

Association between the changes in social-security continuity condition and mortality: MHAS 2001-2018 analysis

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Abstract

Objective. To analyze the association of changes in social security (SS) continuity and mortality, using the Mexican Health and Aging Study (MHAS) in people aged 60 years and more. **Materials and methods.** Retrospective cohort. We analyzed the SS continuity condition -classified as stable, unstable with SS, unstable without SS, and without SS- and its relation with mortality; a probit regression model was utilized to obtain marginal effects, taking into consideration covariates related to mortality. **Results.** Unstable continuity with and without SS and multimorbidity (two or more diseases) increased the probability of dying by 52.9% ($p=0.000$, 95%CI: 0.508,0.551), 50.3% ($p=0.000$, 95%CI: 0.474,0.531) and 13.3% ($p=0.000$, 95%CI: 0.108,0.159), respectively. Meanwhile, being woman, at least one year of formal education, and marriage reduced it in 8.8% ($p=0.000$, 95%CI: -0.106,-0.071), 7% ($p=0.000$, 95%CI: -0.091,-0.050) and 7.8% ($p=0.000$, 95%CI: -0.096,-0.061), respectively. **Conclusion.** Belonging to SS was associated with higher mortality, compared to other social health determinants, like education.

Resumen

Objetivo. Analizar la asociación de los cambios en la continuidad en la seguridad social (SS) y la mortalidad, usando el Estudio Nacional de Salud y Envejecimiento en México (Enasem) en personas de 60 años o más. **Material y métodos.** Estudio de cohorte retrospectiva. Se analizó la condición de continuidad a la SS -clasificada como estable, inestable con SS, inestable sin SS y sin SS- y su relación con mortalidad, usando un modelo de regresión probit para obtener los efectos marginales y tomando en consideración covariables relacionadas con mortalidad. **Resultados.** Inestabilidad con y sin SS y multimorbilidad (dos o más enfermedades) incrementaron la probabilidad de morir en 52.9% ($p=0.000$, IC95%: 0.508,0.551), 50.3% ($p=0.000$, IC95%: 0.474,0.531) y 13.3% ($p=0.000$, IC95%: 0.108,0.159), respectivamente. Mientras, ser mujer, tener al menos un año de educación formal y estar casado la disminuían en 8.8% ($p=0.000$, IC95%: -0.106,-0.071), 7% ($p=0.000$, IC95%: -0.091,-0.050) y 7.8% ($p=0.000$, IC95%: -0.096,-0.061), respectivamente. **Conclusión.** Pertenecer a la SS estuvo asociado con mayor mortalidad, en comparación con otros determinantes sociales de la salud, como educación.

Keywords: older persons; health system; social security; mortality; Mexico

Palabras clave: personas mayores; sistema de salud; seguridad social; mortalidad; México

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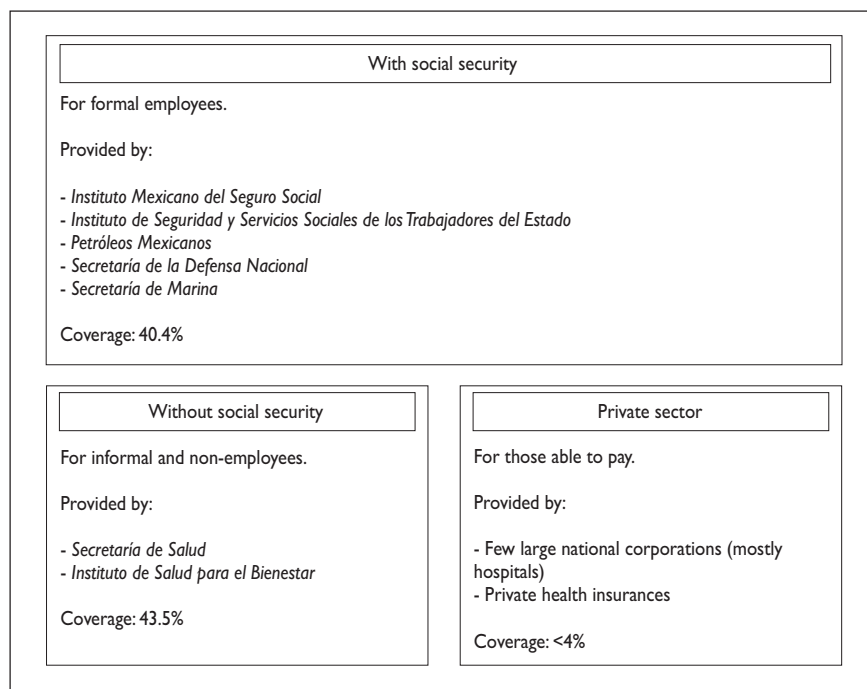
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Several countries experience a fast growth of the older population. In Mexico, the population of people over 60 accounted for 6% in 1990; however, a steady increase reached 15 million older adults in 2020, which means 12% of the total Mexican population.¹ Alongside this demographic transition, the global disease burden in senior Mexican citizens has also increased (i.e., epidemiological transition). Just 28 conditions accounted for 80% of the total disease burden in this group; the top five are diabetes mellitus, ischemic heart disease, chronic kidney disease, sensory organs disease, Alzheimer's disease, and other dementias.² All of them imply a challenge to the Mexican health system.

