



Cohort profile

Cohort Profile: The Mexican Health and Aging Study (MHAS)

Rebeca Wong,^{1*} Alejandra Michaels-Obregon² and Alberto Palloni³

¹University of Texas Medical Branch, Sealy Center on Aging, ²University of Texas Medical Branch, Sealy Center on Aging and ³University of Wisconsin, Population Center for Demography and Ecology

*Corresponding author. University of Texas Medical Branch, Sealy Center on Aging, 301 University Blvd, Rebecca Sealy Building, Room 6.300, Galveston, TX 77555. E-mail: rewong@utmb.edu

Abstract

The Mexican Health and Aging Study (MHAS) was designed to prospectively evaluate the impact of disease on the health, function and mortality of adults over the age of 50 in both urban and rural areas of Mexico. The overall goal of the study is to examine the ageing process and its disease and disability burden in a large representative panel of older Mexicans, using a wide socioeconomic perspective. The study protocols and survey instruments are highly comparable to the U.S. Health and Retirement Study (HRS). The MHAS 2001 baseline is a nationally and urban-rural representative survey of individuals born in 1951 or earlier. Three waves of data have been collected so far: baseline in 2001 and follow-ups in 2003 and 2012. In 2012, the study added a representative sample of the population from the 1952–62 birth cohorts. A fourth wave will be collected in 2015. The data files and documentation are available free of charge at the study website [www.MHASweb.org] in English and [www.ENASEM.org] in Spanish.

KEY MESSAGES

- One in five adults aged 50 and older in Mexico have at least one adult child currently living in the USA.
- Intergenerational transfers are highly prevalent in monetary and in-kind forms, with older Mexicans in particular prior to age 70 giving help to children, and receiving help from children after age 70.
- Health insurance coverage among older adults in the study increased from 52.9% of adults aged 50 and over in wave 1 (2001) to 84.8% in wave 3 (2012), and the increase was higher for rural area residents.
- Beyond chronic diseases, infectious diseases continue to affect overall health and mortality among older adults in Mexico. Thus, current ageing in developing countries may be influenced more by infectious diseases than previously thought.
- There is a meaningful association between early-life health and socioeconomic conditions, and old-age chronic diseases.

Why was the cohort set up?

By 2050, adults aged 60 years and older will be the largest group in the population age pyramid of most countries.¹³ Ageing in developing countries, including Mexico, is characterized by a relatively fast pace compared with developed countries;¹⁴ this is a natural consequence of the epidemiological and demographic transition that brought rapid mortality and fertility declines.¹⁵ Also, the decline in child and adult mortality rates was achieved during this period mainly through successful adoption of health policies and medical technology, not through improved standards of living.^{16–18} Furthermore, Mexico offers a unique opportunity to examine ageing because fast ageing is taking place with insufficient economic development and institutional infrastructure.

The MHAS is the first longitudinal study of older adults in Mexico with a broad socioeconomic perspective. The study also enables cross-national comparisons so as to analyse the health dynamics of older Mexicans with comparably aged Mexican-born migrants in the USA and second-generation Mexican Americans, using similar data from the US population (such as the HRS) to assess the durability of the migrant health advantage in the USA. The HRS is a nationally representative, longitudinal, population-based sample of individuals aged 50 years and older (and their spouses of any age), which began in 1992 (for more information, see <http://hrsonline.isr.umich.edu/>). The study contains multidisciplinary information covering domains including health and socioeconomic status via self-report, administrative data linkages and objective health measures.¹⁹ The HRS data and documentation are available to the public and provide a key resource of population ageing in the USA.

The MHAS design was motivated by research questions related to: the dynamics of health and ageing in Mexico; the consequences of early-life conditions on the multiple domains of health, early- and mid-life health behaviours; migration and employment history; community characteristics; family transfers and socio-economic status; and health selectivity among migrants to the USA and among those returning to Mexico.

Who is in the cohort?

The 2001 baseline survey of the MHAS includes a nationally representative sample of individuals born prior to 1951, that is the population aged 50 or older as of 2001. The sample for the MHAS baseline was selected from residents of both rural and urban areas, from the National Employment Survey (Encuesta Nacional de Empleo, ENE), carried out by the INEGI (Instituto Nacional de Estadística y Geografía) in Mexico; households with at least one resident aged 50 years

or older were eligible to be part of the MHAS baseline sample. If more than one person was age-eligible in the selected household, then one of these was selected at random for the study. If the selected MHAS person was married or in a consensual union, with the spouse residing in the same household, then the spouse or partner was also recruited to be part of the MHAS regardless of his/her age. The sample was distributed in all 32 states of the country in urban and rural areas. In addition, households in the six states accounting for 40% of all migrants to the USA were over-sampled. The 2003 survey completed a follow-up interview with all study subjects from 2001, adding new spouses to the study and completing a next-of-kin interview on deceased study subjects. In 2001, a subsample was selected to provide anthropometric measures, and the same subsample was followed up in 2003.

