Wong, Rebeca; Michaels-Obregón, Alejandra; Palloni, Alberto; Gutiérrez-Robledo, Luis Miguel;
González-González, César; López-Ortega, Mariana; Téllez-Rojo, Martha María; Mendoza-Alvarado,
Laura Rosario

Progression of aging in Mexico: the Mexican Health and Aging Study (MHAS) 2012

Progression of aging in Mexico: the Mexican Health and Aging Study (MHAS) 2012

Rebeca Wong, PhD,[1] Alejandra Michaels-Obregón, MS, MBA,[1] Alberto Palloni, PhD,[2]
Luis Miguel Gutiérrez-Robledo, MD, PhD,[3] César González-González, PhD,[3-5] Mariana López-Ortega, MPP, PhD,[3]
Martha María Téllez-Rojo, PhD,[6] Laura Rosario Mendoza-Alvarado, Lic TS.[7]

Abstract

Objective. To describe the third wave of the Mexican Health and Aging Study (MHAS), completed in 2012, and present preliminary results. **Materials and methods**. Descriptive analyses by gender and age group of demographic and socioeconomic characteristics, health conditions and health behaviors, as well as social support and life satisfaction measures are presented. In addition, external validations are presented by comparing MHAS 2012 indicators with other national data sources. **Results**. For the panel of older adults in the sample, the rate of health care insurance coverage increased greatly between 2001 and 2012, a significantly higher change in rural compared to urban areas. The results for 2012 are consistent with the previous two waves for the main indicators of health and physical disability prevalence, risk factors, and behaviors. **Conclusions**. The MHAS offers a unique opportunity to study aging in Mexico, as well as to complete cross-national comparisons. The cumulative number of deaths in the cohort should support the study of mortality and its association with health outcomes and behaviors

Resumen

Objetivo. Describir la tercera ronda del Estudio Nacional de Salud y Envejecimiento en México (Enasem), completada en 2012, y presentar algunos resultados preliminares. **Material y métodos**. Se presentan análisis descriptivos por género y grupo de edad, de las características demográficas y socioeconómicas, de las condiciones y comportamientos de salud, así como de las medidas de apoyo social y de satisfacción con la vida. Además, se presentan los resultados de validaciones externas realizadas comparando indicadores del Enasem 2012 con los de otras fuentes de datos nacionales. **Resultados**. Para el panel de los adultos mayores en la muestra, la tasa de cobertura de aseguramiento en salud aumentó considerablemente entre 2001 y 2012; el cambio fue significativamente mayor en zonas rurales en comparación con las urbanas. Los resultados de los principales indicadores de salud, prevalencia de la discapacidad física, factores de riesgo y comportamientos de salud son consistentes con los de las dos rondas anteriores. **Conclusiones**. El Enasem ofrece una oportunidad única para estudiar el envejecimiento

(1)   Sealy Center on Aging, WHO/PAHO Collaborating Center on Aging and Health, University of Texas Medical Branch. The United States.
(2)   Center for Demography and Ecology, University of Wisconsin. The United States.
(3)   Instituto Nacional de Geriatría. Mexico.
(4)   Instituto Nacional de Salud Pública. Mexico.
(5)   University of Texas Medical Branch. The United States.
(6)   Centro de Investigación en Nutrición y Salud, Instituto Nacional de Salud Pública. Mexico.
(7)   Centro de Investigación en Evaluación y Encuestas, Instituto Nacional de Salud Pública. Mexico.

over the life cycle. In addition, the sub-samples of objective markers will enable methodological research on self-reports and associations of biomarkers in old age with similar health outcomes and behaviors.

en México así como para realizar comparaciones entre países. El número acumulado de muertes en la cohorte permitirá un mejor estudio sobre mortalidad y las consecuencias en salud de los comportamientos a lo largo del ciclo de vida. Además, los marcadores objetivos en la submuestra permitirán el análisis metodológico de los autorreportes y de las asociaciones de los biomarcadores con los resultados y los comportamientos de salud en la vejez.

