Universidad de La Habana. The life table for Mexico was obtained at WHO website, while the life table for Mexico City uses data from CONAPO. The life table for Montevideo refers to the year 2000 and it was published by the Uruguayan population bureau (Instituto Nacional de Estadísticas) and it is available in the internet (http://www.ine.gub.uy).

Methods

Sullivan method will be used to estimate the diabetes-free life expectancy based on prevalence data from SABE and MHAS 2001. The Sullivan method is the most widely used method to estimate population health indicators. The Sullivan method is based on a standard life table with two states (alive and dead). The “alive” state is subdivided into healthy and diseased (or disabled) using observed prevalence of disease (or disability) (Barendregt, 1999; Jagger, Hauet & Brouard, 2001; Nusselder, 2003). This measure will give an idea about the general burden of diabetes in terms of years lived with and without diabetes.

Finally, multistate life table method (MSLT) will be used to estimate disability-free (DFLE) and disabled life expectancy (DLE) by sex and diabetic status in Mexico based on panel data from MHAS. Compared with Sullivan method, the use of multistate models has the great advantage of incorporating recovery as part of the process. Usually four transitions are measured: incidence (active to disabled), recovery (disabled to active) and mortality (active to dead and disabled to dead). There are also two retention statuses as people declare being active (disability-free) or disabled in both waves. The ability to incorporate improvements and declines in the health state makes incidence modes much closer to the reality. Recently, Lièvre and Brouard (2003) proposed a method of maximum likelihood to estimate the transition probabilities between health states that takes into consideration irregular intervals between interviews across observations. Their software, IMaCh (Interpolative Markov Chain) 0.98g version, estimates the transition probabilities that are used to generate life expectancy estimates as well their confidence intervals.

Measures

Diagnosed diabetes was obtained by self-report in both SABE and MHAS. Individuals who were previously told by a physician that they had diabetes were considered diabetics. In MHAS, those who reported having diabetes in the first wave were assumed to have the condition in the second wave.

Disability was measured using three measures: ADL, IADL and Nagi functional limitations. Six activities were considered in the ADL measure: dressing, bathing, eating, getting in and out of a bed (transferring), toileting, and getting across the room. In MHAS, those who did not declare having Nagi limitations were assumed not to have ADL limitations. The IADL measure includes: preparing a hot meal, money management, shopping, and taking medication. The Nagi physical performance measure included: lifting or carrying objects weighted 5 Kg or over, lifting up a coin (using fingers to grasp or handle), pulling or pushing a large object such as a living room chair, stooping, kneeling or crouching, and reaching or extending arms above shoulder level. ADL, IADL and Nagi measures are in the binary form, in which those scoring '0' indicate that they do not have any limitations, while score '1' was assigned for those who have reported having difficulty performing at least one activity of each scale.

Finally, two measures capture the need for help in basic life activities (ADL and IADL limitations). Individuals were asked in MHAS whether a spouse or another person assisted them on basic and instrumental daily activities. Individuals who require assistance performing these activities are more severely disabled than others that do not require help from others. These measures also give an indication of the extension of personal care assistance necessary to improve the quality of life of those with disability. Help on ADL activities and on IADL activities are in the binary form, in which those scoring '0' indicate that they do not have require assistance on ADL or IADL activities, while score '1' was assigned for those who have reported requiring human assistance in least one activity of each scale.

Results

Diabetes-free life expectancy

The analysis in this section focuses on diagnosed cases for which there is available empirical data in SABE and MHAS. Results indicate that diabetes imposes a heavy burden on elderly individuals in Latin America and the Caribbean with prevalence rates reaching 21.72% in Bridgetown and 21.59% in Mexico City. São Paulo (18.02%) has intermediate levels of diabetes prevalence, while Buenos Aires (12.36%), Santiago (13.27%), Montevideo (13.73%) and Havana (14.77) have the lowest rates.

