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Population-level trends in self-reported healthcare utilization among older adults in Mexico with and without cognitive impairment

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Abstract

Background Older adults with cognitive impairment exhibit different patterns of healthcare utilization compared to their cognitively healthy counterparts. Despite extensive research in high-income countries, similar studies in low- and middle-income countries are lacking. This study aims to investigate the population-level patterns in healthcare utilization among older adults with and without cognitive impairment in Mexico.

Methods Data came from five waves (2001–2018) of the Mexican Health and Aging Study. We used self-reported measures for one or more over-night hospital stays, doctor visits, visits to homeopathic doctors, and dental visits in the past year; seeing a pharmacist in the past year; and being screened for cholesterol, diabetes, and hypertension in the past two years. Cognitive impairment was defined using a modified version of the Cross Cultural Cognitive Examination that assessed verbal memory, visuospatial and visual scanning. Total sample included 5,673 participants with cognitive impairment and 34,497 without cognitive impairment interviewed between 2001 and 2018. Generalized Estimating Equation models that adjusted for time-varying demographic and health characteristics and included an interaction term between time and cognitive status were used.

Results For all participants, the risk for one or more overnight hospital stays, doctor visits, and dental visits in the past year, and being screened for diabetes, hypertension, and high cholesterol increased from 2001 to 2012 and leveled off or decreased in 2015 and 2018. Conversely, seeing a homeopathic doctor decreased. Cognitive impairment was associated with higher risk of hospitalization (RR = 1.13, 1.03–1.23) but lower risk of outpatient services (RR = 0.95, 0.93–0.97), cholesterol screening (RR = 0.93, 0.91–0.96), and diabetes screening (RR = 0.95, 0.92–0.97).

No significant difference was observed in the use of pharmacists, homeopathic doctors, or folk healers based on cognitive status. Interaction effects indicated participants with cognitive impairment had lower risk for dental visits and hypertension screening but that these trajectories differed over time compared to participants without cognitive impairment.

Conclusions We identified distinct population-level trends in self-reported healthcare utilization and differences according to cognitive status, particularly for elective and screening services. These findings highlight the necessity for policy interventions to ensure older adults with cognitive impairment have their healthcare needs met.

Keywords Healthcare utilization, Cognitive impairment, Healthcare access: healthcare policy

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Background

The growth of the older adult population in Mexico will contribute to an increase in the number of older adults living with cognitive impairment and dementia [1]. Data from the 10/66 Dementia Research Group indicates that the incidence of dementia in Mexico is the highest among Latin American countries [1].

Older adults with cognitive impairment and dementia have different healthcare utilization patterns compares to their cognitively healthy counterparts. Studies in the US have consistently shown that older adults with dementia are more likely to be hospitalized and visit the emergency room than those without dementia [2, 3]. These findings have been corroborated by research in countries with different healthcare systems, including Canada, Spain, France, England [4–7]. However, the evidence regarding outpatient service use is mixed; in the US some studies report similar or lower usage among older adults with dementia compared to those without dementia [8, 9]. In Taiwan, people with a dementia diagnosis had significantly more outpatient visits for psychiatric and non-psychiatric services [10]. In Germany, there was a 40% increase in ambulatory services predominantly primary care in the first year after diagnosis [11]. Despite this, most evidence comes from high-income countries, leaving a gap in research concerning lower and middle-income countries.

Mexico's healthcare system is divided into public healthcare, social security healthcare, and private healthcare [12]. Public healthcare is available to all citizens and legal residents of Mexico. Social security healthcare is available to those who are employed in the formal sector and their dependents. Private healthcare is available, but only the people who can afford to pay for services. In 2004, the Mexican government launched a major health reform with the creation of *Seguro Popular* (Popular Health Insurance). *Seguro Popular* is a voluntary public insurance program designed to reduce catastrophic healthcare expenditures, provide access to a comprehensive package of healthcare services, and improve quality of care for its beneficiaries [13]. *Seguro Popular* was implemented gradually, but by 2018, it insured approximately half of the Mexican population [14]. *Seguro popular* has been shown to be effective in increasing rates of doctor visits, hypertension and diabetes testing, and insulin usage for diabetes management [15]. Even though more people gained insurance coverage, inequities in access to services such as prostate screening, hypertension treatment, and medications persisted [16, 17]. Finally, while *Seguro Popular* did not include cognitive impairment or dementia specific services, [18] research using data from the MHAS revealed *Seguro Popular* was associated with 1.46 higher odds for prevalent dementia for women aged 82 and older, indicating that *Seguro Popular* is a more common source of health insurance for older adults with dementia [19].