The 2012 follow-up visit included all age-eligible subjects from the 2001 and 2003 waves. In addition the sample was refreshed, adding a representative sample of the population from the 1952–62 birth cohort as well as their spouses/partners regardless of age.²⁰ The sampling frame for the new cohort sample was the 2012 Mexican National Employment and Occupation Survey (ENOE, previously named National Employment Survey, ENE). In 2012, a subsample was selected from which to obtain objective markers through blood samples, performance tests and anthropometric measures.

How often have they been followed up?

The baseline survey was conducted in summer 2001 with a completed-interviews sample size of 15,186 respondents. A subsample of 2573 completed anthropometric measures. A direct interview was sought with each individual, and proxy interviews were obtained in case of illness, hospitalization or temporary absence that precluded a direct interview. All interviews were conducted in person with paper and pencil (in 2001 and 2003) by trained full-time interviewers of the Instituto Nacional de Estadística y Geografía (INEGI) of Mexico.

The first follow-up survey was carried out in summer 2003; all age-eligible subjects from the 2001 sample were targeted even if they had moved. New spouses or partners of the study subjects were added to the study. If a 2001 study subject had died, an interview was conducted with an informed respondent or next of kin. Similar to the baseline, if it was not possible to obtain a direct interview due to illness, hospitalization or temporary absence, a proxy interview was conducted. In 2003, 14 250 interviews were completed, including 546 next-of-kin interviews. A diagram containing the sample size and response rates is presented in Figure 1. The study exhibits high response and

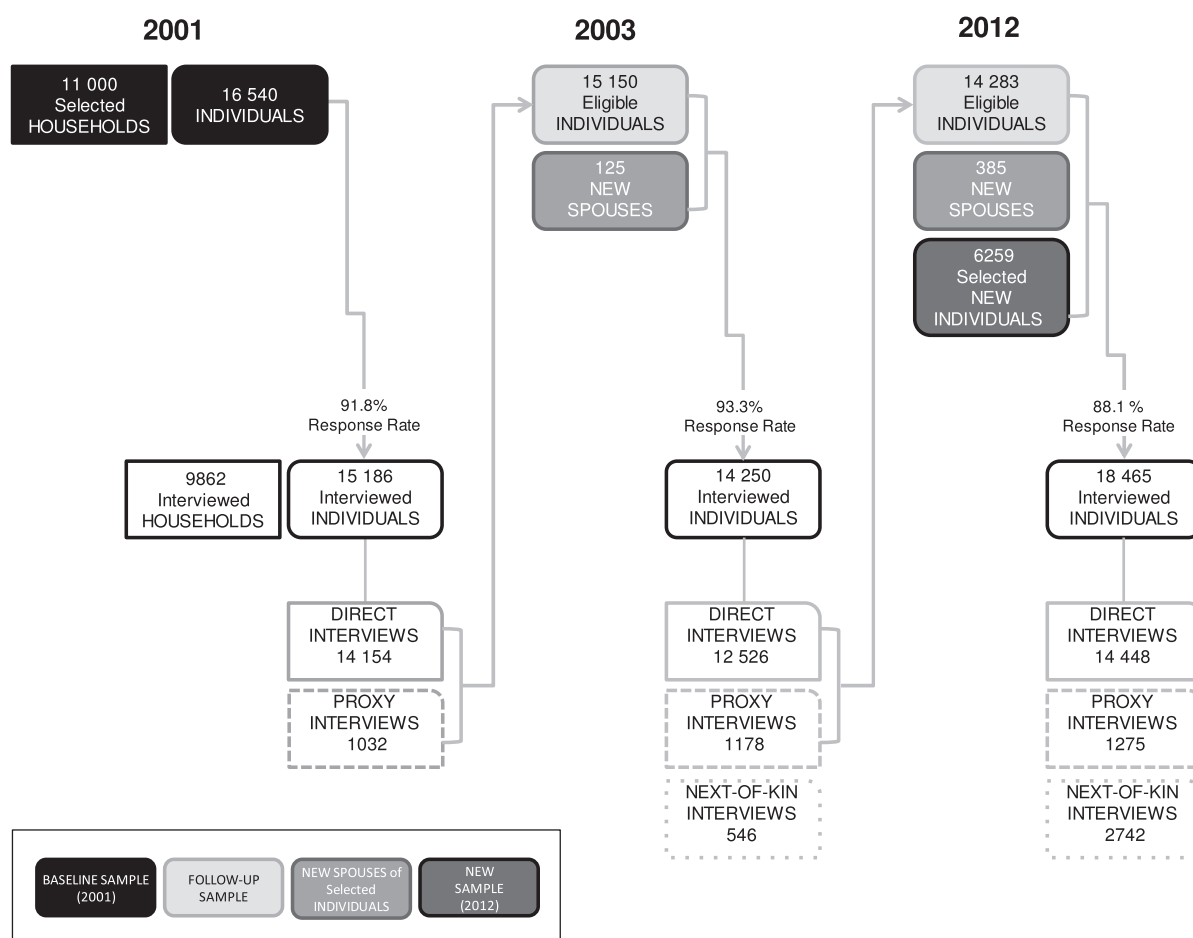


Figure 1. MHAS sample size and response rates across waves.