As a consequence of higher prevalence rates, men at age 60 in Mexico City can expect to live, on average, 20.3 years, 15.8 years without diabetes and other 4.5 years (22.2% of their remaining lives) with diabetes. Their female counterparts are expected to live longer (22.1 years), but a similar (4.6) number of years, on average, with diabetes. The prevalence of diabetes in Mexico is lower than in Mexico City and, as a consequence, the number of years expected to live with diabetes is lower (2.9 and 4.1, respectively for men and women). Given the high prevalence of diabetes in Bridgetown, men and women aged 60 are expected to live 19.5% (3.4 years) and 23.5% (5.4 years), respectively, of their remaining lives with diabetes. In São Paulo, total life expectancy at age 60 reaches 17.2 years for males and 21.9 years for females, while 2.9 (16.7%) and 4.0 (18.3%) years, respectively are expected to be lived with diabetes. In Havana, men aged 60 are expected to live 1.3 years with diabetes, but women are expected to live 4.5 years. The lower prevalence of diabetes in Buenos Aires translates in a smaller percentage of the remaining years of life expected to live with diabetes. For men residing in Buenos Aires, the total life expectancy at age 60 reaches 17.4 years, 2.4 years (13.6%) are expected to be lived with diabetes. Their female counterparts are expected to live an additional 22.1 years and 2.5 years with diabetes. In Santiago, men aged 60 are expected to live, on average, 2.3 years with diabetes and their female counterparts, 3.3 years. For those residing in Montevideo, diabetes life expectancies at age 60 are 2.1 and 3.1 years, for males and females, respectively (Table 1).

Disability-free life expectancy and disabled life expectancy by diabetic status: IMach results

Results presented in this section are obtained using IMaCh 0.98g based on data of individuals aged 50 and over in Mexico (MHAS). The aim is to estimate the impact of diabetes on total life expectancy and disability-free life expectancy in Mexico.

Results show that diabetes has a major impact on total life expectancy in Mexico (Table 2). Individuals aged 50 in Mexico are expected to live about 33 years, on average, if they do not have diabetes. Diabetics, who had survived to age 50, are expected to live, on average, 25 years. This means that for those survivors at age 50, life expectancy is reduced in eight years for those with diabetes.

Diabetes also has important consequences on disability-free life expectancy. Table 2 shows that differences in the absolute number of years expected to be lived with at least one ADL, IADL or Nagi limitation do not vary as much between diabetics and non-diabetics. However, there are large differences on the number of years expected to be lived without disability for those with and without diabetes. As a consequence, diabetics are more likely to live a higher percentage of their lives with some sort of physical disability or functional limitation.

At the baseline, 9% of those aged 50 and over had at least one ADL limitation. These percentages reached 15% among diabetics and 8% among non-diabetics. As a consequence, Table 2 shows that diabetics aged 50 are expected to live 12% of their remaining lives with at least one ADL condition, while this percentage reaches 17% among non-diabetics. At age 80, non-diabetics are expected to live 26% of their remaining years of life with at least one ADL, while this percentage reaches 39% among diabetics (Table 2). Regarding IADL, 8% of those aged 50 and over at the baseline had at least one IADL limitation. These percentages were 13% and 7%, for diabetics and non-diabetics, respectively. As a consequence, non-diabetics who had reached age 50 are expected to live 3.6 years (11% or their remaining lives), on average, with at least one IADL. Diabetics will live a similar number of years with at least one IADL (3.5 years), but this represents 14% of their remaining lives. At age 80, non-diabetics are expected to live 3 years (29.5%) of their remaining lives with difficulty performing at least one IADL limitation and 7.2 years without limitations. Among their diabetic counterparts, the disability-free life expectancy is reduced to 3.8 years and disabled live expectancy reaches 2.8 years (42.2% of their remaining lives) (Table 2). As for Nagi functional limitations, prevalence rate reaches 45.8% of the population aged 50 and over at the baseline. Among diabetics, the prevalence of Nagi limitations reaches 57% and 44% among non-diabetics. Table 2 shows that disability-free life expectancy at age 50 measured by Nagi is about 19 years for non-diabetics and disabled life expectancy reaches 14 years. Disability-free life expectancy for diabetics aged 50 is only 11.6 years, while disabled life expectancy reaches 13.3 years. Therefore, the percentage of remaining years expected to be lived with Nagi limitations after age 50 is considerably higher among diabetics – 53.4% against 42.3% for non-diabetics. At age 80, disabled life expectancy measured by Nagi limitations represents 76% of the remaining lives of those with diabetes and 64% of those without diabetes (Table 2).

Disability-free and disabled life expectancy by sex and diabetic status

Diabetes reduces total life expectancy for both women and men in Mexico. Males without diabetes are expected to live, on average, 31 years if they had reached age 50, while their diabetic counterparts are expected to live 23 years. Mexican women age 50 are expected to live, on average, 34 years if they do not have diabetes, but only 26 years if they have diabetes (Table 3).

Significant reductions on disability-free life expectancy are observed for both men and women with diabetes (Table 3). For both men and women, differences in disability-free life expectancy between diabetics and non-diabetics are larger at younger ages than at older ages. Women have higher disability-free life expectancy than men when ADL and IADL are used as health indicators, but they have considerably lower disability-free life expectancy when Nagi is used as indicator (Table 3). Differentials in disabled life expectancy by diabetic status are much smaller than for disability-free life expectancy. In fact, the largest differentials in disabled life expectancy occur between sexes rather than by diabetic status.