Key words: older adult; longitudinal studies; health; aging; Mexico

Palabras clave: adulto mayor; estudios longitudinales; salud; envejecimiento; México

All countries around the world are experiencing a rapid growth in the population of older adults; adults 60 years and older will be the largest group in the population age pyramid of most countries by 2050, a number reported to grow to 2 billion by 2050, surpassing the population of children 0 to 14 years old.[1,2]

The current relatively fast pace of aging in Latin America compared to that experienced by developed countries in the past is an inevitable consequence of the timing and pace of the demographic transition and the shift due to rapid mortality and fertility declines. In addition to this peculiarity, it is important to note that the decline of child and adult mortality rates in the developing countries was achieved mainly through successful adoption of health policies and medical technology.[3,4] Conversely, in developed countries that aged before, the transition occurred mainly by improving the standards of living in populations that already enjoyed high standards at the time that their aging process started. Another factor is that this fast pace of aging is taking place under insufficient economic development and institutional infrastructure. Aging is thus premature, given the level of economic development in Mexico, as in other developing countries. This set of unique features implies that we have a scientific opportunity to make original contributions to the study of aging by studying the population of countries like Mexico. The current cohorts of older adults in Mexico survived childhood conditions characterized by infectious diseases and generally low socioeconomic infrastructure. Future cohorts will be vastly different, having lived their infancy and adulthood with significant improvements in public health and education compared to the current cohorts of elderly. Thus, comparisons across birth cohorts over time will provide insights on how aging can proceed in rapidly changing societies in developing countries like Mexico.

The Mexican Health and Aging Study (MHAS) is the first longitudinal study of older adults in Mexico with a broad socioeconomic perspective.[5] The study was designed following the blueprints of the first longitudinal study of this kind, the Health and Retirement Study of the United States (HRS) that began in 1992,[6] while incorporating unique features relevant to the Mexican context and culture. Since the launch of the MHAS in 2001, more than 30 similar studies have been conducted in other countries including England,[7] China,[8] India, South Korea, Ireland,[9] Costa Rica, and other countries in Western Europe.

The MHAS primary objective is to collect information from a large representative panel of the Mexican population 50 years old and over to examine the aging process and its disease and disability burden using a wide socioeconomic perspective.[10] The MHAS was designed to prospectively evaluate the impact of disease on the health, function, and mortality of older adults in Mexico.

The study included a baseline survey in 2001 of a national representative sample in both rural and urban areas, of individuals born prior to 1951. The fieldwork was conducted by trained personnel from the *Instituto Nacional de Estadística y Geografía* (INEGI) in Mexico. The baseline sample was drawn from the National Employment Survey (*Encuesta Nacional de Empleo*, ENE), carried out by INEGI. Households with at least one resident aged 50 years or older were selected to be part of the sample; if more than one person was age-eligible, one was randomly selected. Also, if the selected subject was married or in a consensual union, with the spouse residing in the same household, the spouse or partner was also recruited for the study regardless of his/her age. Six states accounting for 40% of all migrants to the U.S. were over-sampled (ratio 1.7 to 1), and a random sub-sample was selected from which to obtain anthropometric measures. The second wave of the study took place in 2003, in which all study subjects from 2001 were followed up and new spouses were added to the study. During the follow-up interview, a next-of-kin interview on deceased study subjects was also completed. The thematic content of the MHAS survey instrument included: demographic data, household residents and children's rosters, self-reported health in several dimensions (chronic diseases, perceived global

health, physical function, cognition, depression), information on parents and children, help received from- and given to- children, institutional support, life satisfaction, time use, social support and social engagement, dwelling conditions, economic aspects such as health expenditures, health insurance coverage, pensions received or expected, income by sources, and the value of accumulated assets. Further details on the study can be found in Wong and colleagues.[11]

The third wave of the MHAS was conducted in 2012, consisting of a third follow-up interview to all age-eligible subjects from the 2001 and 2003 surveys. This wave added also a sample of people born in 1952-1961 (50 to 60 years old in 2012) to "refresh" the study sample, as well as their spouses/partners regardless of age. The new sample was drawn from the 2012 Mexican National Employment and Occupation Survey (ENOE, previously named National Employment Survey, ENE). The MHAS study protocol and instruments were approved by the Institutional Review Board or Ethics Committee of the University of Texas Medical Branch, the INEGI in Mexico, and the *Instituto Nacional de Salud Pública* (INSP) in Mexico. The MHAS thus far has obtained high response and follow-up rates.[11,12] A fourth wave of the MHAS will be collected in 2015.