Table 1. Estimates from MHAS 2012 compared with the 2010 Census: distribution of the population

	MHAS 2012 ^a		Census 2010	
	50–59 years %, mean (SD)	60+ years %, mean (SD)	50–59 years %, mean (SD)	60+ years %, mean (SD)
Sex				
Male	45.02	48.19	47.68	46.54
Female	54.98	51.81	52.32	53.46
Age in years	54.68 (2.74)	69.88 (8.06)		70.79 (8.44)
50–59	100.00	–	100.00	–
60–69	–	56.54		54.04
70–79	–	29.08		31.02
80+	–	14.38		14.94
Marital status				
Married, union	75.85	64.12	76.12	60.14
Single, divorced, separated	18.54	12.00	17.35	13.19
Widowed	5.6	23.88	6.53	26.68
Total sample (n)	4702	10 195		

^aWeighted average and percentages of the population distribution.

follow-up rates: 91.8% and 93.3% for the first two waves, respectively. From those lost to follow-up, 4.2% could not be located or were absent at the time of the interview and 2.5% refused to complete the interview.

The third wave follow-up visit to all panel individuals was conducted in autumn 2012; all age-eligible subjects from the 2001 and 2003 waves were targeted. Similar to the second wave, new spouses/partners of study subjects

were added to the study regardless of age; proxy and next-of-kin interviews were conducted when applicable. A pre-fieldwork visit was completed to facilitate locating subjects between the second (2003) and third (2012) waves. The response rate for the third wave was 88.1% for a total of 18 465 interviews, including 2742 next-of-kin interviews.²¹ The panel losses were: 7.8% could not be located or were absent at the time of the interview and 3.1% refused to complete the interview. As a way of validating the MHAS, Table 1 compares the weighted distribution of the MHAS 2012 sample with the 2010 Census population by sex and age groups, obtaining similar distributions. Other validation measures have been performed with each wave. A fourth wave of the longitudinal study is planned for 2015.

What has been measured?

The MHAS data include information on socioeconomic characteristics, migration, health conditions, disability and family networks. In particular, the study includes the following (see Table 2):

- Health in multiple domains: self-report of global health, chronic conditions, symptom reports, functionality, depression, and cognition;
- childhood socioeconomic and health conditions;
- self-assessments: self-report of general health, personal review of individual economic status, subjective well-being, level of control over decisions and level of family support;
- demographic information: date of birth, education, marital status, fertility, unions or marriages and migration history;
- migration experiences: from the study subject, his/her parents and children;
- family: family structure, transfer behaviours, care arrangements and health and migration histories of children (regardless of place of residence) and household residents;
- health insurance, use of healthcare services, and health expenditures;
- individual income, assets and broad employment and pension history;
- housing characteristics: type of housing, building materials and other indicators of housing quality, property conditions and availability of consumer durables;
- widowhood: changes in economic status, employment and living arrangements as a result of the death of a spouse;
- anthropometric measures (in a subsample of respondents): weight, height; waist, hip, and calf circumference; knee length; and timed one-leg stands.

At baseline, three survey instruments were used to capture specific information (individual core and proxy, and household residents' roster). However, for the 2003 and 2012 follow-up visits, the interviewers used four and five instruments, respectively. In 2003, a next-of kin questionnaire was completed by a suitable informant in case of death of the respondent. In addition to this questionnaire, in 2012 a new section—'Major Events'—was included as a separate questionnaire. This section gathered information regarding health, change of residence, and other major life events during the past 10 years.

The survey data collection was of the responsibility of INEGI-Mexico in the three waves of the study. However, the collection of biomarkers, performance and anthropometric measures for a subsample of respondents in wave 3 was the responsibility of the Instituto Nacional de Salud Pública (INSP-Mexico).

New to the MHAS 2012

An important addition in 2012 to the objective markers section is the collection of new biomarkers in a subsample population. The MHAS, in collaboration with the Instituto Nacional de Salud Pública (INSP, Mexico), obtained anthropometric measures (weight, height; waist, hip, and calf circumference; knee length; and timed one-leg stands), two blood pressure readings, performance tests and new biomarkers. The new biomarkers include: C-reactive protein, total and high-density lipoprotein (HDL) cholesterol, thyroid-stimulating hormone (TSH) and vitamin D with venous blood; and haemoglobin and HbA1c with capillary blood.