Results show that men with diabetes at age 50 are expected to live 19.7 years, on average, without any ADL and 2.9 years, on average, with at least one ADL. Their male counterparts without diabetes are expected to live 28.4 years, on average, without any ADL and the same number of years with at least one ADL. This means that men at age 50 with diabetes are expected to live 13% of their remaining lives with at least one ADL, but this percentage reaches 9.3% among non-diabetics. Disability-free life expectancy (measured by ADL) at age 70 reaches 13.1 years for men without diabetes, but only 7.6 years for men with diabetes. Therefore, 15.5% of the remaining life of a man at age 70 is expected to be lived with at least one ADL limitation if he is not diabetic, but he will spend 23.1% with disability if he is diabetic. Similar conclusions can be drawn if IADL is used instead of ADL. As for Nagi limitations, men aged 50 are expected to live 33.3% of their remaining lifetime with some disability if he does not have diabetes, but 42% if they have diabetes. At age 70, the percentage of remaining years expected to be lived with at least one Nagi limitation reaches 65.4% for men without diabetes, but 75.3% for those with diabetes (Table 3).

For women aged 50, those with diabetes are expected to live, on average, 21 years without any ADL limitation and 5.2 years with at least one ADL. Women without diabetes are expected to live, on average, 29.2 years in good health after they had reached age 50 and other 5.1 years with at least one ADL. Therefore, differences in total life expectancy are almost completely due to differences in disability-free life expectancy. The expected number of years to be lived with disability is quite similar between females who have and don't have diabetes. Similar conclusions are obtained when IADL is used, but it is important to mention that disabled life expectancy is smaller among diabetics than among non-diabetics. When Nagi limitations are used as disability measure, disability-free life expectancy reaches 17.1 years among women without diabetes at age 50, but diabetics will live only 10.6 years, on average, without difficulties performing at least one Nagi function. The percentage of years expected to live with at least one Nagi limitation is 50.4% for women without diabetes at age 50, but 60.5% for their diabetic counterparts. At age 70, the percentages are 65.5% and 75.5%, respectively (Table 3).

The results presented in Table 3 clearly show that diabetes reduces considerably the disability-free life expectancy for those with the disease. The results also show that women are expected to live longer than men, but with a larger percentage of their remaining lives with some disability. Disabled life expectancy at age 50, measured by ADL, reaches 5.1 years for women without diabetes, but 2.9 years for men. This means that women without diabetes are expected to live 14.8% of their lives with difficulty performing at least one ADL, but their male counterparts will face this limitation for 9.3% of their remaining lives. At age 70, women are expected to live an additional 4.2 years (23.7%) with at least one ADL, but men will live 2.4 years (15.5%), on average, disabled. As for diabetics, women are expected to live 20% of their remaining lives after age 50 with at least one ADL, but their male counterparts will spend only 12.7% of their life expectancy in the disabled status. The percentages reach 33.6% and 23.1%, for females and males with diabetes at age 70, respectively.

Assistance on daily activities

The analysis of data from Mexico show that community-dwelling elderly individuals aged 50 will require, on average, about 2 years of help to perform basic activities of daily living and 3.3 years to perform instrumental activities of daily living, either from family or non-family members (Table 4). Table 4 shows that diabetics aged 50 will require help performing activities of daily living for an average of 2.4 years, while non-diabetics will require help during 2 years, on average. Graph 1 clearly shows that diabetics are expected to live a larger number of years, on average, with difficulties performing their basic activities of the daily living and they will also require help performing them for a longer period. As for instrumental activities of daily living, diabetics and non-diabetics at age 50 will require, on average, 3.3 years of help. However, since diabetics live shorter lives, the proportion of their lives in which they will require assistance to perform their instrumental activities of daily living will be higher than for non-diabetics.

Table 5 reinforces previous findings that women live longer, but with a greater number of years in which they require assistance with one or more ADL or IADL. Women aged 50 without diabetes are expected to require assistance on one or more ADL for 2.6 years, on average, while their male counterparts will need help during 1.5 years, on average. Females with diabetes who reach age 70 are expected to require assistance on one or more IADL for about 4 years, while their male counterparts will need assistance for less than 2 years.

