Contribution of socioeconomic factors and health care access to the awareness and treatment of diabetes and hypertension among older Mexican adults

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Abstract

Objective. To estimate changes in self-report and treatment of diabetes and hypertension between 2001 and 2012 among Mexican aged 50-80, assessing the contribution of education and health insurance coverage. **Materials and methods**. The Mexican Health and Aging Study was used to estimate associations of education and insurance on prevalence and treatment of diabetes and hypertension in 2001 and 2012. Multivariate decomposition was used to assess the contribution of changes in the composition of covariates vs. their "effects" on changes in prevalence and treatment over time. **Results**. Increases in the prevalence/diagnosis and treatment during the period are largely attributable to the expansion of health insurance. Its effects on diagnosis/prevalence and treatment have also increased over time. **Conclusions**. The expansion of *Seguro Popular* likely improved screening and treatment. More research is needed to assess if these have translated into better control and a lower burden of disease.

Keywords: diabetes; hypertension; medical care; adult health; health of the elderly; Mexico

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Resumen

Objetivo. Estimar cambios en el autorreporte y en el tratamiento de diabetes e hipertensión en adultos de entre 50 y 80 años en México, en 2001 y 2012, y explicarlos en función de los sufridos en cuanto a composición educativa y de cobertura/derechohabiencia en servicios de salud. **Material y métodos**. Se utilizó la Encuesta Nacional de Salud y Envejecimiento en México y técnicas de descomposición multivariada. **Resultados**. El incremento en la prevalencia/diagnóstico y tratamiento durante el periodo se debe en gran medida al aumento en la cobertura de servicios de salud. Los "efectos" de la cobertura también se incrementaron de forma importante. **Conclusiones**. La expansión del *Seguro Popular* probablemente tuvo un papel importante en la detección y tratamiento de la diabetes e hipertensión. Investigaciones futuras discernirán si dicha expansión se ha traducido en un mejor control y una menor carga de morbilidad.

Palabras clave: diabetes mellitus; hipertensión; atención médica; salud del adulto; salud del anciano; México

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Rapid and uneven demographic and social transformations have been accompanied by profound nutritional and epidemiological changes that have had mixed effects on the Mexican population.[1] Social changes have led to improvements in infant and child nutrition, health, and survival,[2] while also fueling considerable increases in obesity and related chronic conditions, most notably diabetes and hypertension.

These conditions place a high disease burden as a major risk factor for old-age disability and mortality.[3] One-third of Mexican adults were classified as obese in 2012, the highest prevalence worldwide for the year[4]—a result of a particularly rapid increase in obesity prevalence in the first decade of the 21st Century.[5] The forces behind increasing body masses have also caused the rise in the prevalence of major chronic conditions such as type-2 diabetes (i.e., diabetes *mellitus*) and hypertension. Diabetes prevalence in the adult population (aged 20 or older) was estimated at 14% in 2006 after more than doubling during the prior 13 years.[6] Similarly, the prevalence of hypertension among adults aged 20 or older also increased for both men and women between 2000 and 2006;[7] although it remained fairly stable between 2006 and 2012, affecting about one-third of those aged 20 or older.[5]

In developing countries, prior and during the early stages of the nutrition transition, people with lower socioeconomic status (SES) are generally also at a lower risk of being obese and developing diabetes and hypertension than those with higher SES.[8] As the transition unfolds, these risks increase considerably and more rapidly for people with low SES. The burden of disease among the poor is further amplified by their lack of systematic access to private and public forms of health care, which impede prevention efforts and severely hinder early detection and appropriate disease control (e.g., through medication and nutritional and activity changes).[9,10]

While socioeconomic differentials in health among older Mexican adults (ages 50 and over) could be increasing as the nutrition transition has unfolded, the establishment of Seguro Popular in 2005 could have reduced socioeconomic gradients in the detection and treatment of chronic conditions.[11] In this paper we study changes in the awareness and (drug) treatment of diabetes and hypertension between 2001 and 2012. Due to the relevance of increasing socioeconomic gradients during the transition and the likely countervailing influence of the expansion of more steady health care coverage via Seguro Popular, we assess the contribution of changes in self-report and treatment of diabetes and hypertension during the period to shifts in the educational and health insurance coverage composition of the population using multivariate decomposition techniques.

Materials and methods

Data

The Mexican Health and Aging Study (MHAS, or Enasem in Spanish) is a prospective three-wave panel study of a nationally representative cohort of older Mexican adults ages 50 and older at baseline (i.e., born prior to 1951 and alive in 2001) designed to have both urban and rural representation. Data were collected in collaboration with the National Institute of Statistics and Geography (INEGI, in Spanish). Baseline interviews conducted in 2001 had a response rate of 91.8%. A second wave conducted in 2003 had a successful re-interview rate of 93%.[12] The most recent wave, collected during the fall of 2012 with a response rate of 88.1%,[13] added 5 896 additional respondents aged 50-60 to replenish the sample in order to maintain representativeness of people aged 50 or older in both 2001 and 2012. The study was approved by the Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch in the United States, the INEGI and the Instituto Nacional de Salud Pública (INSP) in Mexico. Detailed information on the MHAS survey design is presented elsewhere.[12]

MHAS recorded detailed information on individual health, migration history, SES, family transfers, kin availability and attributes, and household composition for main respondents, as well as their spouses. In the first wave, a total of 15 182 complete interviews were obtained. For this analysis, we used data from the 2001 and 2012 waves, including the supplemental sample of adults aged 50-60 in 2012. We further restricted the samples to those aged 50-80 to minimize mortality selection effects.[14] For 2001, we selected people aged 50-80 (n= 12 804) and excluded individuals with missing values in the outcomes (n=440) and covariates of interest (n=30), leading to a final analytic sample of 12 334 (96.4% of original sample). Similarly, for 2012 we selected people aged 50-80 (n=12 292) and excluded 122 respondents with missing values in the selected variables, leading to a final analytic sample of n=12 170 (99% of the original sample).