Access to health systems is considered an intermediate determinant in the social determinants of health (SDH) model of the World Health Organization (WHO). The model emphasizes that it is possible to improve health in any given population through health system actions.³ Internationally, it's well known that having health insurance reduces mortality in all age groups.⁴ For example, in older adults, a study based on the Irish Longitudinal Study on Ageing (TILDA) showed that not having public or private insurance resulted in a mortality hazard ratio (HR) of 1.97 ($p < 0.001$) for all causes of death.⁵

The Mexican health system comprises three different health provision schemes. Formal employees are entitled to social insurance (also referred to as social security [SS]); for informal and non-employees, the Ministry of Health and a small segment of the private sector supply it.⁶ The coverage of each one is 40.4%, 43.5%, and less than 4%,⁷ respectively. SS has a broader scope beyond health services and provides social and economic benefits such as childcare services or pensions, among others.⁸ SS is integrated by the *Instituto Mexicano del Seguro Social* (IMSS), the *Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado* (ISSSTE), *Petróleos Mexicanos* (Pemex), *Secretaría de la Defensa Nacional* (Sedena), and the *Secretaría de Marina* (Semar).⁹

Those without SS could access health services through the *Secretaría de Salud* (SSA), *Instituto de Salud para el Bienestar* (Insabi), and, previously, through the *Seguro Popular* (SP).⁸ On the other hand, the private sector provides health services through a few large national corporations (primarily hospitals) and private health insurances (figure 1).⁶⁻⁹ The setup of the Mexican health system generated differences between both groups. Generally, SS institutions have a more significant per capita health expense, and more clinical physicians, and



Source: Prepared by the authors, taking into consideration the characteristics of the Mexican health system.⁶⁻⁹

FIGURE 1. MEXICAN HEALTH SYSTEM ORGANIZATION. MEXICO

nurses.¹⁰ Also, they provide adequate healthcare services—in time and frequency—, like antenatal care.¹¹ Persons affiliated with SS have higher utilization rates in certain preventive and curative care services such as in the prevalence of mammography¹² and in the diagnosis and treatment of depressive symptoms.¹³ For some diseases, the mortality rate was lower in the SS population, like HIV-AIDS¹⁴ and chronic kidney disease.¹⁵ However, the comparisons between SS and others must be carefully studied due to the migrations among them.¹⁶ Therefore, we propose using the SS continuity condition to analyze both populations better.

Thus, being insured by a SS institution could generate positive repercussions on health status and longevity, due to a broader spectrum of benefits beyond health services and better medical infrastructure. We hypothesize that older adults with SS who maintain it over time will be less likely to die than those without SS. Therefore, this report aims to analyze the association of changes in SS continuity and in mortality based on the results of the Mexican Health and Aging Study (MHAS) in people of 60 years and older.

Materials and methods

This is a longitudinal, retrospective secondary analysis of the MHAS. The survey has national and rural/urban representation. Information about the MHAS is available elsewhere.¹⁷ In brief, this study has a national probabilistic sample representative of individuals 50 years or older; it was designed to understand the different determinants of aging. It began in 2001, with

subsequent waves in 2003, 2012, 2015, and 2018. In the first one, there were 15 186 people, and the sample cohort was refreshed in the 2012 and 2018 waves. From the second wave, the survey started to report data of those who had died, using a next-of-kin questionnaire.

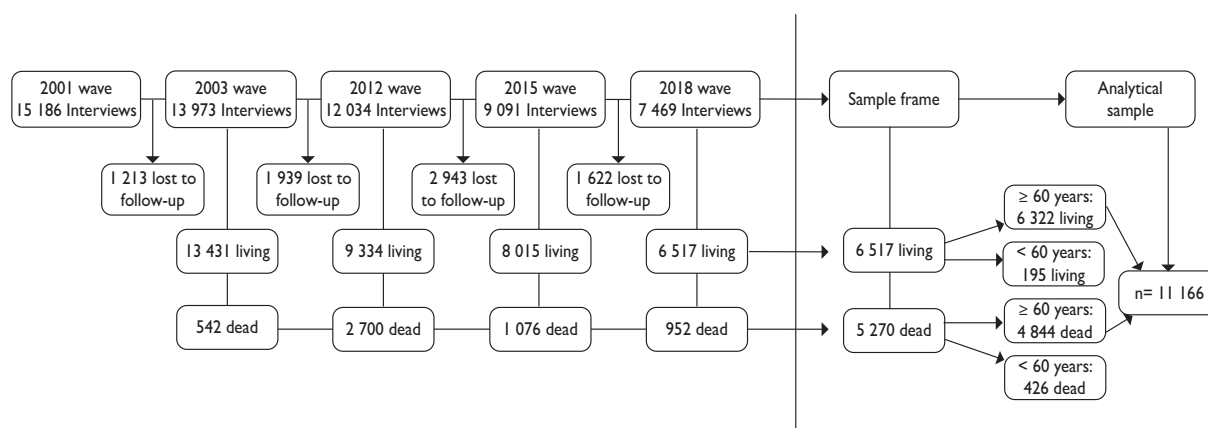
For the purpose of this study, we considered the initial sample of 15 186 (100%) people from the first wave (2001); of these we analyzed 11 166 (73.53%), who were aged 60 years and more and answered the health system entitlement question. Out of that number, 6 322 (56.62%) survived and were followed across every MHAS edition, while 4 844 (43.38%) passed away. Figure 2 depicts this sample selection.