Estimating the gains in total life expectancy and disability-free life expectancy if diabetes was eliminated

Table 6 estimates the percentage changes in life expectancy, disability-free life expectancy and disabled life expectancy if diabetes was eliminated (in this case, the assumption is that indicators at the population level would be equal to the ones of the non-diabetic population). Because the sample sizes are slightly different when dealing with IADL and Nagi indicators, small differences can be found in the life expectancy indicators. Results indicate that total life expectancy would be 1.7 years higher at age 50 if diabetes was eliminated. At age 80, total life expectancy would be 0.8 years higher. In relative terms, total life expectancy at age 50 would be more than 5% higher, but at age 80 the gains would reach 8%. Gains in disability-free life expectancy would be even larger. When IADL is used as a measure of disability, the gains in disability-free life expectancy would reach 1.7 years (6%) at the age 50, but at age 80, DFLE would be 11% higher (absolute gain would be 0.7 years). Even higher would be the relative gains in DFLE based on Nagi indicators: at age 50, DFLE would be 8% higher and at age 80, 14% higher. In absolute terms, the gains in DFLE based on Nagi indicators would be 1.5 and 0.5 years at ages 50 and 80, respectively. At the same time, if diabetes was eliminated, disabled life expectancy would increase, but not as much as DFLE. In the case of IADL the increase would be small – around 1% at age 50 and 2% at age 80, but for Nagi limitations, the increases would be more significant – 0.3 years, which represents 2% increase at age 50 and 5% increase at age 80.

Discussion

This paper uses data from recent surveys conducted in Latin America and the Caribbean to show that diabetes imposes a serious burden on the health status of these populations. Prevalence data from SABE indicate that a large proportion of the remaining lives of those aged 60 are expected to be lived with diabetes. However, there are important differences across settings. For instance, men aged 60 in Havana are expected to live 9.3% of their remaining years with diabetes, while this percentage reaches 21.7% in Mexico City. Among women the diabetes burden is even more pronounced. In Buenos Aires, an elderly woman is expected to live 13.2% of their remaining life with diabetes, but their counterparts residing in Bridgetown are expected to live, on average, 22.7% of their remaining years of life with diabetes.

The availability of MHAS is remarkable achievement for the study of the well-being of elderly in Mexico, and it represents a unique opportunity to study the diabetes burden in a developing country. To my knowledge this is the first study using panel data from a developing country to analyze the effects of diabetes on disability-free life expectancy. Findings from MHAS confirm the previous results in the literature (Bélanger et al., 2002; Jagger et al., 2003; Laditka & Laditka, 2005) that diabetes imposes losses of autonomy and reduces the disability-free life expectancy.

Results from MHAS show that diabetics have a total life expectancy (at age 50) that is about eight years lower than among non-diabetics. Moreover, the results show that this reduction is basically in the form of reduction in the average number of years individuals are expected to live without impairment. Therefore, the elimination or reduction of diabetes would provide important gains in the total life expectancy and in the disability-free life expectancy. More specifically, the elimination of diabetes would increase the total life expectancy at age 50 (at the population level) in about 1.7 years and life expectancy at age 80 would be almost a year higher. Moreover, most of this gain would be in the form of years without disability – the gains in disability-free life expectancy at age 50 would reach 1.4 years in the case of Nagi limitations and 1.7 years for IADL limitations.

The finding that diabetes reduces total and disability-free life expectancy for men and women by a similar amount contrasts with findings from Canada (Bélanger et al., 2002). Bélanger et al. (2002) show that, in Canada, diabetes reduces disability-free life expectancy, for both men and women, while the effects of diabetes on total life expectancy are more remarkable among women. Laditka and Laditka (2005) also conclude that diabetes have, in the United States, a heavier toll for women than for men in terms of total and unimpaired life expectancy. In Mexico, however, reductions in total life expectancy and disability-free life expectancy due to diabetes are very similar for both men and women. Data from MHAS show that diabetes reduces both the total and disability-free life expectancy at age 50 in about 8.7 years for men and 8 years among women.

However, as shown in the literature, women face higher disability burden than men and this study confirms that this finding is also true in Mexico. Women with diabetes at age 50 is expected to live 20% of their remaining lives with limitations on at least one activity of daily living, but their male counterparts will live 12.7% of their remaining years with disability. For non-diabetic women the percentage of years expected to be lived (after reaching age 50) with disability reaches 14.8%, while non-diabetic men will live an additional 9.3% of their remaining lives with at least one ADL. Higher prevalence of disability among women can be due to a several factors. There are some hypotheses to explain why women have higher prevalence of disability than men. The first one is that women would be more likely to report having disability (sex response bias). The second possibility is that women may be more likely than men to suffer from health conditions that result in more disability, but whose contributions to mortality risk are low. Recent study from Case and Paxson (2005) analyzes the differences between men and women reporting having poor health. They show that men and women with similar health profiles are equally likely to report that they are in poor health. In other words, they find that differences in self-rated health can be explained by differences in the distribution of health conditions. Women are more likely than men to suffer from health conditions that are not life threatening, but that lead to poor self-rated health.