Measures

We measured chronic disease with prior diagnosis from self-reports. Individuals were classified as hypertensive if they answered "yes" to the question: "Has a doctor or medical personnel ever told you that you have hypertension or high blood pressure?" Similarly, respondents were classified as diabetic if they answered "yes" to the question: "Has a doctor or medical personnel ever

told you that you have diabetes or a high blood sugar level?" Among those reporting having been diagnosed, the use of antihypertensive medication was assessed by the question: "Are you currently taking any medication to lower your blood pressure?" Finally, we assessed two types of diabetic medication, oral and insulin, through the questions: "Are you currently taking any oral medication?" or "Are you currently using insulin shots in order to control your diabetes?"

Access to health insurance in 2001 and 2012 was assessed through the question: "do you have the right to medical attention in Instituto Mexicano del Seguro Social (IMSS), Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (ISSSTE), Petróleos Mexicanos (Pemex), *Defensa* (Army) or *Marina* (Navy), private medical insurance, or other?" In 2012, we also added individuals who reported being affiliated with *Seguro Popular*. In some models, we assessed the effect of *Seguro Popular* relative to other forms of health insurance.

Finally, we used a measure of socioeconomic status (SES) based on completed years of education aggregated into three categories: no schooling (0 years of education), some primary schooling (1 to 6 years of schooling) and some secondary schooling or more (7+ years). We also included a dummy indicator to identify proxy respondents.

Methods

We followed a two-step process. First, to identify variation in the risk factors of prior diagnosis and lack of treatment by age and sex, we estimated a series of sex- and age group-specific (aged 50-64 and 65-80) logistic regression models for each point in time: 2001 and 2012. These models assessed the role of sex, age, education, an indicator of proxy respondent, and insurance on the prevalence of each health indicator following the functional form in equation 1:

$$\text{logit}[Y_i(t)] = \beta_{At}\text{Age}_i(t) + \beta_{Et}\text{Ed}_i(t) + \beta_{RFt}\text{Proxy}_i(t) + \beta_{It}\text{Insurance}_i(t) + \varepsilon_i(t) \quad (1)$$

where i corresponds to individuals, t represents time period [t Є (2001, 2012)] and Y is a dichotomous variable for each outcome described above.

Second, we performed a regression-based decomposition method that separated the change in prevalence between 2001 and 2012 into two components: 1) changes in the structural composition of the population (i.e., age, education and health care access) versus 2) changes in the impact of these covariates on the prevalence of each condition (i.e., changes in the β's from equation 1). This approach is known as the Blinder-Oaxaca decomposition method. We performed the decomposition as follows:[15]

$$\Delta\text{Prev} = \Delta\text{Age}\beta_{At_0} + \Delta\text{Ed}\beta_{Et_0} + \Delta\text{Insurance}\beta_{It_0} + \text{Age}_{t_0}\Delta\beta_A + \text{Ed}_{t_0}\Delta\beta_E + \text{Insurance}_{t_0}\Delta\beta_I \quad (2)$$

where t_0 represents time 0 (i.e., 2001) and Δ indicates changes between 2001 and 2012. The first row on the right hand side of equation (2) shows the effect of changes in the composition of the population, holding constant their impact on the prevalence, while the second row shows the impact of changes in the relationship between these covariates and the prevalence of each condition, holding constant the composition of the population. We used averages of each explanatory variable in each time period. Seguro Popular was collapsed with all other forms of insurance in these decompositions to allow us to estimate the role of health insurance in changes in prevalence and treatment.

Results

Weighted descriptive estimates for the older Mexican population in 2001 and 2012 are shown in table I. Comparisons across years show a significant increase in diabetes prevalence for all ages, while the prevalence of hypertension significantly increased only for older adults aged 65-80. The prevalence of each condition is high with over a third and about one-fifth of people aged 65-80 being diagnosed with hypertension or diabetes, respectively. Although, at face value, this increase could be a worrying indication that a higher share of older adults is afflicted with these diseases, other results in our analyses suggest these patterns are also an indication of a higher screening and detection of otherwise undiagnosed diseases. Also consistent with this interpretation, is the fact that the proportion of people with diagnosed but untreated diabetes or hypertension significantly declined over time, particularly for hypertension.

Self-reported access to health insurance other than *Seguro Popular* remained fairly constant during the period, covering about half the people aged 50-80 in both 2001 and 2012. *Seguro Popular* thus became an important additional source of health care, covering about one-third of this population by 2012. The expansion of health care coverage exclusively through *Seguro Popular* took place in a context of declines in the proportion of people with no education. Higher schooling is an important measure of higher SES and a predictor of formal sector participation; nonetheless the expansion of coverage occurred mostly via *Seguro Popular*.

