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THE IMPACT OF SOCIAL HEALTH INSURANCE ON DIABETES AND HYPERTENSION OUTCOMES IN OLDER ADULTS: AN INSTRUMENTAL-VARIABLES REPEATED-CROSS-SECTION EVALUATION IN MEXICO

Maricruz Rivera-Hernández, Vincent Mor, Omar Galárraga
Brown University
Center for Gerontology and Healthcare Research

Abstract

With the creation of *Seguro Popular* (People's Health Insurance; *SP*) in 2001, Mexico attempted to reduce out-of-pocket financial burden for low income families (Frenk, González-Pier, Gómez-Dantés, Lezana, & Knaul, 2006). Unfortunately, there is limited evidence on how *SP* has impacted health outcomes and health care utilization for older adults. The main objective of this paper was to examine the impact of *SP* on diabetes care and treatment, including use of treatment (insulin and/or oral medication), blood glucose tests, the use of complementary alternative medicine (CAM), and following nutrition and exercise program focusing on the older adult population over 50. Similarly, we examined the impact of *SP* on hypertension treatment and care, use of oral medication, CAM, and following nutrition and exercise program, focusing on the older adult population over 50. Repeated cross-sectional data from the Encuesta Nacional de Salud y Nutrición (ENSANUT) 2000, 2005-2006 and 2012 surveys were used to assess the effect of SP. The ENSANUT is a nationally representative health and nutrition survey that had a sample of 45,294 adults, 45,241 adults, and 46,277 adults in 2000, 2005-6, and 2012, respectively (ENSANUT, 2012). Considering corrections for the potential biases, an instrumental variables (IV) repeated cross-sectional estimation was performed. There were 731, 868 and 1,416 older adults *SP* enrollees or uninsured with diabetes in 2000, 2005-6 and 2012, respectively. Among those diagnosed with hypertension, there were 1,339, 1,696 and 2,272 older adults over 50 years that were enrolled in *SP* or were uninsured. *SP* seems to have a positive effect on hypertension treatment and care. The results suggest that *SP* increases the use of antihypertensive medication (by 9.5 percentage points), diet (13.8 p.p.) and exercise (7.8 p.p.); and it decreases the use of CAM (9.2 p.p.). These results implied an increase of roughly 12% (9.5 / 75) in use of antihypertensive medication over the period of observation. In addition, those with S*P* were 14 p.p. more likely to report following diet and reported the same increases for exercise programs. However, *SP* does not seem to have major effects on diabetes treatment and care for older adults. *SP* only decreased the use of CAM by8.8 p.p. This may indicate that older adults with diabetes who are enrolled in *SP* are more likely to go to the doctor. These findings are consistent with prior literature that suggests that having health insurance does not necessarily improve health care behaviors (Ross & Mirowsky, 2000)especially for older people with diabetes. Diabetes self-management includes making healthy decisions and behavioral changes (Anderson-Loftin & Moneyham, 2000). The results of the present study suggest that older adults may not have the knowledge, or lack the motivation and skills to engage in diabetes self-care practices (Baca Martínez et al., 2008). The findings suggest the urgent need to implement diabetes education programs for older adults in Mexico. Future research, should explore the long-term effects of *SP* on treatment and care utilization and biological outcomes for people with diabetes and hypertension.

Keywords: *Seguro Popular, health insurance, health care access, Mexico, diabetes, hypertension*

Introduction

To reduce health inequalities and improve access to health care services, the Mexican government started to implement a major health care reform in 2001. *Seguro Popular* [people's insurance; *SP*] intended to provide coverage to the uninsured. At more than a decade of the implementation of *SP*, evidence suggest that compared to the uninsured, program enrollees have better access to healthcare services (Ayanian JZ, Weissman JS, Schneider EC, Ginsburg JA, & Zaslavsky AM, 2000; Duru, Vargas, Kermah, Pan, & Norris, 2007), including access to diagnosis and treatment of diabetes and hypertension (Porell & Miltiades, 2001). However, most of these studies have focused on early periods and used younger samples. With the aging of the Mexican population, it is necessary to evaluate current policies and programs and determine their effectiveness in improving healthcare access and outcomes.