Data from MHAS also shows that diabetics have higher incidence of disability than non-diabetics at any age. Diabetics have an increased risk of developing ADL and Nagi limitations and the differences between diabetics and non-diabetics increase with age, particularly for the ADL limitations. The probabilities of recovering from functional limitations are considerably lower for individuals with diabetes than for those without diabetes. Diabetes is a severe chronic condition associated with increased risks of mortality and mortality risks are even higher for diabetics who were disabled at the baseline. Mortality differentials increase considerably among diabetics and non-diabetics with increases in age.

This study confirms that diabetes has significant effects on total and disability-free life expectancy, however the effects may be somewhat biased because diabetes is self-reported. Previous studies conducted in the United States, Canada and England also face the same limitation, but it is possible that the percentage of undiagnosed diabetes is higher in Latin America and the Caribbean. Therefore, Chapter 6 will explore the potential biases of using self-reports. Another important limitation of MHAS is that it does not include institutionalized population in the first wave. However, since institutionalization rates in Mexico are low, this problem is not expected to be a strong source of bias.

It should be emphasized here that these results for Mexico refer to diagnosed (mainly type 2) diabetes. Therefore, incidence, prevalence and mortality are underestimated under the application of the MSLT. The values presented here are conservative estimates of the real burden faced by this population because it does not take into account the excess mortality of individuals with undiagnosed diabetes and also of those with pre-diabetes – those with impaired glucose tolerance and impaired fasting glucose.

One limitation of using Sullivan method to estimate the expected number of years to be lived, on average, with diabetes comes from problems on its empirical application. Data from diabetes prevalence in Latin America and the Caribbean comes from non-institutionalized population, while mortality data refers to the total population. As a result, estimates may be biased downwards if one expects that institutionalized population is more likely to have poor health, in particular, higher prevalence of diabetes, than the non-institutionalized population. However, it is important to note, that institutionalized population in Latin America and the Caribbean is relatively small.

The use of IMaCh to compute total and disability-free life expectancy also has its limitations. Total life expectancy estimated using IMaCh at age 50 is near 31 years for the total population, about 33 years for females and 30 for males. These estimates are about 2 years higher than the ones estimated by WHO: 31 for females and 28 for males. According to Lièvre, Brouard and Heathcote (2003, p. 237), the estimated life expectancy computed by the multistate model will be higher than the one obtained using vital statistics when the actual prevalence of disability is higher than the stable prevalence computed from the transition rates that are used in the multistate model. This happens because the classical life table estimation assumes homogeneity of risk for individuals who have survived to each age, while the multistate model assumes heterogeneity of risks based on the initial health status in which survivors reach each age.

Finally, one should be aware that the estimation of health life expectancies is subject to more error and variance than traditional life expectancies because the estimates are based on survey data rather than vital statistics. In other words, because sample sizes are smaller, the variance is larger. Another limitation when estimating health life expectancies comes from the fact that there are possible biases involving the individual's responses about his/her health.

In sum, this work shows a significant reduction in total and healthy life expectancy for diabetics indicates that this chronic condition imposes considerable economic, social and individual costs. Given the estimated increase in the prevalence of diabetes in Latin America and the Caribbean, the associated burden is expected to increase in the next decades unless preventive measures are taken. Recent studies have indicated that changes in lifestyle, particularly on diet and exercise, and some medications can delay the onset of the condition. Therefore, these societies should promote campaigns that emphasize that healthy eating and exercising can be translated in longer and more active lives.

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Table 1: Diabetes prevalence, total life expectancy, diabetes-free life expectancy and diabetes life expectancy at age 60, by sex, based on self-reported diabetes from SABE and MHAS (weighted estimates)