Considerable research has examined the healthcare utilization of older adults with cognitive impairment and dementia in high-income countries. However, there is a notable gap in similar research within low-middle-income countries. Our study addresses this gap by utilizing data from a nationally representative cohort of middle-aged and older adults in Mexico, with nearly twenty years of follow-up. The aim of this study is to investigate population-level trends in healthcare use by adults aged 60 and older with and without cognitive impairment in Mexico. Based on evidence that older adults with dementia are at high risk for hospitalization but are less likely to use outpatient services, [3, 5–7] we hypothesized that older adults with cognitive impairment would be more likely to spend one or more nights in the hospital but be less likely to use outpatient services or receive healthcare screenings than participants without cognitive impairment. We selected outcomes that we expected would capture dramatic increases in healthcare use after the implementation of Seguro Popular, such as outpatient services and healthcare screenings [15]. We also included healthcare measures we expected would be less affected by Seguro Popular, such as hospitalizations and visiting a pharmacist. This population-level research is crucial for countries like Mexico, which are undergoing significant demographic shifts, changes in the health profiles of older adults, and major healthcare reforms. The healthcare utilization patterns in a middle-income country like Mexico may differ from those in high-income countries due to disparities in economic resources, healthcare infrastructure, disease burden, and social determinants [20].

Methods

Mexican health and aging study

The Mexican Health and Aging Study (MHAS) is an ongoing, population-based cohort study of population aging in Mexico [21]. The MHAS began in 2001 with a nationally representative sample of 15,186 participants aged 50 and older. A participant's spouse or partner was recruited regardless of age if he or she lived in the same household as the participant. Follow-up interviews have been completed in 2003, 2012, 2015, 2018, and 2021. New participants aged 50–59 and spouses regardless of age were added during the 2012 ($n=5,896$) observation wave. In addition, new participants aged 50–55 and spouses were added in 2018 ($n=4,809$). We used data from the 2001 through 2018 observation waves. We did not include the 2021 interview wave because of the major disruption to healthcare use during the COVID-19 pandemic.

Figure 1 shows the sample selection for each observation wave. First, we selected participants aged 60 and older at the time of interview. Next, we selected participants who completed a direct interview at a given observation wave. We excluded participants who required a proxy to complete an interview because questions about receiving screening tests for high cholesterol, diabetes, and hypertension were not asked in the proxy interview. We then selected participants who had complete information for healthcare use, demographic characteristics, and health characteristics. The final sample size for each observation wave was 6,146 (2001), 6,778 (2003), 8,915 (2012), 9,424 (2015), and 8,907 (2018). In general (Supplemental Table 1), participants excluded at each observation wave because of requiring a proxy interview and did not have complete information were older, more likely to be male, completed fewer years of education, were more likely to live in a rural community, were less likely to have health insurance, and more likely to be widowed than participants in the final sample.

Measures

Healthcare use

Our outcomes were eight self-reported healthcare utilization measures. Participants were asked at each observation wave to report the number of nights spent in a hospital in the past year, the number of outpatient procedures in the past year, the number of times in the past year they saw a doctor or medical personnel, and the number of times in the past year they saw a dentist. These outcomes were dichotomized as zero and one if the number of visits was greater than zero. The variables for outpatient procedure and doctor visits were combined into one outcome because of the small number of participants who reported having an outpatient procedure [22]. Participants were also asked if they consulted a pharmacist in the past year about their health, and if in the last two years they had received screening tests for high cholesterol, diabetes, or hypertension (yes / no). We investigated each screening test separately. Participants interviewed in 2001, 2003, 2012, and 2015 were asked how many times in the last year they had seen a