Background

Diabetes

Diabetes poses serious global concerns as this chronic condition presents a major burden for the developed world, and it is also growing rapidly in low-and middle-income countries. About 347 million people had diabetes in 2008 (Danaei et al., 2011); and these numbers are only expected to increase over the coming years. The higher prevalence rates are closely linked to the aging of the population, and estimates suggest that prevalence will double by 2030 (Shaw, Sicree, & Zimmet, 2010). In 2012, the World Health Organization estimated that one in ten adults was diagnosed with diabetes (World Health Organization (WHO), 2012). In Mexico this condition imposes severe medical and economic costs. According the International Diabetes Federation (IDF, 2007), Mexico has the seventh highest prevalence of diabetes. In 2012, there were about 10.6 million cases of diabetes (IDF, 2013), and about 6.2 million adults have been diagnosed with diabetes, which corresponds to about 9.2% of the population (Instituto Nacional de Salud Pública, 2012a). These rates could be higher since a large proportion of diabetics ignored their condition (King, Aubert, & Herman, 1998). With more than 73,000 deaths, diabetes was among the three major causes of death among older adults in 2011 (Instituto Nacional de Estadística y Geografía, 2013a)

Diabetes is a complex disease that requires rigorous self-management to reduce complications, increase life-expectancy and quality of life. The main objective of diabetes management is to maintain glucose levels indicated by the physician (usually a hemoglobin A1C < 7.0%; test to measure average of glucose levels for the past three months before the test). The condition requires life-long treatment and patients should have regular tests and checkups to avoid or delay micro- and macro-vascular complications. Diabetics should test their blood sugar levels, blood lipids and blood pressure on a regular basis. They may also need to follow a special diet and exercise routine. In addition, physicians may prescribe oral agents and insulin to achieve target blood sugar levels (American Diabetes Association, 2012). Mexico, like other middle-

income countries, faces macro level challenges associated with suboptimal health care systems. These include: 1) shortfalls in prescription medications and medical personnel, and 2) lack of self-management (Secretaría de Salud, 2011), suggesting that many people may receive inadequate treatment. Lack of diabetes self-management can cause long-term complications that may impose a financial burden on the patient, their families and the health care system. Expenses are not only limited to medication, consultations and complications, but also include disability and loss of productive life (Barceló, Aedo, Rajpathak, & Robles, 2003). In 2005-2006 direct costs were estimated to be USD$ 3.4 billion, and indirect costs were estimated to be USD$ 177 million (Barquera et al., 2013).

Hypertension

According to the WHO, one in three adults has hypertension or high blood pressure – 140/90 mmHg or higher (WHO, 2012). Worldwide, hypertension was responsible for about 7.5 million deaths (13%) in 2004 (WHO, 2013). Similarly in Mexico, approximately 31.6% of the adult population has hypertension (Instituto Nacional de Salud Pública, 2012b). Just like diabetes, these higher rates of hypertension are attributed to the aging of the population and behavioral risks factors (WHO, 2013). Uncontrolled hypertension may cause disability and affect people's quality of life (Centers for Disease Control and Prevention (CDC), 2013). Adequate treatment of hypertension may require lifestyle changes such as regular exercise, low-sodium diet, limit alcohol and tobacco consumption. In addition, people with hypertension may need pharmacological therapy. The goal of treatment is to achieve normal blood pressure levels to avoid complications such as chronic kidney disease, heart attacks and heart failure (U.S National Library of Medicine, 2013). Inadequate access to health care and cost of medication may be a burden for many people, which leads to uncontrolled blood pressure (Institute for Clinical Systems Improvement (ICSI), 2013). In 2012 according to the Mexican Census (Instituto Nacional de Estadística y Geografía, 2013b), out of 100 people who died with complications related to hypertension, 34 died of chronic kidney disease, 29 due to heart disease and 4 due to cardio-renal complications, and 33 due to other causes. Recent estimates from the INSP revealed that in 2012 costs of hypertension in Mexico totaled about USD$6.5 billion; direct costs were estimated to be USD$3.1 billion and indirect costs were estimated to be USD$3.4 billion. However, the majority of the expense burden was carried by the patients and family members, which was estimated at USD$2.9 billion (Instituto Nacional de Salud Pública, 2013).

The Mexican Health Care System

The Mexican health care system is composed of multiple insurance providers. The *Instituto Mexicano del Seguro Social* [Mexican Institute of Social Security, IMSS] provides medical services to private sector employees and the *Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado* [Institute of Social Security and Services for the State's Workers, ISSSTE] provides coverage for government workers. In 2000, about half of the population was insured by these providers, but the other half did not have health insurance (Frenk, Sepúlveda,

Gómez-Dantés, & Knaul, 2003). *SP* [People's Health Insurance] was introduced in 2001, as a pilot program, to provide insurance to those who were excluded from the health care system due to their labor or social status.