The study was approved by the Research, Ethics, and Biosafety Committees of the *Instituto Nacional de Geriátría* (DI-PI-002/2023).

Variables analyzed

The dependent variable was death. All deaths reported from 2003 to 2018 were taken into consideration; the information was reported in the next-of-kin questionnaire. A dichotomous variable was constructed; a value of '1' was referred to as dead, and '0', as alive.

The independent variable was the SS continuity condition. In order to build this variable, we used the responses to the question of entitlement to care by health institutions. We first divided the responses in two. Those who answered that they were entitled to care by IMSS, ISSSTE, Sedena, Semar, and Pemex were classified as SS. Those who received their healthcare from the SSA, SP, and the private sector and had no health entitlement were classified as without SS. Then, we reviewed the



MHAS: Mexican Health and Aging Study

Source: Prepared by the authors, taking into consideration all MHAS samples.¹⁶

FIGURE 2. FOLLOW-UP OF THE STUDIED SAMPLE FROM MHAS, MEXICO, MHAS 2001, 2003, 2012, 2015, 2018

answers across all MHAS waves in order to determine the SS continuity condition, which was classified into four categories: 1) stable to SS; 2) unstable with SS; 3) unstable without SS, and 4) without SS. If the person reported having SS entitlement in all MHAS waves since the beginning of the 2001 cohort, the observation was classified as 1) stable to SS. Unstable was subcategorized into 2) unstable with SS and 3) unstable without SS, depending on whether a person had SS or not in the last reported wave, regardless of their reported alive or dead status. Finally, those who didn't report entitlement in any MHAS edition were classified as without SS.

We also considered sex, and we added other covariates that the literature related to SDH and previously reported association with mortality. Between them, we incorporated marital status, parents' level of education,¹⁸ formal years of schooling,¹⁹ multimorbidity,²⁰ locality size,²¹ and self-rated health status.²² All variable values were from the last observation made in the 2018 MHAS edition for the living participants and from the next-of-kin questionnaire for the deceased ones.

In the survey, marital status had six types of answers: single, married, partnership, divorced, separated, and widowed; we classified them into two: married or partnership and single (including responses from single, divorced, separated, and widowed). Parents' education was categorized as with or without education, depending on whether they responded to having at least 'incomplete elementary school'. Formal years of schooling were dichotomized as 'no years of formal schooling' and 'at least one formal year'. Multimorbidity was constructed if people reported one plus two or more of these diseases: hypertension, diabetes mellitus, cancer, respiratory disease, cardiovascular disease, and stroke, along survey editions.²³

Locality size was understood as urbanized or not, depending on whether it was inhabited by more or less than 100 000 people. Finally, the self-rated health status was classified according to a 5-category Likert response scale: excellent, very good, good, fair and poor. The first three were categorized as 'good'. At the end we used good, fair, and poor.

Statistical analysis

We proceeded to perform an initial descriptive analysis for the dead and alive samples and their relationship to the selected variables. All variables were categorical; therefore, the significance of the differences between both groups was evaluated by Chi-square tests. We then performed a probit regression model that was utilized to determine marginal effects for the total sample. The marginal effect estimates the change of probability asso-

ciated with the report of 'presence' or 'absence' of certain categorical variables – the SS continuity condition and covariates – with a specific dummy explanatory variable (yes/no): dead. We held a p value <0.05 . Statistical analyses were performed using Stata 14.

Results

Of a total of 11 166 participants, 4 870 (43.61%) were men, and 6 296 (56.39%) were women, with an age mean of 76.21 years. Of the total population –living and dead–, 3 192 (28.59%) were classified as stable; 4 060 (36.36%), as unstable with SS; 2 137 (19.14%), as unstable without SS, and 1 777 (15.91%), as without SS.