Table I
SAMPLE CHARACTERISTICS OF PEOPLE AGES 50-80 IN MEXICO. MEXICAN HEALTH AND AGING STUDY (MHAS), 2001-2012

Characteristics	*Aged 50-64*				*Aged 65-80*			
	2001	*2012*	*Change: 2001-2012*		*2001*	*2012*	*Change: 2001-2012*	
	% [1]	*% [2]*	*[2] - [1]*	*p-value*	*% [1]*	*% [2]*	*[2] - [1]*	*p-value*
Male								
Disease prevalence								
Diabetes	11.72	15.76	4.04	0.008	15.94	19.81	3.87	0.065
Hypertension	22.97	25.80	2.83	0.160	35.12	37.90	2.78	0.328
Untreated condition*								
Diabetes	20.49	17.79	-2.70	0.659	16.55	11.42	-5.13	0.255
Hypertension	40.44	29.45	-10.99	0.009	24.70	16.47	-8.23	0.036
Age	56.47	57.00	0.54	0.002	71.07	70.91	-0.17	0.705
Education								
None	19.01	8.38	-10.63	< 0.001	35.41	23.89	-11.52	< 0.001
Primary	55.25	48.53	-6.72	0.008	49.59	55.31	5.72	0.048
Secondary+	25.74	43.10	17.35	< 0.001	15.00	20.80	5.79	0.009
Access to health care								
No insurance	48.21	14.63	-33.58	< 0.001	43.19	11.07	-32.13	< 0.001
Insurance‡	51.79	53.04	1.24	0.378	56.81	57.62	0.81	0.346
Seguro Popular	n.a.	32.34	n.a.	n.a.	n.a.	31.32	n.a.	n.a.
Proxy respondent	9.52	8.71	-0.80	0.361	8.55	9.10	0.55	0.782
Female								
Disease prevalence								
Diabetes	15.97	20.24	4.28	0.012	19.43	26.61	7.18	0.001
Hypertension	42.56	39.00	-3.56	0.089	50.04	55.89	5.85	0.027
Untreated condition*								
Diabetes	16.80	6.31	-10.49	0.005	9.18	6.65	-2.53	0.402
Hypertension	30.70	18.83	-11.87	0.001	19.80	7.91	-11.90	< 0.001
Age	56.27	56.52	0.25	0.174	70.96	71.12	0.16	0.681
Education								
None	27.84	11.67	-16.17	< 0.001	42.36	32.45	-9.91	< 0.001
Primary	52.32	48.64	-3.67	0.193	45.57	53.74	8.18	0.001
Secondary+	19.84	39.69	19.85	< 0.001	12.08	13.81	1.73	0.221
Access to health care								
No insurance	42.88	9.79	-33.08	< 0.001	40.74	9.79	-30.95	< 0.001
Insurance‡	57.12	56.27	-0.86	0.973	59.26	59.61	0.35	0.762
Seguro Popular	n.a.	33.94	n.a.	n.a.	n.a.	30.60	n.a.	n.a.
Proxy respondent	4.93	3.88	-1.05	0.157	7.45	8.70	1.25	0.661

* *p*-values are estimated from logistic regressions, except for age for which OLS is used, taking into account the complex survey design (sampling weights)
* Not using antihypertensive medication among hypertensives or not using oral or insulin shots among diabetics
‡ Includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other

Note: Percentages are weighted to reflect the national Mexican older adult population. Sample sizes correspond to actual number of respondents in the analytic sample
Source: Reference 34

Table II
Odds ratios of self-reported diabetes, hypertension and untreated condition with insurance and education for people ages 50-80 in Mexico. Mexican Health and Aging Study (MHAS) 2001-2012

Covariates	Self-reported condition				Untreated condition			
	Aged 50-65		Aged 65-80		Aged 50-65		Aged 65-80	
	2001	2012	2001	2012	2001	2012	2001	2012
Diabetes								
Male								
Insurance[#]	1.66*	0.82	2.59‡	1.69	0.68	0.35	0.39	0.26§
Education (ref=none)								
Primary	0.96	0.92	1.05	1.21	0.95	0.64	0.77	0.37
Secondary+	0.65	0.97	1.07	1.15	0.52	0.77	1.40	0.40
Female								
Insurance[#]	2.14‡	2.11*	2.29‡	1.86§	1.89	0.47	0.38	0.15*
Education (ref=none)								
Primary	0.72	1.04	1.05	1.23	0.46	1.62	1.21	0.70
Secondary+	0.51§	0.63	1.16	0.65	1.19	0.94	5.73§	2.62
Hypertension								
Male								
Insurance[#]	1.31	1.53	1.74*	1.58	0.57§	0.52	0.67	0.36§
Education (ref=none)								
Primary	1.07	1.17	1.37	1.02	0.74	0.60	0.67	0.71
Secondary+	0.85	1.62	2.08§	0.98	0.39§	0.57	0.47	0.47
Female								
Insurance[#]	1.64‡	1.29	1.43§	2.12‡	0.67§	1.23	0.42*	0.23‡
Education (ref=none)								
Primary	1.02	1.70*	0.98	1.07	0.63§	0.57	0.55§	0.56
Secondary+	0.62*	1.11	0.92	1.04	0.72	0.47§	0.16‡	0.65