The program was rolled out in 2002 to 2005. In the first year, twenty states implemented it. Five states were incorporated in 2003 and another four joined in 2004. By 2005, the remaining three (Chihuahua, Mexico City, and Durango) were integrated into the program (http://www.seguro-popular.salud.gob.mx/). The process of how municipalities adopted the program was more complex and somewhat arbitrary (Barros, 2009). Initially, it was intended to incorporate municipalities with high poverty level. However, healthcare institutions needed to be accredited to serve *SP* enrollees. Accredited institutions have resources and infrastructure to offer all the services included in the essential package of health services (Frenk, Gomez-Dantes, & Knaul, 2009). In addition, there were political motivations to achieve universal healthcare, so states with smaller population were given priority and received more resources; as a result of health infrastructure capacity and political factors influencing the rolled-out process, *SP* supply was not correlated to economic or health factors (Barros, 2009). This has implications for our identification strategy. Specifically, no correlation was found when testing the states' percentage of people uninsured in 2000 by year of incorporation to *SP*.

Personal affiliation with *SP* is voluntary and there is no co-payment, for all practical purposes. At the local level, however, affiliation may be, at least partially, determined by infrastructure capacity. According to INEGI, in 2010 there were over 35 million people enrolled in IMSS, over 7 million in ISSSTE and over 15 million families enrolled in *SP* (Instituto Nacional de Estadística y Geografía, 2013c). These numbers have substantially increased since the last Census, and at only ten years after its creation *SP* the number of people receiving insurance through SP has surpassed those of IMSS. In December of 2012, there were 52,908,011 people enrolled in SP, and the goal for 2013 was to enroll more than 55 million people (Secretaría de Salud, 2013).

Services are limited in scope since there are some conditions that may not be covered, and medical services are offered through its own network of health centers (*SP*). Nevertheless, compared to those uninsured, *SP* enrollees appear to have better access to health care services. *SP* enrollees can gain the access to health care services that are crucial to the diagnosis and treatment of diabetes and hypertension (Seguro Popular, 2013). According to our previous research (Sosa-Rubi, Galarraga, & Harris, 2009) *SP* has had a significant impact on obstetrical services. Similarly, other research (Bleich, Cutler, Adams, Lozano, & Murray, 2007) found that hypertensive adults with insurance through *SP* were more likely to be treated (enrollees were 50% more likely to receive treatment than those uninsured), and more likely to control their blood pressure to target levels. Besides hypertension, diabetes is another condition that requires services which are high in demand for the *SP's* beneficiary population. Diabetes services are mostly limited to ambulatory and urgent care, but in 2012, these services included limited coverage for patients with chronic renal failure. In another previous study done by Sosa-Rubi, Galarraga, and Lopez-Ridaura (2009) using data from ENSANUT 2006, it was noted that adults

with diabetes who were *SP* enrollees were more likely to check their blood sugar, go to the physician at least four times per year, and had slightly better glucose control than those who were uninsured. Still, the impact of *SP* on older participants has not been studied.

The main objective of this paper, therefore, is to provide a better understanding of *SP* in treatment and care for older Mexicans diagnosed with diabetes or hypertension. First, we examine the impact of *SP* on diabetes self-management, including use of treatment (insulin and/or oral medication), blood glucose tests, the use of complementary alternative medicine, and following nutrition and exercise program focusing on the older adult population (age>50). Similarly, we evaluate the effect of *SP* on hypertension treatment and care, use of oral medication, complementary alternative medicine, and following nutrition and exercise program, focusing on the older adult population (age>50).

Based on the literature, we hypothesized that older adults with *SP* would have better diabetes and hypertension treatment and care than the uninsured.

Methodology

Data

Individual characteristics

Repeated cross-sectional data from the ENSANUT 2000, 2005-2006 and 2012 surveys were used to assess the effect of *SP* on diabetes treatment, blood glucose tests, use of complementary alternative medicine and performing other self-management activities such as exercise and diet. The ENSANUT is a nationally representative health and nutrition survey that had a sample of 45,294 adults, 45,241 adults, and 46,277 adults in 2000, 2005-6, and 2012, respectively (Instituto Nacional de Salud Pública, 2012a).