At baseline, a subsample for anthropometric measures was randomly selected from the full sample. However, in 2012 the subsample was limited geographically in order to contain costs and maximize standardization of data gathering procedures. The subsample for objective markers was the full sample in four states, which were carefully selected to include a relatively poor state, a highly urban state, a high-migration state and a high-diabetes state.²² This selection prioritizes international migration, poverty, diabetes and disability as research topics.

Also new to the third wave were several adjustments to the scoring of two of the cognitive assessment tasks.²³ The cognitive function assessment uses the screening portion of the Cross-Cultural Cognitive Examination (CCCE) for direct interviews and the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) for proxy interviews.^{24,25} Throughout the study, the cognition section has been modified, adding new measures to the baseline questionnaire but always ensuring comparability

Table 2. MHAS questionnaire content by type of interview and wave

Type of interview	Questionnaire	Sections	Wave		
			2001	2003	2012
Direct Interview	Introductory questions	Introductory questions		X	X
		Core			
	Core	Household roster card for follow-up interview		X	X
		Non-resident children for follow-up interview		X	X
		Household roster card for new person interview	X	X	X
		Non-resident children for new person interview	X	X	X
		Demographic data for follow-up person		X	X
		Demographic data for new person	X	X	X
		Health	X	X	X
		Control and health services	X	X	X
		Parents and help to parents	X	X	X
		Help and children	X	X	X
		Functionality and help	X	X	X
		Employment	X	X	X
		Housing	X	X	X
		Pension, income and assets	X	X	X
		Surviving widow(er)		X	X
		Anthropometrics (subsample)	X	X	
		Anthropometrics and biomarkers (subsample)			X
	Major events and cognitive exercises	Major events in past 10 years			X
		Cognitive exercises	X	X	X
Proxy Interview	Core	Household roster card for follow-up interview		X	X
		Non-resident children for follow-up interview		X	X
		Household roster card for new person interview	X	X	X
		Non-resident children of new person interview	X	X	X
		Demographic data for follow-up person		X	X
		Demographic data for new person	X	X	X
		Health	X	X	X
		Control and health services	X	X	X
		Proxy cognitive condition	X	X	X
		Parents and help to parents	X	X	X
		Children and help to children	X	X	X
		Functionality and help	X	X	X
		Employment	X	X	X
		Housing	X	X	X
		Pension, income and assets	X	X	X
Next-of-kin	Core	Demographic data for deceased subject		X	X
		Major events in past 10 years of life			X
		Temporary living arrangements		X	X
		Health		X	X
		Health services		X	X
		Cognitive condition		X	X
		Help and children		X	X
		Functionality and help		X	X
		Employment		X	X
		Housing and assets		X	X

across waves. Also, between 2001 and 2003, the instructions and scoring of the original tasks were preserved.

Other important changes introduced in 2012 were the addition of new psychosocial measures and a new section to collect data on the occurrence of major life events during the past 10 years, such as loss of a spouse or child,

change of place of residence, traumas due to natural disasters or crime, or major changes in health conditions and care-giving responsibilities.

Lastly, the first two waves of the MHAS were compiled using paper and pencil. In 2012, the interviews were completed using CAPI (Computer Assisted Personal Interview),

resulting in more efficient interviews, better control in the field and greater ease in producing databases for public use. However, in all waves, the cognition battery was applied using paper and pencil.

MHAS main findings

Approximately 1 year after completing the fieldwork, the MHAS data files and documents were distributed to the research community through the study website. The MHAS has been widely used. As of October 2014, more than 100 peer-reviewed publications and book chapters have resulted, from disciplines as diverse as demography, micro-economics, labour economics, public health, epidemiology and healthcare policy. The database of publications available in the study website [www.MHASweb.org / www.ENASEM.org] is a non-exhaustive compilation of peer-review publications, working papers and other research documents using MHAS data. Figure 2 illustrates the penetration of the study at the time of printing this profile. The diagram is organized by main keywords of the manuscripts, and arrows indicate the topic overlap. It includes only journal publications. The numbers identify the publication in the website database. The main subjects include health, demographics, socioeconomic status, disability/functionality/frailty, cognition and social/family support.

Table 3 shows the main sociodemographic characteristics and health measures across the three waves. The mean years of education differ for cohorts aged 50 and older in 2001, 2003 and 2012. The increase in years of education is greater for females than males; however, the mean remains larger for males (7.84 vs 6.96). Also important is the increase in healthcare coverage, in particular after the introduction of Seguro Popular in Mexico around 2003, a social protection policy to provide access to health services to the population without other public or private health care coverage.²⁶ The main health results indicate an increase in self-reported diabetes prevalence to 16.8% for males and 21.8% for females by 2012, as well as an increase in overweight and obesity prevalence, in particular among the cohorts of males aged 50 and older in 2012.