Sex and region	Diabetes Prevalence (%)	Total life expectancy at age 60 (e_{60})	Diabetes life expectancy (DLE_{60})	Diabetes-free life expectancy ($DFLE_{60}$)	s.e. (DFLE)
Males					
Buenos Aires (Argentina)	14.0	17.4	2.4	15.0	0.01
Bridgetown (Barbados)	18.7	17.6	3.4	14.2	0.29
São Paulo (Brazil)	17.0	17.2	2.9	14.3	0.01
Santiago (Chile)	12.0	19.9	2.3	17.6	0.22
Havana (Cuba)	7.3	18.4	1.3	17.1	0.01
Mexico City (Mexico)	22.4	20.3	4.5	15.8	0.01
Montevideo (Uruguay)	12.4	17.6	2.1	15.5	0.01
Mexico	14.5	20.4	2.9	17.5	0.13
Females					
Buenos Aires (Argentina)	11.4	22.1	2.5	19.6	0.01
Bridgetown (Barbados)	23.6	22.8	5.4	17.4	0.32
São Paulo (Brazil)	18.7	21.9	4.0	17.9	0.01
Santiago (Chile)	14.1	24.0	3.3	20.7	0.23
Havana (Cuba)	20.0	22.0	4.5	17.6	0.02
Mexico City (Mexico)	21.0	22.1	4.6	17.5	0.01
Montevideo (Uruguay)	14.5	22.9	3.1	19.9	0.01
Mexico	18.7	22.3	4.1	18.3	0.01

Source: Author's calculations using SABE and MHAS 2001.

Table 2: Total life expectancy, disability-free life expectancy and disabled healthy expectancy by age and diabetes status, Mexico, MHAS

Impairment and sample size	Age 50	(s.d)	60	(s.d)	70	(s.d)	80	(s.d)
ADL (N=12,050)								
Non-diabetics								
TLE	32.8	(0.606)	24.2	(0.585)	16.6	(0.567)	10.4	(0.531)
DFLE	28.8	(0.520)	20.5	(0.498)	13.4	(0.478)	7.8	(0.437)
DLE	3.9	(0.224)	3.7	(0.230)	3.2	(0.239)	2.6	(0.247)
Diabetics								
TLE	24.7	(0.927)	17.2	(0.782)	11.1	(0.656)	6.6	(0.537)
DFLE	20.5	(0.739)	13.4	(0.599)	7.9	(0.470)	4.0	(0.345)
DLE	4.2	(0.381)	3.8	(0.360)	3.3	(0.345)	2.6	(0.336)
IADL (N=12,065)								
Non-diabetics								
TLE	32.6	(0.594)	24.0	(0.568)	16.4	(0.549)	10.2	(0.518)
DFLE	29.0	(0.485)	20.5	(0.454)	13.1	(0.429)	7.2	(0.384)
DLE	3.6	(0.239)	3.5	(0.248)	3.4	(0.264)	3.0	(0.288)
Diabetics								
TLE	24.8	(0.901)	17.2	(0.757)	10.9	(0.636)	6.4	(0.536)
DFLE	21.3	(0.731)	13.8	(0.589)	7.8	(0.455)	3.7	(0.321)
DLE	3.5	(0.355)	3.4	(0.350)	3.1	(0.353)	2.7	(0.371)
Nagi (N=12,056)								
Non-diabetics								
TLE	33.0	(0.604)	24.4	(0.583)	16.7	(0.564)	10.5	(0.530)
DFLE	19.1	(0.357)	12.4	(0.336)	7.3	(0.308)	3.8	(0.252)
DLE	14.0	(0.429)	11.9	(0.424)	9.4	(0.420)	6.7	(0.408)
Diabetics								
TLE	24.9	(0.923)	17.4	(0.769)	11.2	(0.640)	6.6	(0.518)
DFLE	11.6	(0.531)	6.8	(0.379)	3.5	(0.255)	1.6	(0.159)
DLE	13.3	(0.710)	10.6	(0.601)	7.7	(0.517)	5.0	(0.442)

Source: Author's calculations using MHAS 2001 and 2003.
Note: TLE (Total Life Expectancy), DFLE (Disability-free Life Expectancy) and DLE (Disabled Life Expectancy)

Table 3: Total life expectancy, disability-free life expectancy and disabled life expectancy by sex and diabetic status, Mexico, MHAS