Physician-diagnosed diabetes and hypertension was reported by the participants. There were 1,988, 1,896, and 3,133 adults over 50 years who had diabetes in 2000, 2005-6 and 2012, respectively. Excluding participants that were enrolled in IMSS, ISSSTE or private insurance providers, there were 731, 868 and 1,416 older adults with diabetes in 2000, 2005-6 and 2012, respectively. In terms of physician-diagnosed hypertension, there were 3,450, 3,701, and 4,979 older adults in 2000, 2005-6 and 2012, respectively. Also, excluding participants that were enrolled in IMSS, ISSSTE or private insurance providers, there were 1,339, 1,696 and 2,272 older adults over 50 years diagnosed with hypertension that were enrolled in *SP* or were uninsured. Participants answered the same questions about current treatment, access to laboratory tests, and alternative control methods in all three rounds of the survey. A decade after its launch, *SP* has reached a greater number of people. Enrollment in *SP* increased dramatically from 27% in 2005-6 to 75 % in 2012 ($p < .0001$), for people diagnosed with diabetes or hypertension. Since *SP* was launched in 2001, the survey round of 2000 does not have *SP* information, and thus serves as a "pre-treatment" observation.

State and regional characteristics

Mexican Census (INEGI) and Mexican Department of Health Information (SINAIS)

Data about state's uninsured people and people enrolled in *SP* in 2005 and 2010 were obtained from the Census website (http://www.inegi.org.mx/est/contenidos/Proyectos/ccpv/default.aspx). Information about states human and physical resources (total number of doctors, number of nurses, and number of hospitals) from 2000, 2005 and 2009 came from SINAIS (http://www.sinais.salud.gob.mx/basesdedatos/index.html).

Variables and analysis

We examined used of blood glucose control tests per month, treatment with insulin or other oral agents, and alternative control methods. We also evaluated the use of antihypertensive medication, complementary alternative medicine, and following nutrition and exercise program. *SP* enrollees were compared to those without any health insurance. Control variables included sex, age, education, ethnicity, BMI, time to disease diagnosis, state dummies and state and regional characteristics.

First we compared insurance characteristics with demographic and regional characteristics using *chi*-square test for categorical variables and *t*-test for continuous variables. Health insurance status is not a random event. A number of factors influence the decision to enroll on a specific insurance program such as *SP*. If these factors also influence health care utilization, the estimated parameters for health insurance and health care access and treatment utilization may suffer from endogeneity problems. The potential endogeneity of health insurance on health care utilization has been widely researched (Porell & Miltiades, 2001). Considering corrections for the potential biases, we conducted an instrumental variables (IV) cross-sectional estimation. We used a variable indicating when *SP* was incorporated in the adult's state of residence as one of the instruments. We also used as IV the percentage participation rates in *SP* in the adult's area of residence at the locality level in 2005 and 2010 using Mexican Census data. Given that the process of *SP* accreditation at the locality level was driven by several independent factors, there was temporal and geographic variation that helps identify enrollment into *SP*, independently of diabetes outcomes. This approach seeks to isolate the effects of shifts in health care access and utilization that can be associated with changes in insurance status that are associated with the availability of health insurance (Long, Coughlin, & King, 2005)

We used two-stage least squares (2SLS) approach, where ε and μ, in the system of equations below, may be correlated. The main explanatory variable to be analyzed is enrolment into *SP* programs (*T*). Enrolment into *SP* would be determined by age, gender, schooling, income, urban/rural residence and health-status (*X* covariate vector). We assessed whether instrumental variables (IVs) are valid and relevant instruments for health insurance coverage in the regression models. These set of instruments would affect the probability of a person being part of *SP* (relevant), but they would not be correlated with the error term in the diabetes or hypertension care or healthcare utilization equations (valid).

$$Y_j = X_J\beta + T_j\,\delta + \varepsilon_j$$

$$T_j = Z_J\gamma + \mu_j$$

The IV proposed uses the number of years that each of the 32 states have had *SP* at the time of the survey, similar variables have been used in prior work (Galárraga, Sosa-Rubí, Salinas-Rodríguez, & Sesma-Vázquez, 2010; Sosa-Rubi, Galarraga, & Lopez-Ridaura, 2009). For example, individuals who in 2012 resided in states that incorporated *SP* in 2002 were assigned a value of 10. A second IV was used by calculating the level of penetration of *SP* at the locality level. The variable used 2005 and 2010 Mexican Census data to obtain the ratio of *SP* enrollees over uninsured people. People living in localities with higher *SP* coverage have higher probability of enrolling into the program. We tested that policy endogeneity would not be a concern. We found no systematic correlation between the insurance coverage rates in 2000 and the years of enrollment into *SP* (not shown; available upon request).