The MHAS offers a unique opportunity to examine the dynamics of aging in Mexico. The sample size and the periods between waves allow for full estimation of the transitions in physical and mental health, functionality, labor force, and migration over time. In addition, the cumulative number of deaths over time provides enough statistical power to study the association between mortality, migration, physical and mental health, and disability. Also unique to the timing of the three waves is the ability to study the impact of health reforms such as the introduction of *Seguro Popular* in 2003.[13] Finally, also important to the longitudinal characteristics of the study is the possibility to estimate cohort effects thanks to the addition of younger-cohort samples over time. In the rest of the article, we summarize the third wave of the MHAS, completed in 2012, and present select basic results.

Materials and methods

The MHAS 2012 aimed to re-contact the 2001 and 2003 respondents and add a representative sample of the population from the 1952-1961 birth cohorts. In addition, similar to 2003, new spouses/partners of study subjects were added to the study regardless of age, and proxy and next-of-kin interviews were conducted when applicable. A new sub-sample was selected for the 2012 survey in order to collect anthropometric measures,

blood pressure readings, performance tests, and blood biomarkers. The fieldwork was completed once again by trained personnel of the INEGI. The sub-sample fieldwork was completed in collaboration with the INSP. During the 2012 survey 18 465 interviews were completed, including 12 569 follow-up and 5 896 new sample interviews. Of the total, 14 448 were direct, 1 275 were proxy interviews, and 2 742 were next-of-kin. Over the life of the panel, the cumulative number of reported deaths with next-of-kin interviews is 3 288. The response rate for the 2012 survey was 88.1% (i.e., interviews were obtained corresponding to 88.1% of target individuals, dead or alive). Also new to 2012 was that the survey was conducted using a new Computer Assisted Personal Interview (CAPI) system, as interviews were conducted with paper-and-pencil in the first two waves.[11]

To provide an overview of the population 50 years and older in 2012, we begin our analyses with descriptions of a selection of demographic and socioeconomic characteristics, self-reported health conditions and health behaviors, as well as social support and satisfaction items. We then conduct a brief external survey validation of MHAS 2012 by comparing indicators with the 2010 Census[14] and the National Health and Nutrition Survey (*Encuesta Nacional de Salud y Nutrición*, Ensanut) 2012.[15] Both the descriptions and the survey validation results are weighted statistics using individual sampling weights.

Results

Demographic and socioeconomic characteristics

Table I provides descriptive statistics by gender and by age group (50-59 and 60 years and older). As in previous waves of the study, the findings reflect greater survival of women compared to men and a tendency for women to remain without a partner in old age. The mean age was relatively higher for men compared to women (67.8 versus 66.4 years). For both genders, approximately 8% of the population 50 and older was aged 80+. Regarding marital status, a higher percentage of women than men reported being single, widowed, divorced, or separated: 41.1% of women compared to 18.6% of men.

The mean years of education was higher for men (7.8 years) than for women (7.0 years); 10.5% of women reported having no formal education compared to 9% of men. Despite the consistent higher level of educational achievement for men compared to women, the education gap by gender is closing as reflected by comparisons of the younger cohort (ages 50-59) with the older cohort (ages 60+). Regarding employment status,

Table I
DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS.
MEXICO, MEXICAN HEALTH AND AGING STUDY, 2012*