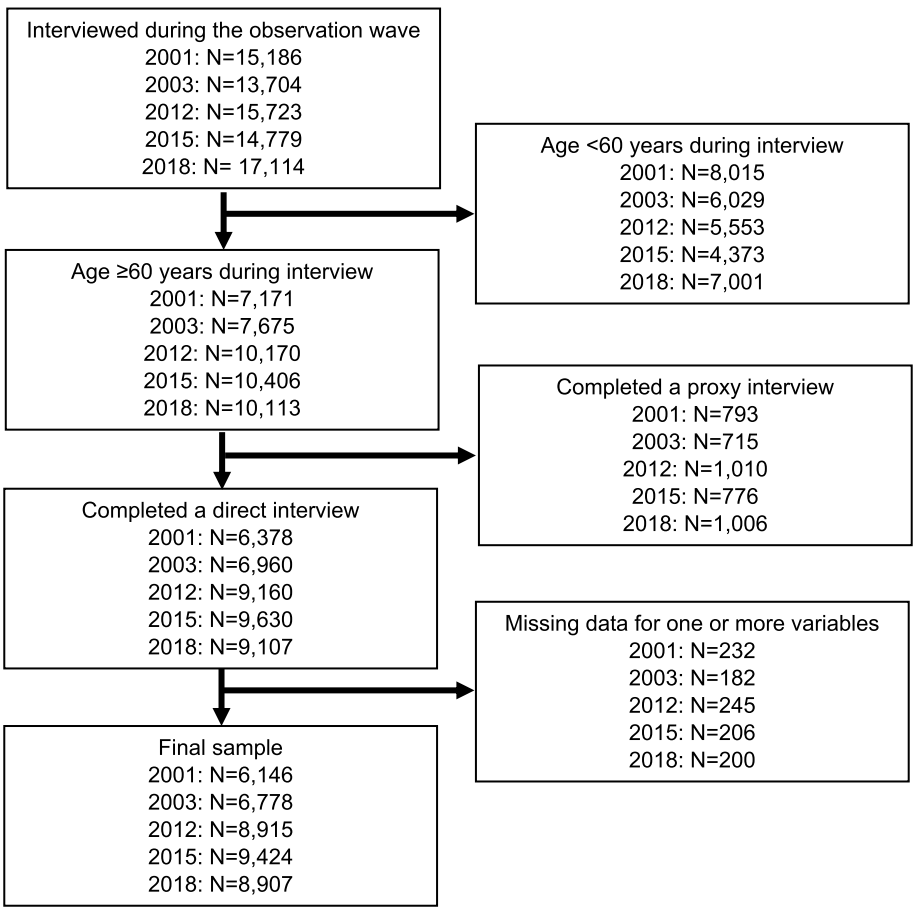

Fig. 1 Selection of Mexican Health and Aging Study participants interviewed in 2001, 2003, 2012, 2015, and 2018

homeopathic doctor or folk healer. We dichotomized the outcome of seeing a homeopathic doctor or folk healer as zero and one if the number was greater than zero.

Cognitive status

The MHAS includes a modified version of the Cross Cultural Cognitive Examination Test that includes the following five cognitive tests in the direct interview at each observation wave [23]: (1) immediate recall of an 8-word list (0–8 points); (2) delayed recall of an 8-word list (0–8 points); (3) copy a figure (0–2 points); (4) draw the figure from memory (0–2 points); (5) and identify a target stimulus in a visual array (0–60 points). We used the MHAS datasets with imputed scores for cognitive functioning to account for missing values [24]. We calculated a z-score for each cognitive test using the sample mean and standard deviation for all participants who completed a direct interview [23]. Participants with a z-score of less than or equal to -1.5 standard deviations on two or more cognitive tests were classified as cognitively impaired [25]. The rest of the participants were classified as not cognitively impaired.

Demographic characteristics

We included demographic characteristics associated with cognitive functioning and healthcare use by older adults in Mexico [22, 26–28]. These included age, sex, education (0 years, 1–6 years, 7 + years), marital status (married, not married, and widowed), community population size (< 2,500; 2,500—14,999; 15,000—99,000; ≥ 100,000 residents), and health insurance. Participants were asked at each observation wave if they had health insurance coverage through the Mexican Social Security Institute, Institute for Social Security and Services for State Workers, Pemex, defense, or navy, private provider, *Seguro Popular* (2012, 2015, 2018), or other. Health insurance was dichotomized as uninsured and any health insurance.

Health characteristics

Participants were asked at each observation wave if they had ever been told by a doctor or medical personnel that they had diabetes or high blood sugar, hypertension or high blood pressure, stroke, heart attack, and arthritis. We dichotomized each health condition as yes or no.

Statistical analyses

Generalized estimating equations (GEE) with a log link function were used to estimate risk ratios (RR) of healthcare use by observation wave (reference 2001) and cognitive status (reference no cognitive impairment) [29]. All models had an exchangeable correlation structure with clustering by participant. First, we used GEE models that included time and status as main effects. Next, we included an interaction term of cognitive status and observation wave to determine if time trends of each healthcare outcome differed by cognitive status.