* $p<0.01$
‡ $p<0.001$
§ $p<0.05$
[#] Includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other. In 2012, it also includes *Seguro Popular*

Note: All models control for age and a dummy for proxy respondent (see Appendix for complete tables). Odds ratios from logistic regression analyses taking into account the complex survey design (sampling weights). Sample size corresponds to the actual analytic sample
Source: Reference 34

Diagnosis and treatment of diabetes and hypertension

Regression results associating access to health care and education with prevalence and treatment measures, all by sex and age group, are shown in table II. Results for self-reported diabetes indicate that people who have access to health insurance are somewhat more likely to self-report having diabetes, particularly for those aged 65-80. However, among those who self-report having been diagnosed with diabetes, neither health insurance nor education appears to be associated with an untreated condition. The exception is found among people aged 65-80 in 2012, for whom access to health care is associated with a lower likelihood of having untreated diabetes.

Similar to diabetes, older adults (aged 65-80) who have access to health insurance are significantly more likely to report having being diagnosed with hypertension, with larger coefficients found among females in 2012 (table II). Education, on the other hand, does not show a consistent link with self-reported hypertension. Among individuals who reported having hypertension, health insurance is associated with a lower likelihood of being untreated among older adults (aged 65-80), particularly women.

Table III

RESULTS OF OAXACA-BINDER DECOMPOSITION ASSESSING THE CONTRIBUTION OF CHANGES IN THE COMPOSITION AND EFFECT OF DEMOGRAPHICS, EDUCATION AND INSURANCE ON CHANGES IN THE PREVALENCE OF SELF-REPORTED DIABETES AND HYPERTENSION AND MEDICAL TREATMENT BETWEEN 2001 AND 2012, PEOPLE AGES 50-80. MEXICAN HEALTH AND AGING STUDY (MHAS)

Health change	*Aged 50-64*				*Aged 65-80*			
	Disease		*Untreated disease*		*Disease*		*Untreated disease*	
	Diabetes	*Hypertension*	*Diabetes*	*Hypertension*	*Diabetes*	*Hypertension*	*Diabetes*	*Hypertension*
Males								
Prevalence								
2001	11.72	22.97	20.49	40.44	15.94	35.12	16.55	24.70
2012	15.76	25.80	17.79	29.45	19.81	37.90	11.42	16.47
Total change	4.04	2.83	-2.70	-10.99	3.87	2.78	-5.13	-8.23
Effect of changes in the composition of covariates in 2001 vs. 2012								
Demographics*	0.25	0.33	-0.56	-0.46	0.03	0.05	-0.68	-0.28
Education	-0.75	-0.59	-2.00	-4.34	0.08	1.33	-0.06	-0.20
Insurance	1.62	1.47	-1.09	-3.85	3.25	3.44	-1.85	-1.57
Effect of changes in the effect of the covariates in 2001 vs. 2012								
Demographics*	1.66	1.73	-3.93	-0.87	1.29	0.85	-0.30	-0.86
Education	0.88	2.58	-5.90	-0.85	0.74	-0.74	-6.00	0.43
Insurance	-3.93	0.96	-15.54	-1.10	-2.23	-0.16	-2.92	-5.40
Constant	5.92	-6.27	26.80	-1.70	1.76	0.10	7.26	1.93
Unexplained	-1.60	2.62	-0.48	2.18	-1.05	-2.08	-0.57	-2.28
Females								
Prevalence								
2001	15.97	42.56	16.80	30.70	19.43	50.04	9.18	19.80
2012	20.24	39.00	6.31	18.83	26.61	55.89	6.65	7.91
Total change	4.28	-3.56	-10.49	-11.87	7.18	5.85	-2.53	-11.90
Effect of changes in the composition of covariates in 2001 vs. 2012								
Demographics*	0.07	0.18	2.62	-0.76	-0.10	0.10	-0.37	-0.20
Education	-1.45	-2.31	0.31	-1.25	0.09	-0.08	-0.65	-1.27
Insurance	2.75	3.63	-3.33	-2.21	3.24	2.45	-1.24	-3.74
Effect of changes in the effect of the covariates in 2001 vs. 2012								
Demographics*	8.27	6.70	-0.21	-1.82	0.21	3.62	28.18	-0.01
Education	4.46	8.56	6.61	-2.23	0.07	1.50	-36.95	2.11
Insurance	-0.15	-3.08	-10.52	7.03	-1.84	6.09	-68.84	-4.57
Constant	-10.37	-17.91	-4.17	-12.76	5.66	-10.73	79.31	-4.03
Unexplained	0.69	0.66	-1.80	2.12	-0.15	2.89	-1.99	-0.18

* Include age and proxy respondents
Source: Reference 34

Impact of insurance and education on self-reported diabetes, hypertension and their medical treatment

Results in table III show how much of the change in prevalence of each outcome between 2001 and 2012 is related to changes in the covariates (health insurance, education, age, and proxy respondent status) versus changes in the impact of these covariates on the prevalence of each condition (i.e., in composition vs. in structure). With the exception of women ages 50-64, for whom hypertension actually declined, diabetes and hypertension prevalence increased between 2001 and 2012. Changes in the composition of the population with

access to health insurance had the largest contribution (among compositional factors) in explaining changes in the prevalence of each condition. Put simply, the fact that health insurance became more prevalent in recent years increased the self-reporting of these chronic conditions as individuals likely became more aware of their disease status. Among adults aged 50 to 64, changes in the educational composition contributed to a *reduction* (negative sign) in the prevalence of both diabetes and hypertension suggesting that, had the schooling levels of older Mexicans not improved, the observed increase in the prevalence of hypertension and, especially, diabetes would have been even higher than the observed change (assuming the effect of schooling on self-reported diabetes and hypertension remained stable between 2001 and 2012). Finally, the aging process, reflected in slight changes in the age distribution of the population and in the share of proxy respondents, contributed to an increase in the prevalence of diabetes and hypertension.