	Males			Females		
	Total %	50-59	60+	Total %	50-59	60+
		%, Mean (SD)	%, Mean (SD)	%, Mean (SD)	%, Mean (SD)	%, Mean (SD)
Age	67.75 (41.33)	-	-	66.44 (37.98)	-	-
50-59	43.3	100	-	46.4	100	-
60-69	32.3	-	56.9	30.1	-	56.2
70-79	16.3	-	28.7	15.8	-	29.4
80+	8.2	-	14.4	7.7	-	14.4
Marital status						
Married, union	81.4	84.5	79.0	58.9	68.8	50.3
Single, divorced, separated	10.6	13.8	8.2	18.7	22.4	15.5
Widowed	8.0	1.7	12.8	22.4	8.8	34.2
Education	7.84 (5.87)	8.26 (5.18)	6.90 (7.11)	6.96 (6.07)	7.25 (6.03)	5.61 (6.11)
0 years	9.0	6.0	16.5	10.5	9.1	17.2
1-5 years	24.1	23.4	25.9	23.6	23.1	25.7
6 years	23.6	23.5	23.7	24.5	25.6	19.3
7 years or more	43.4	47.1	33.8	41.4	42.1	37.9
Locality size (population)						
100 000+	46.7	49.7	44.4	49.4	51.7	47.3
15 000-100 000	14.5	15.9	13.4	14.2	14.8	13.8
2 500-15 000	13.7	13.8	13.7	13.7	13.5	13.8
<2 500	25.2	20.6	28.6	22.7	20.0	25.0
Migration						
Ever migrant to the US	14.8	14.5	15.0	3.5	3.0	3.9
Number of children						
Number of children (alive)	4.68 (3.01)	3.77 (2.60)	5.37 (2.89)	4.63 (2.63)	3.78 (1.96)	5.37 (2.89)
Employment						
Currently works	68.5	88.5	52.3	27.2	40.2	16.4
Is looking for job	2.1	2.8	1.5	0.6	1.1	0.3
Household work	1.4	1.2	1.6	57.4	53.0	61.1
Doesn't work	27.9	7.4	44.5	14.7	5.7	22.3
Health insurance						
Social security (IMSS)	33.5	30.8	35.5	34.1	31.4	36.5
ISSSTE/ State ISSSTE	10.6	10.3	10.8	11.7	11.0	12.3
Seguro Popular	31.3	31.7	31.0	32.5	34.1	31.1
Pemex/Defensa/Marina	1.8	1.1	2.3	2.5	3.4	1.7
Private medical insurance	3.7	4.4	3.2	3.2	3.8	2.7
Other	2.3	2.9	1.9	2.3	3.0	1.8
None	16.9	18.8	15.4	13.7	13.4	14.0
Other benefits						
Social security (IMSS)	30.4	39.9	23.1	15.9	25.6	7.4
ISSSTE	6.5	8.5	4.9	4.7	7.6	2.3
SAR (Saving for retirement)	22.4	29.6	16.9	11.9	19.0	5.8
Accounts in "afores"	22.6	30.6	16.6	11.8	18.7	5.9
Housing credit	23.5	31.7	17.3	14.5	23.6	6.6
Private health insurance/ Insurance for medical expenses	8.5	11.0	6.6	3.0	5.4	1.0
Life insurance	14.7	20.2	10.4	7.6	11.2	4.5
Other	2.9	5.0	1.4	1.2	2.0	0.5
No other benefit	59.4	47.0	68.8	78.6	65.5	89.9
Total sample (n)	6 465	1 800	4 665	8 432	2 902	5 530

* Weighted averages and percentages
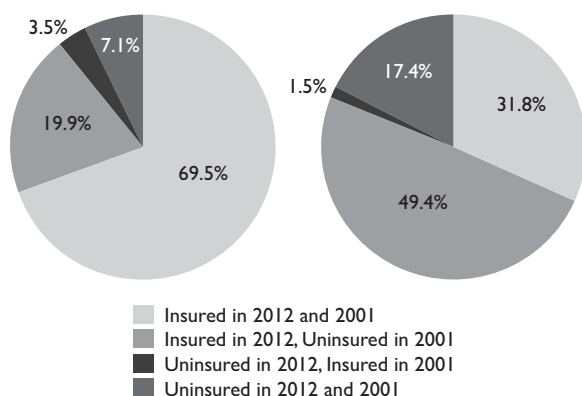
Source: Reference 5

ISSSTE: Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado
IMSS: Instituto Mexicano del Seguro Social

57.4% of women were engaged in household work and 68.5% of men reported to work. The percentage of men 50 years and older who ever migrated (to live or work) to the US was significantly higher compared to women (14.8 versus 3.5%). This result is very similar to the one obtained in 2001 with the baseline MHAS.[16,17]

Compared to the health insurance coverage reported in 2001, the 2012 data confirmed a significant increase in insurance coverage among adults, particularly in rural areas. Figure 1 illustrates the insurance changes by locality size between 2001 and 2012. Of the total *rural* population aged 50 and older in 2001, almost one-half (49.9%) were uninsured in 2001 but had insurance by 2012. This gain was relatively lower in *urban* areas (19.9%). The rise in insurance coverage by 2012 is mainly explained by the introduction of the *Seguro Popular* around 2003, a social protection policy designed to provide access to health services to the population who lacked other public or private health care coverage, a measure which had higher impact in rural areas.[13] In 2001, 49.3% of men and 45.1% of women had no health insurance coverage.[18,19] In 2012, only 16.9% of men and 13.7% of women reported having no insurance (table I).