Our primary exposure of interest was cognitive status. Because participants' cognitive status could change across observation waves, we used the ipwtm function from the R package IPW to estimate inverse probability weights for a time-varying exposure (i.e., cognitive status) with time-varying covariates (i.e., age, community size, health insurance status, and self-reported health conditions) [30]. Estimating these weights allowed us to adjust for time-varying confounders. The weights were calculated using a logistic regression model to estimate the probability of being classified as cognitively impaired at each observation wave according to a participant's demographic and self-reported health characteristics at that observation wave. Standardized inverse probability treatment weights (IPTW) were obtained by dividing a participant's probability of being cognitively impaired at a given observation wave according to the non-time varying covariates divided by the probability of being cognitively impaired at a given wave according to all time-varying and non-time varying (i.e., sex, education) covariates.

The GEE models included the standardized IPTW to adjust for time-varying covariates and the non-time covariates sex and educational attainment. We used the ggeffect function from the R package ggeffects to present the results from the GEE models as estimated marginal means for each observation year and category of cognitive status [31]. Since the GEE models included sex and educational attainment as categorical variables, the estimated marginal mean is the probability for the outcome according to the proportions of each level of the categorical variable [31].

We conducted two sensitivity analyses. The first included participants who required a proxy interview in the analytic sample. The second assessed the relationship between requiring a proxy interview and healthcare use among participants with cognitive impairment. Both sensitivity analyses did not include the outcomes for receiving screening tests for high cholesterol, diabetes, and hypertension since these measures are not in the proxy interview.

Results

Sample characteristics

Table 1 shows the demographic and health characteristics at each observation wave by cognitive status. Large differences in age, educational attainment, and community size by cognitive status persisted across observation waves (Table 1). In general, participants with cognitive impairment were older, completed fewer years

Table 1 Demographic and health characteristics of MHAS participants aged 60 and older interviewed in 2001 – 2018

	2001		2003		2012		2015		2018	
	CI	NCI	CI	NCI	CI	NCI	CI	NCI	CI	NCI
Sample size	997	5,149	571	6,207	1,270	7,645	1,467	7,957	1,368	7,539
Characteristic, col %										
Age, mean (SD)	74.0 (8.7)	68.1 (6.6)	74.6 (9.0)	69.0 (7.2)	75.1 (8.5)	68.9 (7.0)	76.7 (8.3)	69.7 (6.9)	76.5 (8.5)	70.3 (7.1)
Female	53.3	54.0	49.6)	54.1	55.7	54.6	56.7	55.8	55.4	56.4
Education										
0 years	55.7	26.0	62.3	27.4	48.1	16.9	51.6	14.0	45.0	12.9
1–6 years	39.6	56.2	35.6	55.6	46.4	56.3	44.2	56.6	47.7	54.9
≥ 7 years	4.7	17.8	2.1	17.0	5.5	26.7	4.2	29.4	7.3	32.2
Any health insurance	54.7	65.8	50.8	67.6	85.4	89.4	88.8	92.5	89.4	93.2
Community size (number of residents)										
< 2,500	23.9	16.0	32.4	16.8	28.5	16.4	30.5	16.6	32.7	17.6
2,500 – 14,999	10.0	9.2	12.4	9.8	13.5	10.9	11.9	8.9	11.8	9.1
15 k, – 99,99	16.2	14.5	14.0	15.1	11.5	11.9	15.7	14.0	14.2	13.6
≥ 100 k	49.8	60.3	41.2	58.2	46.5	60.7	41.8	60.4	41.2	59.7
Marital Status										
Married	52.6	62.8	53.9	62.6	52.0	66.9	48.5	65.1	51.6	64.5
Not married	9.6	11.9	9.5	11.5	10.8	11.1	13.4	13.5	9.4	12.2
Widowed	37.8	25.3	36.6	25.9	37.2	21.9	38.1	21.4	39.0	23.3
Health conditions										
Diabetes	20.0	16.9	16.8	17.1	22.4	25.3	26.5	26.3	27.6	28.0
Hypertension	42.7	42.6	37.5	38.5	49.7	48.9	52.7	52.4	52.3	51.4
Stroke	7.3	2.5	1.4	1.2	4.6	2.0	3.7	2.0	4.2	2.2
Heart attack	5.8	3.9	3.5	2.6	3.7	4.4	4.5	4.4	4.8	4.7
Arthritis	28.1	24.4	19.1	21.3	15.7	16.5	19.8	17.0	16.5	14.5

CI (cognitive impairment), *NCI* (no cognitive impairment). Percentages are based on the column total

of education, and more often lived in rural communities. Additionally, participants with cognitive impairment were less likely to have health insurance coverage at each observation wave but this difference was greater in 2001 and 2003 than 2012, 2015, and 2018. Participants with cognitive impairment were more likely to have experienced a stroke than those with no cognitive impairment.