Results

Diabetes and hypertension treatment and care and sample characteristics by insurance status

Descriptive statistics for older adults in the sample are contained in Table 1 for people with diabetes, and in Table 2 for people with hypertension. There were 2,077 and 3,538 observations with complete demographic data for those diagnosed with diabetes and hypertension, respectively. Overall, there were not many significant differences between those enrolled in *SP* and the uninsured in 2006. Differences in regional characteristics were found in 2006 and 2012 across years and for both, people with diabetes and hypertension. In 2012, a higher percentage of people with diabetes enrolled in *SP* were married (50.9%) and female (63.0%). They were also slightly younger (63.3 years old, SD = 8.79 compared to 64.6 years old, SD =9.93) and had less family assets. In 2012, *SP* enrollees with hypertension were less likely to be indigenous (90.7%), have less formal education, and on average have had hypertension over nine years compared to 12 years for those uninsured.

[Insert table 1 and 2 about here]

Tables 3 and 4 show diabetes and hypertension treatment and control outcomes, by health insurance status. In 2000, approximately 74% of those with diabetes checked their blood sugar, and 91% used insulin or oral medication. Lower percentage of people used self-care behaviors, about 18% used alternative medicine and 21% followed a diet and 5% followed a nutritional plan. In 2006, the only significant difference between the insured and uninsured was in the use of insulin and/or oral agents. Approximately, 98% of *SP* enrollees use pharmacological treatment compared to 92% of the uninsured. Significant differences in blood sugar monitoring and use of pharmacological therapy were found between the insured and uninsured in 2012. Approximately

74% of those with diabetes checked their blood sugar compared to 66%, and 90% (compared to 82%) used pharmacological treatment.

Among people with hypertension in 2000, approximately 75% used antihypertensive treatment, 6% used alternative medicine, and 8% followed a diet. The only significance difference in 2006 was in the use of alternative medicine. Those enrolled in *SP* were less likely to use alternative medicine (compared to 10%). No significance differences were found by health insurance status and the proportion of people that use antihypertensive medication, alternative medicine, diet or exercise in 2012. But, among insured adults with hypertension, 84% used pharmacological treatment and nobody used alternative medicine. Lower percentage of people (14%) follows a diet or practiced exercise (7%).

[Insert Table 3 and 4 about here]

Health insurance and diabetes and hypertension care and treatment

The joint value of the F-statistics of the instruments (number of years of incorporation of *SP*, and the percentage participation rates in *SP* at the locality level) was greater than 200, exceeding the required value of 10 (See Table 5; Stock, Yogo, & Wright, 2002). Table 5 shows the results from the second stage of the two- stage least square (2SLS) regressions. After adjusting for individual, regional characteristics, state's health characteristics and including state dummies, *SP* has a positive effect on hypertension treatment and care, but we do not see the same for diabetes. The results suggest that *SP* increases the use of antihypertensive medication (by 9.5 percentage points), diet (13.8 p.p.) and exercise (7.8 p.p.); and it decreases the use of alternative medicine (9.2 p.p.).

[Insert Table 5 about here]

For older adults with diabetes, the results show that *SP* did not have a significant effect on care behaviors including blood sugar monitoring, use of pharmacological treatment, following a nutritional plan or practicing exercise. The only significant impact of having *SP* was found on the use of alternative medicine having *SP* decreases the use of alternative medicine by 8.80 p.p.

Discussion

To our knowledge this is the first study that uses repeated resections of data and IV methods to control for endogeneity to evaluate the impact of *SP* in diabetes and hypertension treatment and care in older Mexican adults. We hypothesized that older adults with *SP* would have better diabetes and hypertension treatment and care than the uninsured. The results partially support our hypothesis. We found that *SP* significantly impacted hypertension treatment and care. Contrary to what was expected, the results show that *SP* does not have a significant effect on diabetes treatment and care; specifically self-care behaviors such as blood sugar monitoring,

use of insulin or oral medication or following a diabetic diet and exercise do not seem to be affected.

These results implied an increase of roughly 12% (9.5 / 75) in use of antihypertensive medication over the period of observation. In addition, those with *SP* were 14 p.p. more likely to report following diet, and reported 8 p.p. increases for exercise programs. These results are consistent with those of previous literature (Bleich et al., 2007) who found that adults with hypertension insured through *SP* were more likely to receive antihypertensive treatment than those who were uninsured. The only significant effect of *SP* on older adults with diabetes was related to the use of alternative medicine, which may suggest that older adults with diabetes who are enrolled in *SP* are more likely to go to the doctor. However, when exploring physician visits (variable included in questionnaires in 2006 and 2012), we found that *SP* enrollees where 43 p.p. less likely to go to the doctor at least two times a year. In general, these results suggest that older adults have poor adherence to self-care behaviors. Current results are similar also to those of Aguilar-Salinas et al., (2003), who used ENSA 2000 and found that Mexican adults with diabetes aged 20 and above had poor diabetes self-management behaviors regardless of health insurance.