* Weighted percentages using only follow-up sample. Results presented by locality size in 2012

Source: reference 5

Figure 1. Insurance status in the MHAS panel in 2001 and 2012 by locality size*

Health conditions

Table II provides descriptive statistics of health conditions and health behaviors by gender and for two age groups (50-59 and 60 years and older) in 2012. High percentages of the population reported poor or fair global health status: 57.1% of men and 67.5% of women. These results

are consistent to those obtained with the MHAS 2001 cross-section, where 57.6% of men and 67.9% of women of comparable ages reported poor and fair health status.[20]

Table II indicates also that the self-report of chronic health conditions was higher for the older age group (60 years and older) compared to the younger counterparts. These self-reports were based on answers to the question "has a doctor or medical personnel ever told you that you have…" for each condition. These age differences held for hypertension, diabetes, lung disease, heart attack, stroke, and arthritis. One exception is self-reported cancer among women (those aged 50-59 have similarly low rates as do women aged 60+). In addition, the self-report of chronic diseases was consistently higher among women compared to men, with two exceptions: in the older age group, more men than women self-reported having had a heart attack or stroke.

Physical disability

We used the functional dependence definition to capture the concept of disability, traditionally measured through surveys with self-reports on the ability to conduct the basic activities of daily living (ADL) without help.[21] We focus on six basic ADLs: bathing, toileting, transferring into and out of bed, walking, dressing, and eating. We collapsed the number of disabilities into categories to facilitate analysis: no ADLs, one ADL, two ADLs, and three or more ADLs. Women reported more often than men having difficulty with the six daily tasks. Results also show that, with age, the percentage of men and women reporting difficulty with ADLs was higher, especially in the subgroup of women 60 and older.

As for the instrumental activities of daily living (IADL), we included four IADL: preparing a hot meal, shopping for groceries, taking medication, and managing own money. The 2012 results indicate that women consistently had more difficulty than men with most of the IADL, despite their being closely tied to activities that are commonplace for women throughout their life. Men reported higher percentage of limitations only in "preparing a hot meal", which can be due to their life history, cultural practices, and the historical division of labor between men and women in Mexico.

Risk factors: body mass index and tobacco smoking

We used body mass index (BMI), which was calculated by dividing self-reported weight (kilograms) by self-reported height (meters) squared.[22,23] For the descriptive analysis, we grouped BMI using the World

Table II
HEALTH CONDITIONS AND BEHAVIORS. MEXICO, MEXICAN HEALTH AND AGING STUDY, 2012*

	Males			Females		
	Total	50-59	60+	Total	50-59	60+
	%, Mean (SD)	%, Mean (SD)	%, Mean (SD)	%, Mean (SD)	%, Mean (SD)	%, Mean (SD)
Self reported health						
Excellent	3.0	3.1	2.9	2.9	3.5	2.3
Very good	5.9	7.9	4.3	2.8	3.2	2.4
Good	34.0	39.9	29.5	26.8	29.6	24.4
Fair	47.5	44.5	49.9	52.4	52.9	52.0
Poor	9.6	4.7	13.4	15.1	10.9	18.9
Health conditions						
Hypertension	15.5	11.1	18.8	21.9	17.2	26.0
Diabetes	16.8	14.1	18.9	21.8	18.6	24.6
Cancer	1.1	0.2	1.7	2.4	2.8	2.0
Lung disease	4.2	3.6	4.7	5.9	5.7	6.1
Heart attack	3.5	1.4	5.1	2.7	2.1	3.1
Stroke	2.7	1.9	3.3	1.8	1.6	2.0
Arthritis	7.7	4.5	10.1	17.1	12.4	21.2
Disability						
Number of ADL limitations						
0	89.2	94.7	85.0	82.3	88.4	76.7
1	6.4	3.4	8.7	9.9	7.3	12.2
2	2.0	1.2	2.7	3.1	1.2	4.8
3 or more	2.4	0.7	3.6	4.8	3.1	6.3
Number of IADL limitations						
0	85.9	92.8	80.6	86.2	91.2	81.6
1	8.0	4.2	11.0	6.9	4.5	9.0
2	3.2	2.0	4.1	1.7	0.8	2.5
3 or more	2.9	1.0	4.3	5.2	3.5	6.8
Body mass index	26.90 (4.31)	27.58 (4.31)	26.63 (4.29)	27.88 (5.43)	28.55 (5.35)	27.51 (5.44)
Underweight	1.1	0.3	1.8	1.6	0.4	2.6
Normal weight	32.1	26.5	36.6	31.9	29.8	33.8
Overweight	44.6	45.5	43.8	39.9	41.4	38.4
Obese	22.3	27.7	17.8	26.7	28.3	25.2
Health behaviors						
Ever smoked	60.0	59.5	60.4	20.7	24.6	17.2
Current smoker	20.6	22.8	19.0	8.0	12.0	4.5
Total sample (n)	6 465	1 800	4 665	8 432	2 902	5 530