Healthcare use by observation wave and cognitive status

As shown in Table 2, the adjusted relative risk for spending one or more nights in the hospital was significantly higher in 2003, 2012, 2015, and 2018. Cognitive impairment was associated with 1.13 (CI = 1.03–1.23) higher risk for one or more nights in the hospital (Table 2). The predicted probability for one or more nights in the hospital increased from 0.09 in 2001 to 0.16 in 2018 for participants with no cognitive impairment and from 0.11 to 0.17 for participants with cognitive impairment (Fig. 2a). The interaction between cognitive status and observation wave was not statistically significant ($p = 0.58$).

The RR for one or more outpatient procedures or doctor visits was significantly higher in 2012 (RR = 1.15, 1.13–1.18), 2015 (RR = 1.24, 1.21–1.27), and 2018 (RR = 1.17, 1.14–1.20) but not 2003 (RR = 1.01, 0.98–1.04) (Table 2). Participants with cognitive impairment had 0.95 (CI = 0.93–0.97) lower risk for one or more outpatient procedures or doctor visits. The predicted probability for one or more outpatient procedures or doctor visits was significantly lower at each observation wave for participants with cognitive impairment compared to those without cognitive impairment (Fig. 2b). The interaction between cognitive status and observation wave was not statistically significant ($p = 0.78$).

Except for the 2018 observation wave (RR = 1.56, 1.40–1.75), there were no significant differences in the RR of seeing a pharmacist compared to 2001 (Table 2). Cognitive status was not associated with seeing a pharmacist at any observation wave (Fig. 2c). The interaction between cognitive status and observation wave was not statistically significant ($p = 0.07$).

The risk of having a blood test for high cholesterol was similar in 2003 to 2001 (RR = 1.02, 0.99–1.06), but was significantly higher in 2012 (RR = 1.33, 1.29–1.37), 2015 (RR = 1.33, 1.29–1.37), and 2018 (RR = 1.29, 1.24–1.33)

Table 2 Adjusted association betweencognitive status and healthcare use in 2001, 2003, 2012, 2015, and 2018 among Mexican Health and Aging Study participants aged 60 and older

	1 + nights in hospital	1 + doctor visits	Saw a pharmacist	Screening cholesterol	Screening diabetes	Screening hypertension	Saw homeopathic doctor or folk healer	Saw dentist
Year	RR	RR	RR	RR	RR	RR	RR	RR
	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI
2001 (n = 6,146)	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
2003 (n = 6,778)	**1.21** **1.09–1.35**	1.01 0.98–1.04	1.07 0.96–1.20	1.02 0.99–1.06	**1.04** **1.01–1.07**	**1.02** **1.01–1.05**	**0.72** **0.63–0.82**	1.06 0.99–1.14
2012 (n = 8,915)	**1.25** **1.12–1.39**	**1.15** **1.13–1.18**	1.11 0.99–1.24	**1.33** **1.29–1.37**	**1.21** **1.18–1.24**	**1.12** **1.10–1.15**	**0.57** **0.50–0.66**	**1.25** **1.17–1.33**
2015 (n = 9,424)	**1.53** **1.38–1.70**	**1.24** **1.21–1.27**	1.00 0.90–1.12	**1.33** **1.29–1.37**	**1.17** **1.14–1.20**	**1.09** **1.07–1.11**	**0.62** **0.53–0.71**	**1.40** **1.31–1.50**
2018 (n = 8,907)	**1.63** **1.43–1.86**	**1.17** **1.14–1.20**	**1.56** **1.40–1.75**	**1.29** **1.24–1.33**	**1.13** **1.09–1.16**	**1.03** **1.01–1.06**	–	**1.45** **1.36–1.56**
Cognitive status								
No impairment (n = 34,497)	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Impairment (n = 5,673)	**1.13** **1.03–1.23**	**0.95** **0.93–0.97**	0.99 0.91–1.07	**0.93** **0.91–0.96**	**0.95** **0.92–0.97**	**0.92** **0.88–0.97**	0.89 0.77–1.02	**0.58** **0.47–0.72**
Cognitive status by year						***p* = 0.007**		***p* = 0.003**
Impairment 2003						0.94 0.86–1.03		1.10 0.79–1.52
Impairment 2012						1.04 0.98–1.10		**1.55** **1.20–1.99**
Impairment 2015						**1.08** **1.01–1.14**		**1.38** **1.08–1.77**
Impairment 2018						1.03 0.96–1.10		**1.45** **1.14–1.85**