More importantly, the prevalence of untreated diabetes or hypertension declined across all sex and age groups. The contribution of changes in the composition of the population on explaining changes in untreated condition is similar to that of the prevalence of diabetes and hypertension. The only exception is found among males aged 50-64 for whom compositional changes in education seem to have contributed the most in reducing the prevalence of an untreated condition. Nonetheless, the expansion of health coverage contributed the most to the observed reduction in the prevalence of being untreated for diabetes or hypertension.

Although compositional changes had some relevance in explaining changes in the prevalence and treatment of diabetes and hypertension, the largest contributions to the reduction in untreated conditions came from increases in the effect of the covariates. Interestingly and perhaps because we are studying chronic conditions that are closely related to aging, the impact of demographics on changes in prevalence rates is rather large and positive, contributing to the increase in diagnosis prevalence. Education also has a nontrivial impact on the likelihood of reporting diabetes and (to a lesser extent) hypertension. In contrast, the impact of insurance on diabetes reporting declined slightly over time with milder and mixed effects for hypertension. Similarly, the impact of having health insurance on untreated diabetes, and to a lesser extent hypertension, was large, contributing to decreases in an untreated condition during the period.

The case of *Seguro Popular* on diabetes, hypertension and their medical treatment

Additional analyses examining the role of having only access to *Seguro Popular* versus other forms of health insurance and those who report no insurance for the most recent wave of MHAS are shown in table IV. Other forms of insurance include IMSS, ISSSTE, Pemex, *De-*

Table IV
Odds ratios examining the role of *Seguro Popular* versus other forms of health insurance on self-reported diabetes, hypertension and untreated conditions for people ages 50-80 in Mexico. Mexican Health and Aging Study (MHAS) 2012

Covariates	Aged 50-64				Aged 65-80			
	Disease		Untreated disease		Disease		Untreated disease	
	Diabetes	Hypertension	Diabetes	Hypertension	Diabetes	Hypertension	Diabetes	Hypertension
Male								
Access to health care (ref= insurance*)								
Seguro Popular	0.70	0.72	0.68	3.81‡	0.54§	0.73	0.54	1.30
No insurance	1.08	0.59#	2.59	3.07#	0.48#	0.56#	3.23	3.08#
Female								
Access to health care (ref= insurance*)								
Seguro Popular	1.18	1.17	0.81	0.94	0.59§	0.76	1.49	2.21#
No insurance	0.51§	0.82	1.94	0.79	0.45§	0.43‡	7.86§	6.15‡

* Insurance includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other
‡ $p<0.001$
§ $p<0.01$
# $p<0.05$

Note: All models control for age, education and a dummy for proxy respondent (see Appendix for complete tables). Odds ratios from logistic regression analyses taking into account the complex survey design (sampling weights). Sample size corresponds to the actual analytic sample
Source: Reference 34

fensa, *Marina*, Private or Other (grouped as the insurance category in table IV). The increase in health insurance coverage through *Seguro Popular* has had an important role in the detection and treatment of hypertension and diabetes with mixed results between younger (ages 50-64) and older adults (ages 65-80). Among younger adults there is no significant difference in reporting being diagnosed with diabetes or hypertension between *Seguro Popular* and other forms of insurance, but older adults with *Seguro Popular* are significantly less likely to report being diagnosed with diabetes. However, there is no significant difference in reporting untreated diabetes between *Seguro Popular* and other forms of insurance, although younger adult males and older adult females with *Seguro Popular* are significantly more likely to report untreated hypertension.

Discussion

Our results indicate that access to health insurance, and the expansion of *Seguro Popular* in particular, have likely played a major role in self-reporting diagnosis and treatment of major chronic diseases. These findings corroborate previous studies showing that having health insurance is associated with increased disease awareness and improved outcomes for disease care,[16] even though having health insurance may not necessarily guarantee effective treatment or treatment adherence.

Further, these associations seem to be gender-specific, with larger effects for females than males. In Mexico, women are more likely than men to report having access to health care (as shown in table I), to use preventive care and to visit the doctor, which increase their disease awareness and disease treatment.[17] Having access to health coverage further increases medical service utilization, as shown by Wong and Díaz,[17] which may help explain this gender differences.

We also found a significant increase in the prevalence of diabetes for people aged 50-80, while the prevalence of hypertension significantly increased only for people aged 65-80. This increase is partly due to more screening resulting from the expansion of health care access through *Seguro Popular*. However, evidence from the National Health and Nutrition Survey in Mexico (2006) indicates a high prevalence of cardiometabolic risk factors in the adult population,[7,18] suggesting that disease "acquisition" also played an important role in the observed prevalence increase.