One important area of research of the MHAS deals with the comorbidity of chronic and infectious diseases. Researchers have shown the need to emphasize the continuing importance of communicable diseases in developing countries such as Mexico. Chronic conditions seemed weakly associated with self-reported global health or mortality in Mexico, compared with associations observed in US populations;²⁷ however, findings showed that self-reported health and mortality in Mexico were strongly affected by infectious conditions.^{6,7} Other important features of the lifestyle of older adults are apparent. Smoking and physical activity-related transitions toward healthier

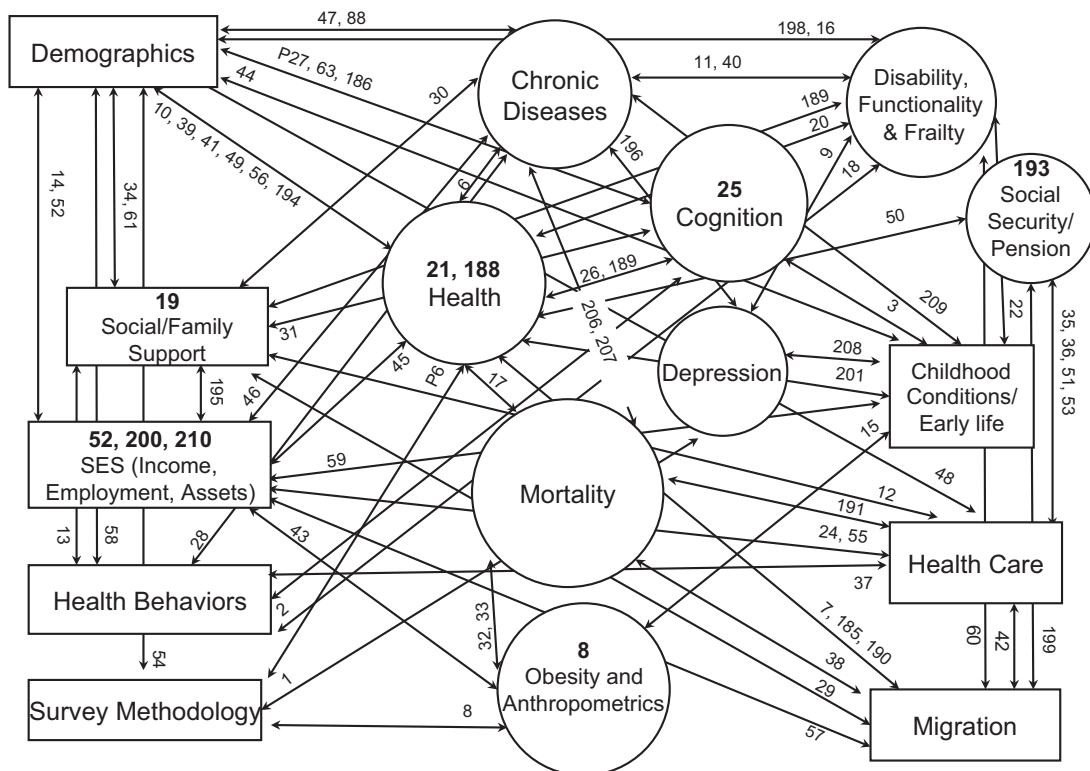


Figure 2. MHAS publications list by main topics of study.

Table 3. Descriptive statistics of major indicators by wave and sex—adults aged 50 and older, Mexico