Impairment	Age 50		Age 60		Age 70	
and sample size	Males	Females	Males	Females	Males	Females
ADL (N=12,050)						
Non-diabetics						
TLE	31.3	34.3	22.9	25.5	15.6	17.7
DFLE	28.4	29.2	20.2	20.8	13.1	13.5
DLE	2.9	5.1	2.7	4.7	2.4	4.2
DLE/TLE (%)	9.3%	14.8%	11.8%	18.5%	15.5%	23.7%
Diabetics						
TLE	22.6	26.3	15.5	18.6	9.9	12.3
DFLE	19.7	21.0	12.9	13.8	7.6	8.1
DLE	2.9	5.2	2.6	4.8	2.3	4.1
DLE/TLE (%)	12.7%	20.0%	16.9%	25.6%	23.1%	33.6%
IADL (N=12,065)						
Non-diabetics						
TLE	31.1	34.2	22.8	25.4	15.5	17.4
DFLE	29.0	29.0	20.7	20.3	13.5	12.6
DLE	2.1	5.2	2.1	5.1	2.0	4.8
DLE/TLE (%)	6.8%	15.2%	9.2%	20.0%	13.1%	27.5%
Diabetics						
TLE	22.6	26.4	15.6	18.6	9.9	12.0
DFLE	20.8	21.5	13.8	13.9	8.1	7.7
DLE	1.8	4.9	1.8	4.7	1.8	4.4
DLE/TLE (%)	8.1%	18.4%	11.7%	25.4%	17.8%	36.2%
Nagi (N=12,056)						
Non-diabetics						
TLE	31.6	34.6	23.2	25.7	15.7	17.8
DFLE	21.1	17.1	14.0	10.9	8.3	6.1
DLE	10.5	17.5	9.2	14.9	7.4	11.7
DLE/TLE (%)	33.3%	50.4%	39.6%	57.8%	47.0%	65.5%
Diabetics						
TLE	22.6	26.8	15.6	18.9	10.0	12.4
DFLE	13.1	10.6	7.8	6.0	4.1	3.0
DLE	9.5	16.2	7.8	12.9	5.8	9.3
DLE/TLE (%)	42.0%	60.5%	50.0%	68.2%	58.7%	75.5%

Source: Author's calculations using MHAS 2001 and 2003.
Note: TLE (Total Life Expectancy), DFLE (Disability-free Life Expectancy) and DLE (Disabled Life Expectancy)

Table 4: Total life expectancy, independent life expectancy and dependent life expectancy by diabetic status based on measures of assistance with daily activities, Mexico, MHAS

Impairment and sample size	Age							
	50	(s.d)	**60**	(s.d)	**70**	(s.d)	**80**	(s.d)
ADL assistance (N=12,050)								
Non-diabetics								
Life expectancy	32.4	(0.594)	23.8	(0.569)	16.2	(0.550)	10.2	(0.516)
Without help	30.4	(0.543)	21.8	(0.515)	14.4	(0.494)	8.5	(0.456)
With help	2.0	(0.165)	2.0	(0.171)	1.9	(0.183)	1.7	(0.202)
Diabetics								
Life expectancy	24.6	(0.903)	17.0	(0.765)	10.9	(0.635)	6.4	(0.517)
Without help	22.2	(0.785)	14.7	(0.647)	8.7	(0.512)	4.5	(0.381)
With help	2.4	(0.289)	2.3	(0.288)	2.2	(0.296)	2.0	(0.318)
IADL assistance (N=12,065)								
Non-diabetics								
Life expectancy	32.4	(0.588)	23.8	(0.561)	16.2	(0.542)	10.1	(0.513)
Without help	29.1	(0.484)	20.6	(0.451)	13.1	(0.424)	7.2	(0.379)
With help	3.3	(0.228)	3.2	(0.237)	3.1	(0.252)	2.8	(0.278)
Diabetics								
Life expectancy	24.7	(0.885)	17.1	(0.745)	10.8	(0.624)	6.3	(0.525)
Without help	21.5	(0.727)	13.9	(0.588)	7.9	(0.453)	3.7	(0.319)
With help	3.3	(0.338)	3.2	(0.333)	2.9	(0.337)	2.6	(0.356)

Source: Author's calculations using MHAS 2001 and 2003.

Table 5: Total life expectancy, independent life expectancy and dependent life expectancy by diabetic status and sex based on measures of assistance with daily activities, Mexico, MHAS

Impairment	Age 50		Age 60		Age 70	
and sample size	Males	Females	Males	Females	Males	Females
ADL assistance (N=12,050)						
Non-diabetics						
Life expectancy	31.0	33.8	22.6	25.1	15.3	17.3
Without help	29.5	31.2	21.2	22.5	13.9	14.8
With help	1.5	2.6	1.4	2.5	1.4	2.4
With help (%)	4.8%	7.7%	6.4%	10.2%	9.0%	13.9%
Diabetics						
Life expectancy	22.7	26.0	15.5	18.3	9.8	11.9
Without help	21.1	23.0	13.9	15.3	8.3	9.1
With help	1.6	3.0	1.6	2.9	1.5	2.8
With help (%)	7.1%	11.6%	10.2%	16.1%	15.5%	23.3%
IADL assistance (N=12,065)						
Non-diabetics						
Life expectancy	30.9	33.9	22.6	25.1	15.3	17.2
Without help	29.0	29.1	20.7	20.4	13.5	12.7
With help	1.9	4.8	1.9	4.7	1.8	4.5
With help (%)	6.1%	14.1%	8.4%	18.7%	12.0%	26.0%
Diabetics						
Life expectancy	22.8	26.2	15.7	18.3	9.9	11.8
Without help	21.1	21.6	14.0	13.9	8.2	7.7
With help	1.7	4.6	1.7	4.4	1.6	4.1
With help (%)	7.5%	17.4%	10.8%	24.2%	16.6%	34.9%