Our study did not find strong educational differences in awareness or treatment of diabetes and hypertension. Previous studies have shown an inverse link between education and physiological dysregulation across multiple systems. In particular, studies have found high levels of plasma glucose and higher likelihood of having hypertension among Mexicans with low education.[19,20] This difference may be due to underdiagnosed cases that we are unable to identify when using self-reported measures. Previous research in Mexico shows a greater than 20% difference between the prevalence of hypertension based on self-reports and measured blood pressure among people aged 50 or older.[19] Although socioeconomic differentials in health are milder among older adults (aged 65-80) due to mortality selection, these differentials were weak even among younger older adults (aged 50-64), where mortality biases are less strong, suggesting higher under-reporting among those with lower SES. As socioeconomic differentials remained weak even after controlling for health insurance, these results may also indicate that the epidemiologic transition is still undergoing for the cohorts studied here.

We also found that changes in the composition of the population between 2001 and 2012 explain some of the changes in the prevalence of diabetes and hypertension and their treatment. By far, the considerable expansion of health insurance coverage, mainly through *Seguro Popular*, had the largest contribution of compositional factors on explaining changes in the prevalence of diagnosed diabetes and hypertension. This is consistent with previous evidence indicating an increase in health care utilization through *Seguro Popular*.[21] Additionally, the bulk of the change in the prevalence of these conditions comes from changes in the impact of insurance and education on the prevalence of each disease. For example, the impact of education is particularly important on younger older adults (aged 50-64) as it has a larger effect over time on the likelihood of being aware of diabetes and hypertension status. However, the impact of insurance seems to decline over time for diabetes but not for hypertension. For instance, there is an increase in the impact of insurance on being aware of hypertension for younger adult males (aged 50-64) and older females (aged 65-80), and a larger impact of insurance on being untreated for hypertension among younger adult females.

Seguro Popular is emerging as an important health care resource for the older adult Mexican population, at least for conditions that are easily detectable. Beneficiaries of *Seguro Popular* aged 50-64 are equally likely to be aware of their diabetes or hypertension status relative to other forms of insurance, and there is no significant difference in reporting untreated diabetes between *Seguro Popular* and other forms of insurance. Thus, *Seguro Popular* may be contributing to ameliorate the large economic costs associated with the progression of these conditions by providing an important source of preventive care.[22] Yet,

from the current analyses, it seems that *Seguro Popular* has not been equally effective in the early detection and control of chronic diseases relative to other forms of insurance and health care. We found that older adults (ages 65-80) with *Seguro Popular* are significantly less likely to report being diagnosed with diabetes relative to other forms of insurance, and that younger adult males (ages 50-64) and older adult females (ages 65-80) with *Seguro Popular* are significantly more likely to report untreated hypertension. Although increasing access to health care may raise disease awareness, it is also important to continue improving the quality and efficiency of the treatment provided. In particular, to further improve the results of *Seguro Popular* there will be a need to train specialists to adequately care and manage chronic conditions and to provide access to rural areas.[11]

This study has some limitations. Our measures are based on self-reports in both waves, which does not allow us to separate changes in the actual prevalence of diabetes and hypertension from increases in awareness. Without biomarker/anthropometric measures in both waves, we cannot identify undiagnosed cases or those under control while using medication. We are also unable to assess treatment efficacy such as use of specific medication (e.g., statins), because the survey does not provide information about specific medications. Similarly, our results for lack of medical treatment, as opposed to, say, diet and exercise, need not imply lack of appropriate control. As such, our estimates of untreated conditions are likely to be conservative, i.e. lower than they could be, if drug availability or treatment adherence was a problem or they could be too high if people controlled the disease in other ways. Our results do not provide sufficient evidence to ascertain if SES gradients might have widened further due to better access to screening and, at the same time, whether access to health care could be responsible for better prevention. Our findings represent the net yet protective effect of these factors and further research is needed to disentangle these effects.

Declaration of conflict of interests. The authors declare that they have no conflict of interests.

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Appendix 1

Sample characteristics of Mexican people aged 50-80. Mexican Health and Aging Study (MHAS) 2001-2012