Current study findings are also consistent with prior literature that suggests that having health insurance does not necessarily improve health care behaviors (Ross & Mirowsky, 2000), specially for older people with diabetes. As in the article discussed by Karolewicz (2014), insurance is only a first step toward better health care. People need to take responsibility in managing their health. Diabetes self-management includes making healthy decisions and behavioral changes (Anderson-Loftin & Moneyham, 2000). The results of the present study suggest that older adults may not have the knowledge, or lack the motivation and skills to engage in diabetes self-care practices. Our current results may also be explained by those of previous researchers (Barquera et al., 2013) who stated that poor diabetes control is not due to lack of access to physicians and health care services. Using ENSANUT 2006, Barquera and colleagues found that 94% of people with diabetes were using oral agents and insulin; however; a very low percentage of people understood the importance of diet (24%) and exercise (2%) as important components of diabetes management. In addition, Baca Martínez et al. (2008) found that people with diabetes living in Culiacan, Mexico have poor knowledge about diabetes care and treatment (conventional medicine, nutrition and exercise). Participants in their study did not have formal diabetes education. Similarly, Saldaña et al. (2007) found that health center patients middle-aged and older of rural and urban communities in Jalisco, Mexico had poor knowledge glycemic control, specially diet and exercise knowledge, and thus poor glycemic control (15% had target HbA1c levels). *SP* does not cover diabetes education classes. Hence, the results of the present study may suggest the need to implement diabetes education programs for older adults in Mexico, and other interventions to improve quality of care for older adults.

Although, health insurance and poor diabetes knowledge impacts diabetes management, are not the only factor influencing poor outcomes. Barquera et al. (2013) discussed that lack of effective diabetes treatment is in part attributed to the Mexican healthcare system, as well, as

healthcare providers. This is supported by research at the National Institute of Health that stated that current challenges in the Mexican healthcare system included shortfalls in pharmacological treatment, lack of specialized care and physicians, poor infrastructure, medical equipment and laboratory facilities (Instituto Nacional de Salud Pública, 2010). This suggests that health clinics are not prepared to provide specialized care for people with diabetes. Diabetes management is based on patient-physician interaction in short time visits (Saldaña et al., 2007). Often, other healthcare professionals are not part of diabetes care team. In addition, education of healthcare professionals is more focused on treating communicable diseases and not necessarily treating chronic conditions (Barquera et al., 2013). Policy makers need to create more programs that will increase the quality of care for older adults with diabetes.

These findings should be interpreted with caution, as this study has some limitations. The findings reflect medium-term effects of *SP* on self-management activities. Future research should explore long-term effects of *SP* on self-management behaviors, health care utilization and biological outcomes for people with diabetes and hypertension. It would be also important to incorporate access to physicians and clinics and distance to healthcare facilities to explore differences in healthcare utilization and health outcomes.

Despite the limitations, our results suggest that access to *SP* improves hypertension treatment and care. However, policy-makers and practitioners need to better address the burden of diabetes in Mexico among older populations. Education programs for consumers and health care providers for diabetes prevention and management should be incorporated into healthcare institutions to ameliorate poor quality of diabetes care in Mexico. Having the *SP*-insurance card may be only the beginning in achieving good outcomes: better quality of care is needed to improve quality of life and decrease mortality among older adults with diabetes.

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Tables

Table 1

Characteristics of older adults (age>50) with diabetes enrolled in *Seguro Popular* or uninsured (n=2077) in Mexico: Mexican Health and Nutrition Surveys (2000, 2006 and 2012)