Table I shows the demographic and health characteristics of the participants. A greater percentage of women (60.85%) are alive, compared to men (39.15%). Women also had the greatest stability in SS for both dead and alive participants than men. As for educational variables –mother's education, father's education, and at least one year of formal schooling–, those who survived had better percentages than those who died. Furthermore, those who maintain stability in SS had higher percentages than those without SS in both the living and dead samples for the same variables. The unstable with and without SS groups also had better values in these variables than those without SS.

In regard to multimorbidity results, 17.48% in the living sample, and 12.59% in the dead sample didn't have any diseases. This is in contrast with the 45.10% and 58.82% that had two or more diseases in the two populations, respectively. On the other hand, the percentages of multimorbidity were higher in the stable population than the unstable one with and without SS and among those without SS. People living in more urbanized areas had more stability to SS. For the self-rated health status variable, those with stability to SS reported having a better health status than those without SS (32.77 vs. 26.67% in the living sample, and 29.72 vs. 26.70% in the dead one).

For both the dead and alive groups, the comparisons of variables exhibited statistically significant differences, with a p value <0.05 . The exceptions were the relationship between sex and SS continuity condition among the dead participants ($p=0.455$), and between the self-rated health status and the SS continuity condition in the same group ($p=0.369$).

Table II shows the estimated marginal effects of the probit regression model. The model successfully classified 78.70% of cases overall.

All variables were statistically significant, apart from no SS ($p=0.934$), the mother's education ($p=0.075$), and locality size ($p=0.722$). As table II shows, women had an 8.8% ($p=0.000$, 95%CI: -0.106,-0.071) lower prob-

Table I
DESCRIPTIVE ANALYSIS OF THE POPULATION AGED 60 YEARS AND OLDER BY DEMOGRAPHIC AND HEALTH CHARACTERISTICS, 2001-2018 (N= 11 166). MEXICO, MHAS 2001, 2003, 2012, 2015, 2018

Variable	Living (6 322)*					p<05‡	Dead (4 844)*					p<05‡
	Total	Stable to SS	Unstable with SS	Unstable without SS	Without SS		Total	Stable to SS	Unstable with SS	Unstable without SS	Without SS	
Sex												
n	6 322	2 832	1 258	676	1 556	0.002	4 844	360	2 802	1 461	221	0.455
Men %	39.15	36.86	42.29	38.17	41.20		49.44	46.39	50.25	48.53	50.23	
Women %	60.85	63.14	57.71	61.83	58.80		50.56	53.61	49.75	51.47	49.77	
Marital status %												
n	6 322	2 832	1 258	676	1 556	0.000	4 844	360	2 802	1 461	221	0.000
Married or in union %	55.39	55.76	58.98	48.67	54.76		49.77	46.94	53.14	45.52	39.92	
Single %	44.61	44.24	41.02	51.33	45.24		50.23	53.06	46.86	54.48	60.18	
Mother's education												
n	5 742	2 595	1 145	611	1 391	0.000	4 042	317	2 349	1 185	191	0.000
With %	44.83	57.03	44.80	35.84	26.02		35.82	44.16	42.10	24.05	17.80	
Without %	55.17	42.97	55.20	64.16	73.98		64.18	55.84	57.90	75.95	82.20	
Father's education												
n	5 540	2 483	1 099	590	1 368	0.000	3 935	305	2 270	1 170	190	0.000
With %	52.76	62.06	54.69	45.25	37.57		44.27	55.41	50.62	31.62	28.42	
Without %	47.24	37.94	45.31	54.75	62.43		55.73	44.59	49.38	68.38	71.58	
At least one year of formal education												
n	6 317	2 830	1 257	676	1 554	0.000	4 832	360	2 794	1 457	221	0.000
With %	77.41	86.75	79.47	71.30	61.39		66.39	78.89	74.05	51.41	47.96	
Without %	22.59	13.25	20.53	28.70	38.61		33.61	21.11	25.95	48.59	52.04	
Morbidity												
n	6 322	2 832	1 258	676	1 556	0.000	4 844	360	2 802	1 461	221	0.000
None %	17.48	15.11	17.41	18.93	21.21		12.59	5.56	10.71	18.00	12.22	
1 %	37.42	36.65	37.60	36.54	39.07		28.59	22.50	27.59	32.10	28.05	
2 or more %	45.10	48.23	44.99	44.53	39.72		58.82	71.94	61.71	49.90	59.73	
Locality size												
n	6 322	2 832	1 258	676	1 556	0.000	4 844	360	2 802	1 461	221	0.000
Urbanized %	54.54	70.94	57.95	47.63	24.94		54.17	68.61	67.81	35.66	23.98	
Not urbanized %	45.46	29.06	42.05	52.37	75.06		43.83	31.39	32.19	64.34	76.02	
Self-rated health status												
n	5 655	2 588	1 116	605	1 346	0.000	4 745	360	2 754	1 410	221	0.369
Good %	30.49	32.77	31.27	27.77	26.67		29.38	29.72	29.99	28.51	26.70	
Fair %	56.22	55.45	56.99	56.86	56.76		37.70	39.17	37.22	37.23	44.34	
Poor %	13.30	11.79	11.74	15.37	16.57		32.92	31.11	32.79	34.26	28.96	

MHAS: Mexican Health and Aging Study.