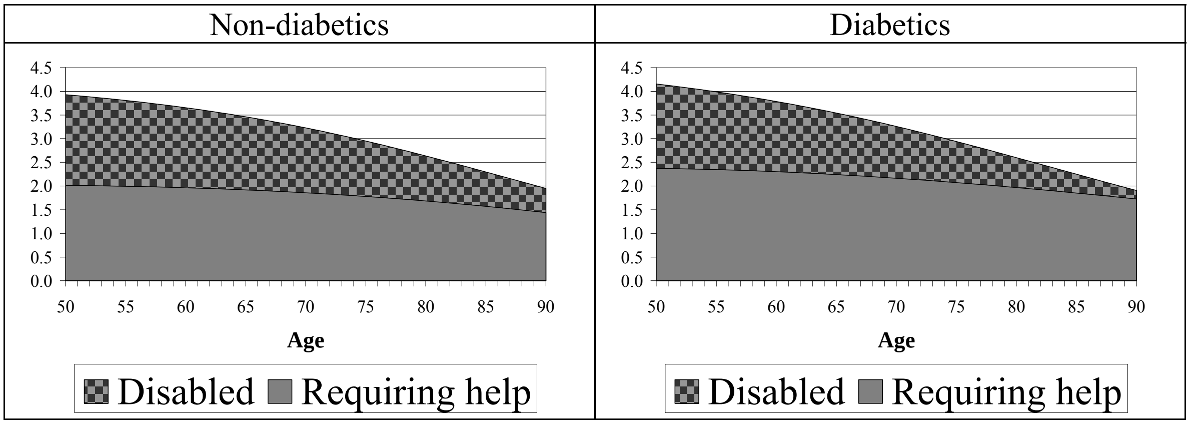
Source: Author's calculations using MHAS 2001 and 2003.

Table 6: Total life expectancy, disability-free life expectancy and disabled life expectancy based on IADL and Nagi indicators and gains in life expectancy if diabetes were eliminated, Mexico, MHAS

Diabetic status And disability measure		Age 50	 60	 70	 80
IADL					
Total	TLE	*30.9*	*21.8*	*15.3*	*9.5*
	DFLE	27.4	18.3	12.0	6.5
	DLE	3.5	3.5	3.3	3.0
Non-diabetics	TLE	*32.6*	*23.2*	*16.4*	*10.2*
	DFLE	29.0	19.7	13.1	7.2
	DLE	3.6	3.5	3.4	3.0
Diabetics	TLE	*24.8*	*16.5*	*10.9*	*6.4*
	DFLE	21.3	13.1	7.8	3.7
	DLE	3.5	3.3	3.1	2.7
Diabetes eliminated					
Gains in TLE (%)		**5.6**	**6.7**	**7.6**	**8.0**
Gains in DFLE (%)		**6.1**	**7.7**	**9.2**	**10.8**
Gains in DLE (%)		**1.2**	**1.4**	**1.8**	**1.9**
Nagi					
Total	TLE	*31.3*	*22.9*	*15.6*	*9.7*
	DFLE	17.6	11.3	6.5	3.3
	DLE	13.7	11.6	9.1	6.4
Non-diabetics	TLE	*33.0*	*24.4*	*16.7*	*10.5*
	DFLE	19.1	12.4	7.3	3.8
	DLE	14.0	11.9	9.4	6.7
Diabetics	TLE	*24.9*	*17.4*	*11.2*	*6.6*
	DFLE	11.6	6.8	3.5	1.6
	DLE	13.3	10.6	7.7	5.0
Diabetes eliminated					
Gains in TLE (%)		**5.4**	**6.4**	**7.4**	**8.0**
Gains in DFLE (%)		**8.2**	**10.0**	**11.9**	**13.5**
Gains in DLE (%)		**1.8**	**2.9**	**4.1**	**5.1**

Source: Author's calculations using MHAS 2001 and 2003.
Note: TLE (Total Life Expectancy), DFLE (Disability-free Life Expectancy) and DLE (Disabled Life Expectancy)

Graph 1: Average number of years expected to be lived with ADL limitations (disabled) and requiring help to perform ADL activities by diabetic status, Mexico, MHAS



Source: Author's calculations using MHAS 2001 and 2003.