	Year 2000	Year 2006		Year 2012	
	Uninsured (n=655)	Uninsured (n=258)	SP (n=92)	Uninsured (n=290)	SP (n=782)
Individual characteristics					
Female	448 (68.40)	123 (47.67)	47 (51.09)	163 (56.21)	493 (63.04)*
Age	62.59 (8.69)	63.70 (9.01)	64.55 (8.94)	64.60 (9.93)	63.34 (8.79)*
Married	357 (54.50)	94 (36.43)	37 (40.22)	128 (44.14)	398 (50.90)*
Indigenous	43 (6.56)	14 (5.43)	8 (8.70)	25 (8.62)	90 (11.51)
No education	48 (7.33)	66 (25.16)	24 (26.09)	72 (24.83)	204 (26.09)
Primary education	396 (60.46)	162 (62.79)	60 (65.22)	166 (57.24)	480 (61.38)
Time to diagnosis (months)	113.36 (146.86)	105.00 (93.22)	89.50 (77.61)	118.95 (110.45)	115.69 (105.64)
BMI_1	252 (38.47)	108 (41.86)	43 (46.74)	97 (33.45)	274 (35.04)
BMI_2	193 (29.47)	83 (31.17)	35 (38.04)	70 (24.14)	226 (28.90)
Family assets					
Mean (asset index)	-0.25 (2.15)	-0.33 (1.76)	-0.79 (1.77)*	-0.31 (2.19)	-0.78 (1.99)*
Regional characteristics					
East central	143 (21.83)	75 (29.07)	16 (17.39)*	88 (30.34)	184 (23.53)*
West central	211 (32.21)	73 (29.07)	42 (46.65) *	83 (28.62)	292 (37.34)*
North	154 (23.51)	46 (17.83)	17 (18.48)	56 (19.31)	140 (17.90)
Rural	436 (66.56)	198 (76.74)	56 (60.87)*	211 (72.76)	479 (61.25)*

Notes: SP = *Seguro Popular*. SP was launched in 2001, thus the survey in 2000 does not have a SP column, and serves as a "pre-treatment" observation.

Time to diagnosis is measured in months.

BMI_1=Body mass index overweight (>25 kg/m^2)

BMI_2=Body mass index obese (>30 kg/m^2)

Family asset index based on the following assets: household infrastructure, household materials and assets. This is a proxy for household's wealth. It was calculated using principal components analysis. This measure is centered at 0 and negative values indicate lower household wealth.

*Significant at $p \leq 0.05$ (for a *t*-test for continuous variables, or *chi*-square test for categorical variables, comparing SP and uninsured populations).

Table 2

Characteristics of older adults (age>50) with hypertension enrolled in *Seguro Popular* or uninsured (n=3538) in Mexico: Mexican Health and Nutrition Surveys (2000, 2006 and 2012)

	Year 2000	Year 2006		Year 2012	
	Uninsured (n=1151)	Uninsured (n=505)	SP (n=182)	Uninsured (n=468)	SP (n=1232)
Individual characteristics					
Female	896 (77.85)	281 (55.64)	98 (53.85)	308 (65.81)	861 (69.89)
Age	63.88 (9.87)	66.86 (10.70)	66.20 (9.22)	65.33 (10.90)	64.84 (9.99)
Married	558 (48.48)	161 (31.88)	69 (37.91)	207 (44.23)	604 (49.03)
Indigenous	77 (6.69)	32 (6.34)	10 (5.49)	28 (5.98)	115 (9.33)*
No education	69 (5.99)	145 (16.24)	53 (29.12)	95 (20.30)	318 (25.81)*
Primary education	705 (61.25)	305 (60.40)	117 (64.29)	260 (55.56)	750 (60.88)*
Time to diagnosis (months)	104.33 (210.70)	76.76 (103.97)	60.42 (78.94)	148.35 (247.20)	114.85 (201.66)*
BMI_1	397 (34.49)	174 (34.46)	69 (37.91)	114 (24.36)	382 (31.01)*
BMI_2	439 (38.14)	190 (37.62)	71 (39.01)	158 (33.76)	458 (37.18)
Family assets					
Mean (asset index)	-0.43 (2.33)	-0.53(1.99)	-1.01(1.89)*	-0.12 (2.28)	-0.78 (2.02)*
Regional characteristics					
East central	241 (20.94)	131 (25.94)	34 (18.86)*	136 (29.05)	595 (23.94)*
West central	443 (38.49)	171 (33.86)	83 (45.60)*	140 (29.91)	475 (38.56)*
North	237 (20.59)	82 (16.94)	36 (19.78)	106 (22.65)	228 (18.51)
Rural	719 (62.47)	341 (68.91)	107 (58.79)*	337 (72.01)	658 (53.41)*

Notes: SP = *Seguro Popular*. SP was launched in 2001, thus the survey in 2000 does not have a SP column, and serves as a "pre-treatment" observation.

Time to diagnosis is measured in months.