SS: Social security.

*The n values on each variable changed due to the fact that for some variables there were no answers to the interview or the interviewee did not know the requested information.

‡ Chi² test for categorical variables.

Source: Own calculations based on data from the Mexican Health and Aging Study, 2001-2018.¹⁷

Table II
MARGINAL EFFECTS OF THE PROBIT REGRESSION MODEL (N= 8 424).
MEXICO, MHAS 2001, 2003, 2012, 2015, 2018

Variable	Marginal effect	Standard error	z value	p value	CI Low*	CI High*
Sex						
Men	Ref.	-	-	-	-	-
Women	-0.088	0.009	-9.730	0.000	-0.106	-0.071
Condition of permanence in SS						
Stable	Ref.	-	-	-	-	-
Unstable (last year with SS)	0.529	0.011	47.120	0.000	0.508	0.551
Unstable (last year without SS)	0.503	0.015	34.090	0.000	0.474	0.531
Without SS	-0.001	0.012	0.080	0.934	-0.024	0.025
Married or partnership	-0.078	0.009	-8.720	0.000	-0.096	-0.061
Mother's education	-0.019	0.011	-1.780	0.075	-0.039	0.019
Father's education	-0.021	0.011	-2.090	0.036	-0.042	-0.013
At least one year of formal education	-0.070	0.010	-6.760	0.000	-0.091	-0.050
Morbidity						
None	Ref.	-	-	-	-	-
1	0.039	0.013	2.880	0.004	0.012	0.065
2 or more	0.133	0.013	10.290	0.000	0.108	0.159
Locality size						
Urbanized	Ref.	-	-	-	-	-
Not urbanized	0.003	0.009	0.360	0.722	-0.015	0.021
Self-rated health status						
Good	Ref.	-	-	-	-	-
Fair	-0.072	0.010	-7.040	0.000	-0.092	-0.052
Poor	0.115	0.013	9.150	0.000	0.090	0.139

* CI: Confidence interval at 95%.

MHAS: Mexican Health and Aging Study.

SS: Social security.

Source: Calculated by the authors based on data from the Mexican Health and Aging Study, 2001-2018.¹⁷

ability of dying compared to men. Being married or in a partnership also reduced it by 7.8% ($p=0.000$, 95%CI: -0.096,-0.061). The father's education and at least one year of formal schooling reduced the probability of dying by 2.1% ($p=0.036$, 95%CI: -0.042,-0.013) and by 7% ($p=0.000$, 95%CI: -0.091,-0.050), respectively. Having a fair health status was also reported to reduce it by 7.2% ($p=0.000$, 95%CI: -0.092,-0.052).

On the other hand, having unstable continuity with and without SS increased this probability by 52.9% ($p=0.000$, 95%CI: 0.508,0.551) and 50.3% ($p=0.000$, 95%CI: 0.474,0.531), respectively. Also, having one and two or more concomitant diseases increased this per-

centage to 3.9% ($p=0.004$, 95%CI: 0.012,0.065) and 13.3% ($p=0.000$, 95%CI: 0.108,0.159), respectively. Additionally, in those who reported a poor self-rated health status, it increased by 11.5% ($p=0.000$, 95%CI: 0.090,0.139).

Discussion

To the best of our knowledge, this is the first study in Mexico reporting the association of SS stability and mortality in older adults. The main discovery was that the findings from the marginal effects of the probit regression model, controlled with the selected covariates, showed that people with SS stability had a higher

probability of mortality than those without SS, contrarily to our hypothesis.

Following the SDH model, the health system must intervene to improve the health status. People who enroll with the system throughout their life cycle can maintain and restore their health more easily than those not in the system.³ This is quite true in a context where the most prevalent health issues are non-communicable and chronic diseases. Evidence showed that having health insurance promotes the use of health services,²⁴ self-reporting diagnosis, and treatment of major chronic diseases, and, consequently, it improves disease outcomes.²⁵ Also, a study shows that being in contact with regular health care providers increases the adherence to diabetic retinopathy examinations.²⁶ Furthermore, uninsured individuals, compared to insured ones, take longer to restore a good health status if they suffer unintentional injuries or new chronic diseases.²⁷

We cannot determine why the continuity of SS entitlement didn't have the expected effect on mortality, despite the role that the health system plays throughout the SDH model. It may be due to differences in certain characteristics that could contribute to a lower mortality in the uninsured sample. The prevalence of multimorbidity was higher in the stable SS continuity group versus the group without SS among the living (84.88 vs. 78.79%) and among the dead (94.44 vs. 87.78%); this may reduce the mortality on the group without SS. This difference in morbidity between the two groups has been reported previously.²⁸ Moreover, the age differences may be an additional factor to explore. The last edition of the National Survey of Employment and Social Security (*Encuesta Nacional de Empleo y Seguridad Social, 2017*) in Mexico reported that the SS population is older. From the total population with entitlement, 14.78% were aged 60 years or older, while the percentage among the population without SS aged 60 years and more was 9.56%.²⁹