	2001		2003		2012	
	Male %, Mean (SD)	Female	Male %, Mean (SD)	Female	Male %, Mean (SD)	Female
Age in years	62.34 (9.59)	62.26 (9.67)	65.51 (33.86)	63.98 (24.28)	67.75 (41.33)	66.44 (37.98)
50–59	44.2%	46.6%	33.9%	37.7%	43.3%	46.4%
60–69	31.1%	30.2%	35.4%	34.4%	32.3%	30.1%
70–79	17.6%	14.9%	21.4%	18.6%	16.3%	15.8%
80+	7.1%	8.3%	9.3%	9.3%	8.2%	7.7%
Marital status						
Married, union	78.8%	55.4%	80.3%	54.5%	81.4%	58.9%
Single, divorced, separated	10.4%	17.1%	8.4%	14.4%	10.6%	18.7%
Widowed	10.8%	27.5%	11.3%	31.1%	8.0%	22.4%
Education	5.14 (6.23)	4.11 (4.96)	4.92 (4.78)	4.07 (3.97)	7.84 (5.87)	6.96 (6.07)
0 years	27.7%	34.2%	27.2%	34.3%	9.0%	10.5%
1–5 years	35.8%	34.0%	36.6%	34.6%	24.1%	23.6%
6 years	16.0%	15.2%	16.4%	15.1%	23.6%	24.5%
7 or more years	20.5%	16.6%	19.8%	16.1%	43.4%	41.4%
Employment						
Currently works	69.7%	34.0%	65.4%	21.3%	68.5%	27.2%
Is looking for job	0.6%	0.3%	1.3%	0.6%	2.1%	0.6%
Household work	1.0%	50.9%	0.3%	57.3%	1.4%	57.4%
Doesn't work	28.7%	14.9%	33.0%	20.9%	27.9%	14.7%
Health insurance provider						
Social Security (IMSS)	35.8%	39.2%	36.8%	40.4%	33.5%	34.1%
ISSSTE/State ISSSTE	9.7%	11.4%	10.7%	11.7%	10.6%	11.7%
Seguro Popular	—	—	—	—	31.3%	32.5%
Pemex, Defensa, Marina	2.2%	1.8%	1.8%	2.1%	1.8%	2.5%
Private medical insurance	0.0%	0.0%	0.0%	0.0%	3.7%	3.2%
Other	3.0%	2.4%	1.8%	1.9%	2.3%	2.3%
None	49.3%	45.1%	48.9%	43.9%	16.9%	13.7%
Self-reported health						
Excellent	2.3%	1.2%	2.0%	1.2%	3.0%	2.9%
Very good	5.5%	3.4%	3.7%	2.4%	5.9%	2.8%
Good	34.6%	27.5%	29.9%	25.1%	34.0%	26.8%
Fair	42.0%	50.7%	47.8%	50.7%	47.5%	52.4%
Poor	15.6%	17.2%	16.6%	20.6%	9.6%	15.1%
Self-reported health conditions						
Hypertension	26.4%	44.1%	24.5%	40.5%	15.5%	21.9%
Diabetes	12.5%	16.7%	13.6%	17.8%	16.8%	21.8%
Cancer	1.2%	2.5%	0.7%	0.7%	1.1%	2.4%
Lung disease	5.3%	6.2%	4.2%	4.9%	4.2%	5.9%
Heart attack	2.6%	2.9%	2.3%	2.4%	3.5%	2.7%
Stroke	2.6%	2.6%	1.1%	1.2%	2.7%	1.8%
Arthritis	15.5%	23.5%	13.3%	20.9%	7.7%	17.1%
Disability						
Number of ADL limitations ^(a)						
0	91.4%	89.2%	92.6%	89.1%	89.2%	82.3%
1	3.5%	5.1%	3.6%	5.6%	6.4%	9.9%
2	2.2%	1.7%	1.4%	2.1%	2.0%	3.1%
3 or more	2.8%	4.0%	2.4%	3.3%	2.4%	4.8%
Number of IADL limitations ^(b)						
0	86.5%	87.9%	85.9%	90.8%	85.9%	86.2%
1	6.9%	4.6%	7.9%	4.5%	8.0%	6.9%
2	3.0%	1.9%	3.3%	1.1%	3.2%	1.7%
3 or more	3.6%	5.6%	2.9%	3.5%	2.9%	5.2%

(Continued)

Table 3. Continued

	2001		2003		2012	
	Male %, Mean (SD)	Female	Male %, Mean (SD)	Female	Male %, Mean (SD)	Female
Body mass index (BMI) ^(c)	26.83 (4.86)	27.49 (5.28)	26.95 (5.05)	27.93 (5.67)	26.90 (4.31)	27.88 (5.43)
Underweight	2.8%	2.3%	1.3%	2.2%	1.1%	1.6%
Normal weight	36.2%	33.6%	36.8%	32.5%	32.1%	31.9%
Overweight	42.3%	38.9%	44.2%	38.9%	44.6%	39.9%
Obese	18.7%	25.2%	17.7%	26.3%	22.3%	26.7%
Total sample (n)	6414	7250	5768	7053	6465	8432

Percentages, means and standard deviations are weighted statistics; sample sizes may vary due to missing values; data included adults 50 years and older in 2001, 2003 and 2012.

(a) Activities of Daily Living (ADL) limitation if reported difficulty performing one or more of the following: dressing, bathing, toileting, transferring into/out of bed, walking, eating.

(b) Instrumental Activities of Daily Living (IADL) limitation if reported difficulty performing one or more of the following: preparing a hot meal, shopping for groceries, taking medications, managing own money.

(c) WHO BMI classification available at: [http://apps.who.int/bmi/index.jsp?introPage=intro_3.html]. Underweight <18.50, normal weight 18.50–24.99, overweight 25.00–29.99, and obese >30.00.

Source: own calculations using data from the Mexican Health and Aging Study (MHAS).

lifestyles are well under way among older adults in the USA but not in Mexico. Likewise, a trend toward reduced levels of obesity has just begun among older adults in the USA but not in Mexico.^{28–30} Mexicans who migrate to the USA and stay until old age are self-selected for good health, in particular males who are found in Mexico as return migrants.^{31,32}

Because of poor housing and low levels of sanitation during their childhood, most of the older adults born in 1900–50 were exposed to infectious diseases associated with adult diseases. Research in this area confirmed the association between early-life and old-age chronic conditions.^{10–12} In addition, the usual health advantage associated with additional educational achievement seems to apply only to the highest educational groups in Mexico.^{33,34}

Main strengths and weaknesses

The MHAS offers a unique opportunity to examine ageing in developing countries. The study provides three waves of data focusing on ageing in Mexico that is highly comparable to the US Health and Retirement Study (HRS). The following are some unique features and main strengths of the study.