Characteristics	Aged 50-64						Aged 65-80					
	2001		2012		Change: 2001-2012		2001		2012		Change: 2001-2012	
	% [1]	Sample size	% [2]	Sample size	[2] - [1]	p-value*	% [1]	Sample size	% [2]	Sample size	[2] - [1]	p-value*
Male												
Disease prevalence												
Diabetes	11.72	514	15.76	563	4.04	0.008	15.94	306	19.81	575	3.87	0.065
Hypertension	22.97	1 005	25.80	890	2.83	0.160	35.12	671	37.90	1 095	2.78	0.328
Untreated condition‡												
Diabetes	20.49	94	17.79	62	-2.70	0.659	16.55	47	11.42	50	-5.13	0.255
Hypertension	40.44	377	29.45	221	-10.99	0.009	24.70	158	16.47	140	-8.23	0.036
Age	56.47	3 761	57.00	2 950	0.54	0.002	71.07	1 943	70.91	2 641	-0.17	0.705
Education												
None	19.01	586	8.38	251	-10.63	0.000	35.41	596	23.89	550	-11.52	0.000
Primary	55.25	2 015	48.53	1 347	-6.72	0.008	49.59	1 064	55.31	1 497	5.72	0.048
Secondary+	25.74	1 160	43.10	1 352	17.35	0.000	15.00	283	20.80	594	5.79	0.009
Access to health care												
No insurance	48.21	1 510	14.63	388	-33.58	0.000	43.19	721	11.07	200	-32.13	0.000
Insurance§	51.79	2 251	53.04	1 692	1.24	0.378	56.81	1 222	57.62	1 702	0.81	0.346
Seguro Popular	n.a.	n.a.	32.34	870	n.a.	n.a.	n.a.	n.a.	31.32	739	n.a.	n.a.
Proxy respondent	9.52	309	8.71	211	-0.80	0.361	8.55	150	9.10	239	0.55	0.782
Female												
Disease prevalence												
Diabetes	15.97	761	20.24	825	4.28	0.012	19.43	419	26.61	895	7.18	0.001
Hypertension	42.56	1 987	39.00	1 507	-3.56	0.089	50.04	1 082	55.89	1 791	5.85	0.027
Untreated condition‡												
Diabetes	16.80	88	6.31	63	-10.49	0.005	9.18	48	6.65	44	-2.53	0.402
Hypertension	30.70	563	18.83	250	-11.87	0.001	19.80	215	7.91	125	-11.90	0.000
Age	56.27	4 513	56.52	3 498	0.25	0.174	70.96	2 117	71.12	3 081	0.16	0.681
Education												
None	27.84	956	11.67	413	-16.17	0.000	42.36	776	32.45	816	-9.91	0.000
Primary	52.32	2 480	48.64	1 726	-3.67	0.193	45.57	1 066	53.74	1 704	8.18	0.001
Secondary+	19.84	1 077	39.69	1 359	19.85	0.000	12.08	275	13.81	561	1.73	0.221
Access to health care												
No insurance	42.88	1 610	9.79	277	-33.08	0.000	40.74	739	9.79	177	-30.95	0.000
Insurance§	57.12	2 903	56.27	2 091	-0.86	0.973	59.26	1 378	59.61	2 054	0.35	0.762
Seguro Popular	n.a.	n.a.	33.94	1 130	n.a.	n.a.	n.a.	n.a.	30.60	850	n.a.	n.a.
Proxy respondent	4.93	184	3.88	133	-1.05	0.157	7.45	145	8.70	246	1.25	0.661

* *p*-values are estimated from logistic regressions, except for age for which OLS is used, taking into account the complex survey design (sampling weights)
‡ Not using antihypertensive medication among hypertensives or not using oral or insulin shots among diabetics
§ Includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other

Note: Percentages are weighted to reflect the national Mexican older adult population. Sample sizes correspond to actual number of respondents in the analytic sample
Source: Reference 34

Appendix 2

Odds ratios of self-reported diabetes and untreated diabetes with insurance and education for Mexican people aged 50-80. Mexican Health and Aging Study (MHAS) 2001-2012

	Self-reported diabetes				*Untreated diabetes*			
	Aged 50-64		*Aged 65-80*		*Aged 50-64*		*Aged 65-80*	
Covariates	*2001*	*2012*	*2001*	*2012*	*2001*	*2012*	*2001*	*2012*
Male								
Age	1.03	1.05*	0.98	1.00	0.99	0.96	0.99	0.95
Insurance[#]	1.66‡	0.82	2.59§	1.69	0.68	0.35	0.39	0.26*
Education (ref=none)								
Primary	0.96	0.92	1.05	1.21	0.95	0.64	0.77	0.37
Secondary+	0.65	0.97	1.07	1.15	0.52	0.77	1.40	0.40
Proxy respondent	0.42‡	0.76	0.75	0.93	0.27	0.98	0.11*	1.69
Sample size	3 761	2 950	1 943	2 641	514	563	306	575
BIC	3 019.39	2 877.09	1 709.08	2 795.88	519.13	423.87	291.58	373.33
AIC	2 981.99	2 841.15	1 675.64	2 760.61	493.67	397.87	269.24	347.21
Female								
Age	1.01	1.09§	0.99	0.99	0.90	0.89*	0.90	0.98
Insurance[#]	2.14§	2.11‡	2.29§	1.86*	1.89	0.47	0.38	0.15‡
Education (ref=none)								
Primary	0.72	1.04	1.05	1.23	0.46	1.62	1.21	0.70
Secondary+	0.51*	0.63	1.16	0.65	1.19	0.94	5.73*	2.62
Proxy respondent	0.79	0.69	0.70	0.77	0.57	1.88	0.61	0.04§
Sample size	4 513	3 498	2 117	3 081	761	825	419	895
BIC	4 051.51	3 773.34	2 126.51	3 724.84	580.09	468.19	328.52	374.55
AIC	4 013.03	3 736.38	2 092.56	3 688.64	552.29	439.90	304.29	345.77

* $p<0.05$
‡ $p<0.01$
§ $p<0.001$
[#] Includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other. In 2012, it also includes *Seguro Popular*

BIC: Bayesian Information Criterion
AIC: Akaine Information Criterion
Note: Odds ratios from logistic regression analyses using sampling weights. Sample size corresponds to the actual analytic sample. BIC and AIC are computed from models with no sampling weights
Source: Reference 34

Appendix 3

Odds ratios of self-reported hypertension and untreated hypertension with insurance and education for Mexican people aged 50 or older. Mexican Health and Aging Study (MHAS) 2001-2012