Nevertheless, previous research has shown that risk of death varies depending on subsystem entitlement. In the United States, privately insured individuals had a 17% lower risk of all-cause mortality (HR=0.83 [95%CI: 0.80,0.87]), in contrast with those that had public insurance (21% higher risk of all-cause mortality, HR=1.21 [95%CI: 1.15,1.27]).³⁰ Also, SS institutions may not provide the necessary solutions for current health issues. An amenable mortality comparison between populations with and without SS showed that the group with SS had the greatest mortality rates since the beginning of the twentieth century.³¹ This is contrary to the evidence provided about mortality for HIV-AIDS¹⁴ and chronic kidney disease,¹⁵ in which the ones without SS had the higher rates. This may be

because, for certain diseases, SS provides a wide range of services with many resources, like antiretroviral medicines or dialysis treatments.

Additionally, using the MHAS, a research compared an uninsured population against the insured group and found that the latter had higher disability incidence rates²⁸ but found no relationship between disability improvement in elders and health entitlement (with or without SS).³²

Because of these paradoxical findings, it's relevant to understand the role that the access to health system provided by the SS institutions in Mexico plays in older individuals in order to design new health strategies.

It is well known that health services intended for older individuals should not be the same as those intended for other age groups. Older individuals place a higher value on functionality, autonomy, and social support than on the complete restoration of health status by any medium.³³ Besides, care services need to be long term, not just to attend acute diseases or complications. In fact, the Mexican health system does not have the necessary requirements to make this possible due to a series of problems such as high fragmentation, inequities among sub-systems, insufficient funding, high of out-of-pocket expenditures, poor quality performance, difficulty to address preventive and primary health programs for older adults¹⁶, and the great emphasis on acute care services²⁹ that fail to bring the expected results in health.

Regarding the other variables, the people with better results in educational variables exhibited less probability of dying. Also, being married or in a partnership, being a woman, and reporting good and fair self-rated health status reduced this probability. Meanwhile, having one or two and more diseases and a poor self-rated health status increased it. These findings agree with previous evidence in studies using the MHAS^{20,34} and other surveys in elders, like the Study on Global Ageing and Adult Health (SAGE).¹⁸

Thus, the performance of the health system may not provide sufficient support to delay mortality in older individuals. This is in contrast with other SDH, like education. The way education impacts mortality is by empowering people, enhancing their skills and knowledge to allow them to have better income opportunities. Education also improves health literacy, which makes it possible to understand the health-disease process and participate more in one's personal health care.¹⁸

On the other hand, the classification used in this research overcomes the inconvenience of not being able to analyze the SS continuity by allowing us to follow up on the migration between the two schemes. Despite this strength, this study has some limitations. Even when SS institutions have similarities in the provision of benefits, they may have differences in the quality of service

and the sociodemographic conditions of the covered population. Consequently, a comprehensive assessment would require a specific analysis. Secondly, the MHAS is a self-report survey, and it may exhibit a memory bias. Thirdly, the construction of the SS continuity variable was associated to the entitlement response. We did not analyze access to the health system. The fourth limitation is related to the outcome (survival condition). We studied all causes of mortality, some of which may not be covered by the health system (like violence or suicide). Also, mortality does not give us more information about the health services' impact on older adults' health status (i.e., rehabilitation, pain control, restoring autonomy). Other required perspectives, beyond mortality, are disability adjusted life years or healthy life expectancy. The fifth relates to the statistical approach, for which we need to use better analytical techniques, like survival analysis, in order to have a correct approach. With HRs we may assess the risk of death between groups by taking in consideration the time of the cohort. Finally, we need to precisely characterize the four populations constructed with additional variables in order to better understand the results obtained.

In conclusion, in our marginal effects model, stable and unstable SS continuity, multimorbidity, and poor self-rated health status response increased the probability of dying in older populations. Meanwhile, being a woman, education, marriage or partnership, and good and fair self-rated health status reduced it. We can assume that the health system has a smaller impact on mortality than other SDHs in Mexican elders. Consequently, we must review the role of services provided by SS –and the health system itself– among the older population, and the grade in which it attends to and solves their needs. Additionally, governments and health policies should aim at improving education among life-course to achieve lower mortality rates in the years to come.