Risk ratios estimated using generalized estimating equation that included year, cognitive status, sex, educational attainment, and inverse probability weights. The models used a log link function, exchangeable correlation structure, and clustering by participant

The outcome 1 + doctor visits also include participants who had 1 + outpatient procedures

Participants interviewed in 2018 are not asked how many times in the last year they saw a homeopathic doctor or folk healer

RR risk ratio

Bold indicated $p < 0.05$

compared to 2001. Cognitive impairment was associated with 0.93 (CI = 0.91–0.96) lower risk for having a blood test for high cholesterol (Table 2). Additionally, participants with cognitive impairment had significantly lower predicted probability at each observation wave to have a blood test for high cholesterol (Fig. 2d). The findings for a screening test for diabetes over time and by cognitive status were similar to having a screening test for high cholesterol (Table 2, Fig. 2e). The interaction between cognitive status and observation wave for having a blood test for high cholesterol ($p = 0.22$) and screening test for diabetes ($p = 0.08$) was not statistically significant.

The RR of seeing a homeopathic doctor or folk healer was significantly lower at each follow-up observation wave compared to 2001 (Table 2). However, the risk for seeing a homeopathic doctor or folk healer was not significantly different between participants with and without cognitive impairment (RR = 0.89, 0.77–1.02) (Table 2, Fig. 2f). The interaction between cognitive status and observation wave was not statistically significant ($p = 0.17$).

We detected statistically significant interactions between cognitive status and time for having seen a dentist ($p = 0.003$) and being screened for hypertension ($p = 0.007$). In general, participants with cognitive impairment had lower probability to have seen a dentist and to receive a screening test for hypertension. The predicted probabilities of having seen a dentist and receiving a screening test for hypertension increased for participants with and without cognitive impairment but the increase was greater for participants with cognitive impairment (Fig. 2g, h).

Sensitivity analyses

The results of the first sensitivity analysis that included participants who required a proxy interview were consistent with the results of the main analysis (Supplemental Table 2). We detected similar increasing trends by

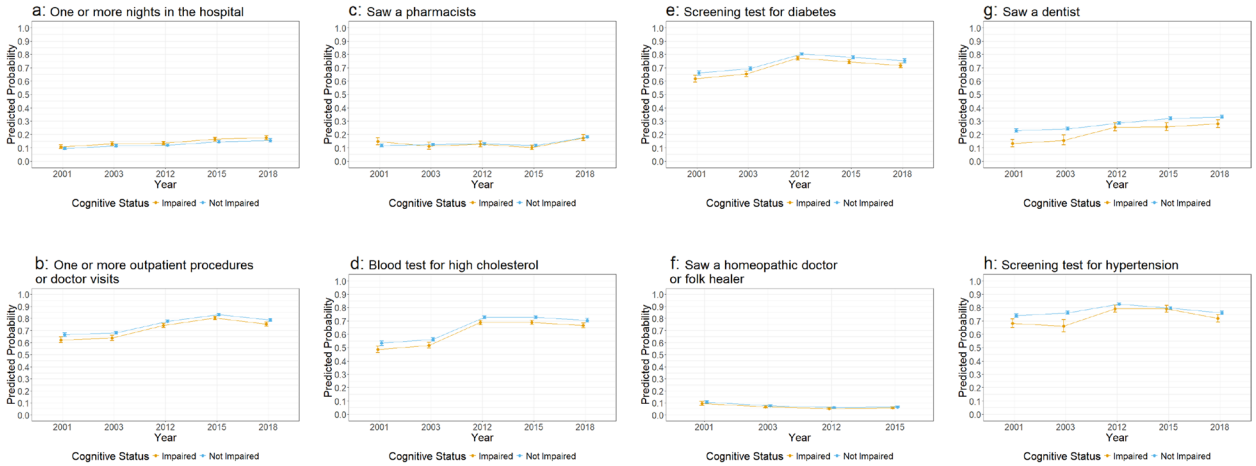

Fig. 2 The predicted probability for one or more nights in the hospital (**a**), outpatient procedures or doctor visits (**b**), saw a pharmacist (**c**), blood test for cholesterol (**d**), diabetes screening (**e**), saw a homeopathic doctor (**f**), saw a dentist (**g**), and hypertension screening (**h**) from 2001 to 2018 for Mexican adults with and without cognitive impairment. Predicted probabilities were estimated using estimated using generalized estimating equations with a log link function, exchangeable correlation structure, and clustering by participant. Participants interviewed in 2018 are not asked how many times in the last year they saw a homeopathic doctor or folk healer. The samples sizes for each year were 6,146 (2001), 6,778 (2003), 8,915 (2012), and 9,424 (2015). The sample sizes for participants with no cognitive impairment and cognitive impairment were 26,958 and 4,305, respectively

year in the relative risk for one or more nights in the hospital, doctor visits, and seeing a dentist, and a decreasing trend in the relative risk of seeing a homeopathic doctor or folk healer. Additionally, cognitive impairment was associated with significantly higher relative risk for one or more nights in the hospital and significantly lower risk for one or more doctor visits and dental visits.