BMI_1=Body mass index overweight (>25 kg/m^2)

BMI_2=Body mass index obese (>30 kg/m^2)

Family asset index based on the following assets: household infrastructure, household materials and assets. This is a proxy for household's wealth. It was calculated using principal components analysis. This measure is centered at 0 and negative values indicate lower household wealth.

*Significant at $p \leq 0.05$ (for a *t*-test for continuous variables, or *chi*-square test for categorical variables, comparing SP and uninsured populations).

Table 3

Diabetes care and treatment outcomes for older adults (age>50) enrolled in *Seguro Popular* or uninsured in Mexico: Mexican Health and Nutrition Surveys (2000, 2006 and 2012)

	Year 2000	Year 2006		Year 2012	
	Uninsured	Uninsured	SP	Uninsured	SP
Outcome					
Blood sugar monitoring	n = 645	n = 258	n = 92	n = 290	n = 782
Yes	477 (73.95)	198 (76.74)	69 (75.00)	192 (66.21)	578 (73.91)*
Insulin/Oral agents	n = 573	n = 232	n = 82	n = 290	n = 782
Yes	520 (90.75)	214 (92.24)	82 (98.80)*	240 (82.76)	706 (90.28)*
Alternative medicine	n = 545	n = 203	n = 67	n = 290	n = 782
Yes	100 (18.35)	21 (10.24)	4 (5.88)	28 (9.66)	69 (8.82)
Diet	n = 566	n = 235	n = 84	n = 290	n = 782
Yes	121 (21.38)	52 (22.13)	21 (25.00)	56 (19.31)	169 (21.61)
Exercise	n = 466	n = 199	n = 72	n = 290	n = 782
Yes	21 (4.51)	16 (8.04)	9 (12.50)	23 (7.93)	65 (8.31)

*Significant at $p \leq 0.05$ (for a *t*-test for continuous variables, or *chi*-square test for categorical variables, comparing SP and uninsured populations).

Table 4

Hypertension care and treatment outcomes for older adults (age>50) enrolled in *Seguro Popular* or uninsured in Mexico: Mexican Health and Nutrition Surveys (2000, 2006 and 2012)

	Year 2000	Year 2006		Year 2012	
	Uninsured	Uninsured	SP	Uninsured	SP
Outcome					
Antihypertensive medication	n = 874	n = 503	n = 182	n = 455	n = 1208
Yes	657 (75.17)	358 (71.17)	136 (74.73)	372(81.76)	1015 (84.02)
Alternative medicine	n = 932	n = 366	n = 139	n = 372	n = 1015
Yes	57 (6.12)	37 (10.11)	5 (3.60)*	0 (0)	0 (0)
Diet	n = 953	n = 412	n = 162	n = 372	n = 1015
Yes	78 (8.18)	83 (20.15)	28 (17.28)	59 (15.86)	151 (14.88)
Exercise	n = 875	n =374	n = 144	n = 372	n = 1015
Yes	0 (0)	45 (12.03)	10 (6.94)	32 (8.60)	72 (7.09)

*Significant at $p \leq 0.05$ (for a *t*-test for continuous variables, or *chi*-square test for categorical variables, comparing SP and uninsured populations).

Table 5

Instrumental variables evaluation of the effect of *Seguro Popular* on diabetes and hypertension treatment and care among older Mexicans (age>50): 2SLS second stage results

	N	First-state F-test of excluded instruments	Coefficient	95% CI
Diabetes care & treatment				
Blood sugar monitoring	2070	291.71***	.0085	[-.0893, .1063]
Insulin/oral agents	1962	262.26***	-.0402	[-.1095, .0291]
Alternative medicine	1890	247.52***	-.0880	[-.1646, -.01154]***
Diet	1959	260.67***	-.0108	[-.1061, .0845]
Exercise	1811	215.19***	.0499	[-.0154, .1153]
Hypertension care & treatment				
Antihypertensive medication	3223	409.85***	.0956	[.0220, .1693]*
Alternative medicine	2828	437.73***	-.0921	[-.1261, -.0580]***
Diet	2918	431.43***	.1389	[.0744,.2034]***
Exercise	2784	408.71***	.0780	[.0337, .1224]***

Notes: The table presents the second stage results of the two-stage least squares (2SLS) regression models, adjusted for individual characteristics (sex, age, marital status, indigenous background and education, time to diagnosis, BMI, and family assets) regional characteristics, number of health resources (health care units, doctors and nurses) in 2000, 2005, 2009 and state dummies.

*Significant at $p \leq 0.05$ ***Significant at $p \leq 0.01$