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

References

- Instituto Nacional de Estadística y Geografía. Encuesta Nacional de Empleo y Seguridad Social (ENESS) 2017. Mexico: INEGI, 2017 [cited August 30, 2022]. Available from: <https://www.inegi.org.mx/programas/eness/2017/>
- Parra-Rodríguez L, González-Meljem JM, Gómez-Dantés H, Gutiérrez-Robledo LM, López-Ortega M, García-Peña C, et al. The burden of disease in Mexican older adults: premature mortality challenging a limited-resource health system. *J Aging Health*. 2020;32(7-8):543-53. <https://doi.org/10.1177/0898264319836514>
- Moiso A. Determinantes de la salud. In: Barragán H. Fundamentos de Salud Pública. Argentina: Universidad Nacional de La Plata, 2007 [cited August 10, 2022]. Available from: https://www.academia.edu/10571414/Barragan_Horacio_Luis_Fundamentos_de_la_salud_publica
- Woolhandler S, Himmelstein DU. The relationship of health insurance and mortality: is lack of insurance deadly? *Ann Intern Med*. 2017;167(6):424-31. <https://doi.org/10.7326/m17-1403>
- Nolan A, May P, Matthews S, Normand C, Kenny RA, Ward M. Public health insurance and mortality in the older population: Evidence from the Irish Longitudinal Study on Ageing. *Health Policy*. 2022;126(3):190-96. <https://doi.org/10.1016/j.healthpol.2022.01.014>
- Gonzalez-Block MA, Reyes-Morales H, Cahuana-Hurtado L, Baladrán A, Méndez E, Allin S. Mexico: Health system review. *Health System in Transitions*. 2020;22(2):i-222 [cited August 10, 2022]. Available from: <https://apps.who.int/iris/handle/10665/334334>
- Gómez-Dantés O, Sesma S, Becerril VM, Knaut FM, Arreola H, Frenk J. Sistema de salud de México. *Salud Publica Mex*. 2011;53(sup2):220-32 [cited August 10, 2022]. Available from: <https://www.scielo.org.mx/pdf/spm/v53s2/17.pdf>
- Santana-Cartas A, Alvarado-Baena L, Birtwistle S, Rivera-Saldaña CD. El Seguro Popular de Salud en México: Posibles efectos sobre la economía informal. Mexico: Ethos Fundación, 2011 [cited August 10, 2022]. Available from: https://www.ethos.org.mx/inclusion/publicaciones/el_seguro_popular_de_salud_en_mexico_posibles_efectos_sobre_la_economia_informal
- Mayer-Serra EC. El derecho a la protección de la salud. *Salud Publica Mex*. 2007;49(2):144-55 [cited August 10, 2022]. Available from: https://www.scielo.org.mx/scielo.php?pid=S0036-36342007000200010&script=sci_abstract
- Centro de Investigación Económica y Presupuestaria. Sistema Universal de Salud: Retos de cobertura y financiamiento. Mexico City: CIER, 2018 [cited August 10, 2022]. Available from: <https://saludenmexico.ciep.mx/images/sistema-universal-de-salud.pdf>
- Servan-Mori E, Avila-Burgos L, Nigenda G, Lozano R. A performance analysis of public expenditure on maternal health in Mexico. *PLoS ONE*. 2016;11(4):e0152635. <https://doi.org/10.1371/journal.pone.0152635>
- McClellan SP, Unger-Saldaña K, Neuhaus JM, Potter MB, García-Peña C, Torres JM. Mammography prevalence in Mexico from 2001-2018: Results from the Mexican Health and Aging study. *Prev Med Rep*. 2023;32:102150. <https://doi.org/10.1016/j.pmedr.2023.102150>
- Cerecero-García D, Macías-González F, Arámburo-Muro T, Bautista-Arredondo S. Síntomas depresivos y cobertura de diagnóstico y tratamiento de depresión en población mexicana. *Salud Publica Mex*. 2020;62(6):840-50. <https://doi.org/10.21149/11558>
- Cahuana-Hurtado L, Chilian-Herrera OL, Bautista S, Lozano R. Trends in HIV/AIDS mortality among populations with and without social security protection. Mexico, 1983-2012. 2014. Available from: https://www.researchgate.net/publication/291347757_TRENDS_IN_HIVAIDS_MORTALITY_AMONG_POPULATIONS_WITH_AND_WITHOUT_SOCIAL_SECURITY_PROTECTION_MEXICO_1983-2012/stats
- Valdez-Ortiz R, Navarro-Reynoso F, Olvera-Soto MG, Martín-Alemañy G, Rodríguez-Matías A, Hernández-Arciniega CR, et al. Mortality in patients with chronic renal disease without health insurance in Mexico: opportunities for a national renal health policy. *Kidney International Reports*. 2018;3(5):1171-82. <https://doi.org/10.1016/j.ekir.2018.06.004>
- Organización para la Cooperación y el Desarrollo Económicos. Estudios de la OCDE sobre los Sistemas de Salud: México 2016. Resumen ejecutivo y diagnóstico y recomendaciones. France: OCDE, 2016. <https://doi.org/10.1787/9789264265523-es>
- Mexican Health and Aging Study. Mexican Health and Aging Study website. Mexico: Mexican Health and Aging Study, 2022 [cited December 8, 2022]. Available from: <https://mhasweb.org/Home/index.aspx>