- Sample size and periods between waves. The long panel period from baseline to 2012 allows for full estimation of the transitions in physical and mental health, functionality, labour force and migration over time. Key among these is mortality. The cumulative number of deaths in the cohort, approximately 3200 by 2012, provides more than enough statistical power to study the association

between mortality and migration, physical and mental health and disability.

- Health sector reforms. The timing of the three waves permits the study of the impact of health reforms such as the introduction in 2003 of Seguro Popular (a health insurance system for the uninsured).²⁶
- Interaction of infectious and chronic conditions. The MHAS allows the study of the interaction of infectious and chronic conditions. The study includes information on early infections through self-reports of past diseases and of frequent late-life or current infections. In addition, the biomarkers included in 2012 complement the epidemiological profile by providing objective markers for malnutrition, for example.
- Consequences of international migration. The study allows the observation of the old-age consequences of international migration for the populations of both Mexico and the USA, by including both an over-sample in areas of historical high migration to the USA and details on migration history within the survey content.
- Cross-national comparisons of ageing processes. These comparisons are supported because the MHAS was designed after the US study; in addition, the HRS increased the size of the over-sample of Hispanics in 2010.
- Cohort effects. The combination of refreshment samples and additional observations over time permits the estimation of cohort effects.

How to access MHAS Data

All study databases and documentation can be accessed free of charge from the MHAS study website, a

user-friendly environment designed to enhance the use of and access to the study products. The platform is in English [www.MHASweb.org] and in Spanish [www.ENASEM.org]. The website also features a dynamic searchable database of publications using MHAS data and a discussion forum.

Funding

The first phase of MHAS (waves 1 and 2) was supported by a grant from the National Institutes of Health/National Institute on Aging [R01AG18016, B.J.S., PI]. The study was a collaborative effort of researchers from the Universities of Pennsylvania, Maryland and Wisconsin in the USA and the Instituto Nacional de Estadística, Geografía e Informática (INEGI) in Mexico.

The second phase of MHAS (waves 3 and 4) is supported by the National Institutes of Health/National Institute on Aging [R01AG018016, R.W., PI] and by the INEGI in Mexico. The new study is a collaborative effort from the University of Texas Medical Branch (UTMB), the Instituto Nacional de Estadística y Geografía (INEGI, Mexico), the University of Wisconsin, the Instituto Nacional de Geriátría (INGGer, Mexico) and the Instituto Nacional de Salud Pública (INSP, Mexico).

Acknowledgements

MHAS acknowledges infrastructure support from the Sealy Center on Aging and the WHO/PAHO Collaborating Center on Aging and Health, both at the University of Texas Medical Branch (UTMB). We also acknowledge the participation of the Instituto Nacional de Estadística y Geografía (INEGI, Mexico) and the Instituto Nacional de Salud Pública (INSP, Mexico) in particular for data collection, and the University of Wisconsin and the Instituto Nacional de Geriátría (INGGer, Mexico) in particular in the conceptual design of the study.

Conflict of interest: None declared.