The results of the second sensitivity analysis on the association between requiring a proxy interview and healthcare use of participants with cognitive impairment are shown in Supplemental Table 3. Participants with cognitive impairment who received a proxy interview had significantly higher relative risk to have one or more nights in the hospital and to have one or more doctor visits. Conversely, these participants had significantly lower relative risk to have seen a pharmacist or a dentist.

Discussion

We examined population-level trends in self-reported healthcare utilization over nearly twenty-years among individuals aged 60 and older in Mexico with and without cognitive impairment. Our study revealed significant patterns in the self-reported healthcare usage of older adults. Specifically, we observed an upward trend in the use of most healthcare services from 2001 to 2012, regardless of cognitive status. However, post-2012, these trends began to diverge based on the type of healthcare service.

We noted a continued increase in the number of hospital nights and dental visits in both 2015 and 2018. In contrast, the use of outpatient procedures, doctor visits, and cholesterol screenings leveled off, showing no meaning differences from the probabilities predicted for 2012. Additionally, we observed a slight decrease in the frequency of diabetes and hypertension screenings. Interestingly, these trends in healthcare utilization mirrored the growth patterns of *Seguro Popular* enrollment from 2003 to 2018. *Seguro Popular* saw its enrollment swell from 5.3 million beneficiaries in 2004 to 52.9 million by the end of 2012 [14]. Enrollment peaked in 2014 at 57.3 million beneficiaries before decreasing to 53.5 million beneficiaries in 2018 and 51.4 million in 2019. *Seguro Popular* increased health service utilization and improved screening for chronic diseases, including diabetes, hypertension, and high cholesterol [32].

We detected low probabilities of seeing a pharmacist and a homeopathic doctor or folk healer for all participants across all MHAS observation waves. The low probability of participants visiting a pharmacist could be partly due to the absence of public policies and regulations that establish standardized norms for the pharmaceutical profession leading to limited accessibility across the country [33]. Regarding homeopathic doctors and folk healers, our findings indicate a modest yet statistically significant decrease in the relative risk of utilization from 2001 to 2015. This decreasing trend may be due in part to the observed increase in doctor visits and the fact that *Seguro Popular* does not offer coverage for these alternative services.

Overall, participants with cognitive impairment had significantly higher risk for one or more nights in the

hospital. This higher risk could be attributed to factors such as difficulties in medication management, which may lead to more frequent hospitalizations, and behavioral problems that increase the risk of fall-related injuries [34, 35]. Conversely, participants with cognitive impairment were less likely to use healthcare services that could be considered as elective, such as outpatient procedures and doctor visits and healthcare screenings. These differences could be attributed to challenges associated with navigating the healthcare system, transportation limitations, and caregiver responsibilities for older adults with cognitive impairment [36]. Additionally, negative attitudes toward cognitive impairment and inadequate support systems can discourage older adults and their caregivers from seeking formal care. These barriers can be exacerbated by prior negative encounters with healthcare professionals, lack of acceptance of the diagnosis, and limited awareness of the necessary care, ultimately leading to delays in accessing formal care, particularly for elective services [37].

We did find evidence that participants with cognitive impairment had a greater increase in dental visits and hypertension screening from 2001 to 2012 than participants without cognitive impairment. The observed rise in dental visits aligns with previous research indicating an increased prevalence of dental care utilization among older Mexican adults during the same period [38]. This increase can be attributed, in part, to changes in health policies implemented by Seguro Popular, which incorporated essential dental interventions into their covered services [18]. This finding holds particular relevance considering that older adults with dementia are at a higher risk of developing oral health problems due to declines in self-care abilities and motor skills [39]. Therefore, regular professional dental care and oral health screening tools can be beneficial in managing the oral health of individuals with cognitive impairment.

In terms of hypertension screening, our study highlights the importance of increased screening for older adults with cognitive impairment. Hypertension is associated with greater cognitive decline for older adults with mild cognitive impairment [40]. Conversely, timely diagnosis of hypertension and appropriate management are crucial to avoid overtreatment with antihypertensive drugs [41]. Excessive lowering of systolic blood pressure, which has been associated with greater cognitive decline for older adults with dementia and mild cognitive impairment, [41] can be mitigated through appropriate hypertension management.