	Self-reported hypertension				*Untreated hypertension*			
	Aged 50-64		*Aged 65-80*		*Aged 50-64*		*Aged 65-80*	
Covariates	*2001*	*2012*	*2001*	*2012*	*2001*	*2012*	*2001*	*2012*
Male								
Age	1.03	1.05*	0.99	1.04*	0.96	0.95	0.99	0.95
Insurance[#]	1.31	1.53	1.74‡	1.58	0.57*	0.52	0.67	0.36*
Education (ref=none)								
Primary	1.07	1.17	1.37	1.02	0.74	0.60	0.67	0.71
Secondary+	0.85	1.62	2.08*	0.98	0.39*	0.57	0.47	0.47
Proxy respondent	0.95	1.27	1.04	0.94	0.90	1.37	0.37	2.14
Sample size	3 761	2 950	1 943	2 641	1 005	890	671	1 095
BIC	4 374.69	3 600.88	2 505.69	3 595.66	1 340.50	1 011.45	759.59	845.33
AIC	4 337.30	3 564.94	2 472.26	3 560.39	1 311.03	982.70	732.53	815.34
Female								
Age	1.03*	1.08§	1.00	1.03	0.94‡	0.93	0.97	0.97
Insurance[#]	1.64§	1.29	1.43*	2.12§	0.67*	1.23	0.42‡	0.23§
Education (ref=none)								
Primary	1.02	1.70‡	0.98	1.07	0.63*	0.57	0.55*	0.56
Secondary+	0.62‡	1.11	0.92	1.04	0.72	0.47*	0.16§	0.65
Proxy respondent	0.97	0.91	1.38	0.99	0.71	0.48	0.84	1.20
Sample size	4 513	3 498	2 117	3 081	1 987	1 507	1 082	1 791
BIC	6 150.25	4 697.59	2 954.47	4 191.54	2 353.66	1 368.64	1 056.18	937.51
AIC	6 111.76	4 660.63	2 920.53	4 155.34	2 320.09	1 336.73	1 026.26	904.57

* $p<0.05$
‡ $p<0.01$
§ $p<0.001$
[#] Includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other. In 2012, it also includes *Seguro Popular*

BIC: Bayesian Information Criterion
AIC: Akaine Information Criterion
Note: Odds ratios from logistic regression analyses using sampling weights. Sample size corresponds to the actual analytic sample. BIC and AIC are computed from models with no sampling weights
Source: Reference 34

Appendix 4

Odds ratios of self-reported diabetes, hypertension and untreated conditions with Seguro Popular and education for people aged 50-80 in Mexico. Mexican Health and Aging Study (MHAS) 2012

Covariates	*Aged 50-64*				*Aged 65-80*			
	Disease		*Untreated disease*		*Disease*		*Untreated disease*	
	Diabetes	*Hypertension*	*Diabetes*	*Hypertension*	*Diabetes*	*Hypertension*	*Diabetes*	*Hypertension*
Male								
Age	1.04	1.05*	0.96	0.96	0.99	1.04*	0.94	0.96
Access to health care (ref= insurance[#])								
Seguro Popular	0.70	0.72	0.68	3.81[§]	0.54[‡]	0.73	0.54	1.30
No insurance	1.08	0.59*	2.59	3.07*	0.48*	0.56*	3.23	3.08*
Education (ref=none)								
Primary	0.88	1.11	0.61	0.56	1.10	0.97	0.36	0.74
Secondary+	0.84	1.41	0.69	0.88	0.91	0.87	0.36	0.51
Proxy respondent	0.76	1.26	0.95	1.51	1.03	0.99	1.77	2.15
Sample size	2 950	2 950	563	890	2 641	2641	575	1 095
BIC	2 883.91	3 599.38	430.51	1 000.94	2 784.71	3 598.13	377.89	840.95
AIC	2 841.98	3 557.45	400.18	967.4	2 743.55	3 556.98	347.41	805.96
Female								
Age	1.09[§]	1.08[§]	0.88[‡]	0.93	0.98	1.03	0.98	0.97
Access to health care (ref= insurance[#])								
Seguro Popular	1.18	1.17	0.81	0.94	0.94	0.59[‡]	0.76	1.49
No insurance	0.51[‡]	0.82	1.94	0.79	0.79	0.45[‡]	0.43[§]	7.86[‡]
Education (ref=none)								
Primary	1.07	1.74[‡]	1.60	0.57	1.12	1.02	0.76	0.65
Secondary+	0.68	1.20	0.87	0.46	0.52[‡]	0.93	3.10	0.92
Proxy respondent	0.69	0.91	1.91	0.48	0.78	1.00	0.04[§]	1.19
Sample size	3 498	3 498	825	1 507	3 081	3 081	895	1 791
BIC	3 782.56	4 709.01	473.95	1 370.88	3 722.82	4 199.07	378.58	936.63
AIC	3 739.44	4 665.89	440.95	1 333.65	3 680.59	4 156.84	345	898.2

* $p<0.05$
‡ $p<0.01$
§ $p<0.001$
[#] Includes Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, Petróleos Mexicanos, *Defensa*, *Marina*, private or other

BIC: Bayesian Information Criterion
AIC: Akaine Information Criterion
Note: Odds ratios from logistic regression analyses take into account the complex survey design (sampling weights). Sample size corresponds to the actual analytic sample.
Source: Reference 34