References

- Wong R, Palloni A, Soldo B. Wealth in middle and old age in Mexico: the role of international migration. *Int Migr Rev* 2007; 41:127–51.
- Riosmena F, Gonzalez-Gonzalez C, Wong R. Recent returns from the United States: Health, wellbeing and vulnerability of older adults. *Coyuntura Demografica* 2012;23:1019–26.
- Gomes da Conceição M. Intergenerational exchanges in Mexico – types and intensity of support. *Curr Sociol* 2007;55:545–60.
- Antman F. Elderly care and intrafamily resource allocation when children migrate. *J Hum Resources* 2012;47:331–63.
- Wong R, Espinoza M. Ingreso y bienes de la población de edad media y avanzada en México. [Income and assets of population in middle- and old-age in Mexico.] *Papeles de Población* 2003;9: 129–66.
- González-González C, Samper-Ternent R, Wong R, Palloni A. Mortality inequality among older adults in Mexico: the combined role of infectious and chronic disease. *Rev Panam Salud Publica* 2014;35:89–95.
- Samper-Ternent R, Michaels-Obregon A, Wong R, Palloni A. Older adults under a mixed regime of infectious and chronic diseases. *Salud Publica Mex* 2012;54:487–95.
- Palloni A, Thomas JR. Estimation of covariate effects with current status data and differential mortality. *Demography* 2013; 50:521–44.
- Palloni A, Souza L. The fragility of the future and the tug of the past: longevity in Latin America and the Caribbean. *Demogr Res* 2013;29:543–78.
- Grimard F, Laszlo S, Lim W. Health, aging and childhood socioeconomic conditions in Mexico. *J Health Econ* 2012;29:630–40.
- Kohler I, Soldo B. Childhood predictors of late-life diabetes: the case of Mexico. *Soc Biol* 2005;52:112–31.
- Ruiz-Pantoja T, Ham-Chande R. Childhood health and social factors associated to elderly morbidity. *Salud Publica Mex* 2007; 49:495–504.
- Shamah-Levy T, Cuevas-Nasu L, Mundo-Rosas V *et al.* Estado de salud y nutrición de los adultos mayores en México: resultados de una encuesta probabilística nacional (Health and nutritional status of older adults in Mexico: results from a national probabilistic survey). *Salud Publica Mex* 2008;50:383–89.
- Palloni A, Pinto-Aguirre G, Pelaez M. Demographic and health conditions of ageing in Latin America and the Caribbean. *Int J Epidemiol* 2002;31:762–71.
- Brea J. Population dynamics in Latin America. *Popul Bull* 2003; 58:3–34.
- Preston S. *Mortality Patterns in National Populations*. New York, NY: Academic Press, 1976.
- Preston S. Causes and consequences of mortality decline in less developed countries during the XXth century. In: Easterlin RA (ed). *Population and Economic Change in Developing Countries*. Chicago, IL: Chicago University Press, 1980.
- Palloni A, Wyrick R. Mortality decline in Latin America: changes in the structure of causes of deaths: 1950–75. *Soc Biol* 1981;28:187–216.
- Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JW, Weir DR. Cohort profile: the Health and Retirement Study (HRS). *Int J Epidemiol* 2014;43:576–85.
- MHAS. *Mexican Health and Aging Study MHAS 2012 – Sample Design*. 2014. http://mhasweb.org/Resources/DOCUMENTS/2012/Methodological_Document_2012-SEC.pdf (12 February 2014, date last accessed).
- MHAS. *The Mexican Health and Aging Study: MHAS 2012 Data Files Description, Version 2*. 2013. <http://www.mhasweb.org> on (12 February 2014, date last accessed).
- Barquera S, Tovar-Guzman V, Campos-Nonato I, Gonzalez-Villalpando C, Rivera-Dommarco J. Geography of diabetes mellitus mortality in Mexico: an epidemiologic transition analysis. *Arch Med Res* 2003;34:407–14.
- Michaels-Obregón A, Mejía-Arango S, Wong R. *The Mexican Health and Aging Study: Cognitive Functioning Measures, Version 2*. 2014. [http://www.mhasweb.org/DiscussionForum/File%20Upload/Documents/Mexican%20Health%20and%20Aging%20Study%20\(MHAS\)%20-%20Cognition%20Battery%20\(v2\).pdf](http://www.mhasweb.org/DiscussionForum/File%20Upload/Documents/Mexican%20Health%20and%20Aging%20Study%20(MHAS)%20-%20Cognition%20Battery%20(v2).pdf) (10 July 2014, date last accessed).
- Glosser G, Wolfe N, Albert ML *et al.* Cross-cultural cognitive examination: validation of a dementia screening instrument for neuroepidemiological research. *J Am Geriatr Soc* 1993;41: 931–39.

25. Jorm A. A short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): development and cross-validation. *Psychol Med* 1994;24:145–53.
26. Knaul F, Frenk J. Health insurance in Mexico: achieving universal coverage through structural reform. *Health Aff (Millwood)* 2005;24:1467–76.
27. Markides KS, Salinas J, Sheffield K. The health of older immigrants. *Generations* 2009;32:46–52.
28. Angel R, Angel J, Hill T. A comparison of the health of older Hispanics in the United States and Mexico - methodological challenges. *J Aging Health* 2008;20:3–31.
29. Monteverde M, Noronha K, Palloni A, Novak B. Obesity and excess mortality among the elderly in the United States and Mexico. *Demography* 2012;47: 79–96.
30. Wong R, Ofstedal M, Yount K, Agree E. Unhealthy lifestyles among older adults: exploring transitions in Mexico and the US. *Eur J Ageing* 2008;5:311–26.
31. Crimmins E, Soldo B, Kim J, Alley D. Using anthropometric indicators for Mexicans in the United States and Mexico to understand the selection of migrants and the “Hispanic paradox”. *Soc Biol* 2005;52:164–77.
32. Palloni A, Arias E. Paradox lost: explaining the Hispanic adult mortality advantage. *Demography* 2004;41:385–415.
33. Smith K, Goldman N. Socioeconomic differences in health among older adults in Mexico. *Soc Sci Med* 2007;65:1372–85.
34. Wong R, Palloni A. Aging in Mexico and Latin America. In: Uhlenberg P (ed). *International Handbook of Population Aging*. New York, NY: Springer Publications, 2009.