A strength of our analysis is that we were able to assess population-level changes in self-reported healthcare use among older adults with and without cognitive impairment over an unprecedented length of time. However, there are limitations that should be acknowledged. First, we relied on self-reported measures of healthcare utilization. These self-reported measures may be prone to recall bias particularly for participants with cognitive impairment. Second, our analysis was limited to the five cognitive items included in every MHAS wave. The MHAS has added cognitive items to provide more comprehensive data on participants' cognitive functioning. Using these cognitive assessments may have identified additional participants with cognitive impairment who we classified as having normal cognitive functioning. Thus, we may have underestimated the magnitude of the difference in healthcare use between participants with and without cognitive impairment. Third, the sample size was insufficient to stratify individuals into cognitive impairment no dementia and dementia subgroups. Sample size limitations also prevented us from stratifying insurance coverage by type, which would have accounted for differences in healthcare use between Seguro Popular, Social Security, and private healthcare insurance. Finally, we dichotomized the outcomes for one or more nights in the hospital and one or more outpatient procedures or doctor visits. Dichotomizing a variable reduces statistical power and results in a loss of information, [42] but we wanted to reduce potential of participants misreporting the number of nights in the hospital, doctor visits, and outpatient procedures.

Conclusions

This study provides valuable insights into population-level trends in self-reported healthcare utilization among individuals aged 60 and older in Mexico, stratified by cognitive status. The findings highlight an overall increase in various healthcare services, with notable variations in the rate of increase post-2012. The implementation of healthcare policies such as *Seguro Popular* may have played a role in these trends. However, individuals with cognitive impairment exhibited lower utilization rates for elective services, indicating potential barriers to accessing outpatient care that need to be addressed through policy measures. Improving transportation options, enhancing caregiver education, and implementing patient navigation services can help mitigate these barriers. Additionally, training healthcare professionals to recognize and manage cognitive impairment effectively can improve patient outcomes and healthcare experiences. In geriatric practice, the increased hospitalization rates among cognitively impaired individuals indicate a need for enhanced support systems to manage chronic conditions and prevent hospitalizations. This could include community-based interventions, improved caregiver support, and better integration of healthcare services to manage comorbidities associated with cognitive decline. While our results for trends in self-reported healthcare use coincide with the introduction of *Seguro Popular*, our study

did not formally analyze the effects of health insurance expansion on self-reported healthcare utilization for older adults with and without cognitive impairment. Future research should explore specific factors, including health insurance, that contribute to the observed utilization patterns and their impact on healthcare outcomes. Overall, these findings emphasize the need for comprehensive and inclusive healthcare policies that cater to the specific needs of the aging population in Mexico, particularly those with cognitive impairment. Policymakers and healthcare providers must collaborate to create an integrated care model that ensures all older adults receive the necessary support and services to maintain their health and well-being.

Abbreviations

CIND	Cognitive impairment no dementia
GEE	Generalized estimating equations
IPTW	Inverse probability treatment weights
MHAS	Mexican Health and Aging Study

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

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Authors' contributions
J.E.C.C. contributed to the conceptualization of the study, data curation, investigation, methodology, validation, visualization, and the writing of the original draft as well as review and editing. R.W. played a role in the conceptualization, investigation, methodology, validation, visualization, and contributed to the writing, review, and editing of the manuscript. R.S.T. was instrumental in the study's conceptualization, investigation, methodology, validation, and visualization. He also took part in writing, reviewing, and editing the manuscript. B.D. contributed to the conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, supervision, validation, visualization, writing of the original draft, and review and editing of the manuscript. All authors had full access to all data in the study and share the final responsibility for the decision to submit the paper for publication.

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Availability of data and materials
The data utilized in this study is sourced from the Mexican Health and Aging Study. It is publicly accessible upon registration on the MHAS official website: https://mhasweb.org/Home/index.aspx. Researchers and practitioners interested in replicating or extending the analyses presented in this study are encouraged to register and access the dataset for their scholarly work.

Declarations

Ethics approval and consent to participate
This research was a secondary analysis of de-identified data previously collected by the MHAS and is publicly available. Ethical approval and consent to participate are not required for this study.
The University of Texas Medical Branch Institutional Review Board and the National Institute of Statistics and Geography, and the National Institute of Public Health in Mexico have approved the MHAS study procedures and survey instruments.

Competing interests
The authors declare no competing interests.

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