18. González-Bautista E, Manrique-Espinoza B, Ávila-Funes JA, Naidoo N, Kowal P, Chatterji S, et al. Social determinants of health and frailty are associated with all-cause mortality in older adults. *Salud Publica Mex.* 2019;61(5):582-90. <https://doi.org/10.21149/10062>
19. González-González C, Samper-Ternent R, Wong R, Palloni A. Mortality inequality among older adults in Mexico: the combined role of infectious and chronic diseases. *Rev Panam Salud Pública.* 2014;35(2):89-95.
20. Pereria-Nunes B, Ramos-Flores T, Iven-Mielke G, Thumé E, Facchini LA. Multimorbidity and mortality in older adults: A systematic review and meta-analysis. *Arch Gerontol Geriatr.* 2016;67:130-38. <http://doi.org/10.1016/j.archger.2016.07.008>
21. Probst JC, Zahnd WE, Hung P, Eberth JM, Crouch EL, Merrell MA. Rural-urban mortality disparities: Variations across causes of death and race/ethnicity, 2013-2017. *Am J Public Health.* 2020;110(9):1325-27. <https://doi.org/10.2105/AJPH.2020.305703>
22. DeSalvo KB, Fan VS, McDonell MB, Fihn SD. Predicting mortality and healthcare utilization with a single question. *Health Serv Res.* 2005;40(4):1234-46. <https://doi.org/10.1111/j.1475-6773.2005.00404.x>
23. Ho IS, Azcoaga-Lorenzo A, Akbari A, Davies J, Khunti K, Kadam UT, et al. Measuring multimorbidity in research: Delphi consensus study. *BMJ Med.* 2022;1:e000247. <http://doi.org/10.1136/bmjmed-2022-000247>
24. Wong R, Díaz JJ. Health care utilization among older Mexicans: health and socioeconomic inequalities. *Salud Publica Mex.* 2007;49(suppl4):S505-14. <https://doi.org/10.1590/s0036-36342007001000010>
25. Beltrán-Sánchez H, Drummond-Andrade FC, Riosmena F. Contribution of socioeconomic factors and health care access to the awareness and treatment of diabetes and hypertension among older Mexican adults. *Salud Publica Mex.* 2015;57(Suppl1):6-14. <http://doi.org/10.21149/spm.v57s1.7584>
26. Cai CX, Li Y, Zeger SL, McCarthy ML. Social determinants of health impacting adherence to diabetic retinopathy examinations. *BMJ Open.* 2021;9(1):e002374. <http://doi.org/10.1136/bmjdr-2021-002374>
27. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. *JAMA.* 2007;297(10):1073-84. <https://doi.org/10.1001/jama.297.10.1073>
28. Cabrero-Castro JE, García-Peña C, Ramírez-Aldana R. Transiciones de la discapacidad según afiliación a instituciones de salud en adultos mayores en México. *Salud Publica Mex.* 2021;63(4):565-74. <https://doi.org/10.21149/12031>
29. Instituto Nacional de Estadística y Geografía. Estadísticas a propósito del Día Internacional de las personas adultas mayores (1º de octubre). Mexico City: INEGI, 2021 [cited August 8, 2022]. Available from: https://www.inegi.org.mx/contenidos/saladeprensa/aproposito/2021/EAP_ADUL-MAYOR_21.pdf
30. Song L, Wang Y, Chen B, Yang T, Zhang W, Wang Y. The association between health insurance and all-cause, cardiovascular disease, cancer and cause-specific mortality: A prospective cohort study. *Int J Environ Res Public Health.* 2020;17(5):1525. <https://doi.org/10.3390/ijerph17051525>
31. García-Hernández H, Dávila-Cervantes CA. Análisis de la mortalidad evitable en México durante el periodo 1998-2019. *Población y Salud en Mesoamérica.* 2022;20(1):338-66. <https://doi.org/10.15517/psm.v20i1.50116>
32. Cabrero-Castro JE, García-Peña C, Ramírez-Aldana R. Transitions of disability, disability-free life expectancy and health insurance among adults aged 50 and older in Mexico: A multistate life table analysis. *BMJ Open.* 2021;11(8):e045261. <https://doi.org/10.1136/bmjopen-2020-045261>
33. Hillgaard-Bulow M, Söderqvist T. Successful ageing: A historical overview and critical analysis of a successful concept. *J Aging Stud.* 2014;31(1):139-49. <https://doi.org/10.1016/j.jaging.2014.08.009>
34. González-González CA, Orozco-Rocha K, Arias-Soto MP, Carbajal-Santillán MG, Samper-Ternent R. Aging and mortality: Health, economic and family conditions in the last year of life of the elderly in Mexico. *Papeles de Población.* 2018;24(97):43-62. <https://doi.org/10.22185/24487147.2018.97.24>