* Weighted averages and percentages

Source: Reference 5

ADL: activities of daily living
IADL: instrumental activities of daily living

Health Organization cut-off points[24] into the following categories: <18.5=underweight, 18.5-24.9=normal, 25-29.9=overweight, and >30=obese. The mean BMI was higher for women compared to men; this result is also observed across age groups. The percentage of obesity was significantly higher for women than for men (26.7 versus 22.3%). However, the combined percentage of obese and overweight men was 66.9%, a result similar to that for women (66.6%).

Respondents were asked if they were "current tobacco smokers". The 2012 results (table II) confirmed that cigarette smoking was more prevalent among males (20.6%) than females (8.0%).[25] The difference in smoking prevalence between men and women was higher in the 60 years and older cohort compared to the younger cohort, reflecting an increasing propensity to smoke among younger women (12%) compared to older women (4.5%).

Social support and satisfaction

An important addition introduced in MHAS 2012 was the inclusion of several psychosocial measures. Table III shows results for the main measures of the new section, including health care decisions and life satisfaction.

A majority of both men and women (84-89%) perceived that they had a lot of power over personal health decisions. In addition, both men and women indicated a strong preference for making final decisions regarding personal health, either by themselves (55-59%) or with their doctor and family (30-38). Only 11.4% of men and 8.3% of women would leave the decisions to the doctor only. Finally, the results indicate higher life satisfaction among men compared to women. While 71.4% of men believed their life was close to ideal, 67.8% of women

agreed with this statement. This result was similar for the statement "conditions of life are excellent", "satisfied with life", and "got things that are important". In general, life satisfaction seemed similar or slightly higher for older (aged 60+) adults compared to the younger cohort (age 50-59).

External survey validation

Table IV provides the results of the survey validation exercise comparing indicators of MHAS 2012 with the 2012 Ensanut, for both age cohorts 50-59 years and 60 years and older. Despite the differences found across studies, the validation exercise revealed satisfactory comparisons. We present only a selection of measures that were comparable across the two data sources.

Table III
SOCIAL SUPPORT AND SATISFACTION. MEXICO, MEXICAN HEALTH AND AGING STUDY, 2012*

	Males			Females		
	Total %	50-59 %	60+ %	Total %	50-59 %	60+ %
Health decisions						
Perception of power over personal health decision						
A lot	86.2	89.0	84.0	87.4	89.1	85.8
Little	13.1	10.5	15.0	11.8	10.3	13.2
Not at all	0.7	0.4	1.0	0.8	0.6	1.0
Preferences over who makes final decision over personal health						
Individual or his/her family	57.9	56.0	59.4	55.5	54.5	56.4
Between the doctor, individual and family	30.7	30.1	31.1	36.2	37.7	34.8
Doctor	11.4	13.9	9.5	8.3	7.8	8.8
Life satisfaction						
Life is close to ideal						
Agree	71.4	70.6	72.0	67.8	65.7	69.8
Neutral	17.0	15.7	18.0	18.9	18.6	19.1
Disagree	11.6	13.7	10.0	13.3	15.7	11.1
Conditions of life are excellent						
Agree	59.8	59.4	60.1	54.6	51.0	58.0
Neutral	28.1	27.2	28.7	27.7	29.0	26.6
Disagree	12.1	13.4	11.2	17.7	20.0	15.5
Satisfied with life						
Agree	83.7	80.8	85.9	79.8	77.2	82.1
Neutral	10.7	11.0	10.4	11.9	11.8	12.0
Disagree	5.7	8.2	3.7	8.4	11.0	5.9
Got things that are important						
Agree	79.6	80.3	79.1	78.0	78.3	77.8
Neutral	14.0	13.2	14.6	14.1	12.5	15.5
Disagree	6.4	6.5	6.3	7.9	9.2	6.7
Would change almost nothing from life						
Agree	64.4	61.6	66.6	61.5	59.0	63.8
Neutral	18.1	19.9	16.7	16.7	14.8	18.5
Disagree	17.5	18.5	16.7	21.8	26.2	17.7
Total sample (n)	6 465	1 800	4 665	8 432	2 902	5 530

* Weighted averages and percentages

Source: Reference 5

Regarding chronic health conditions, the prevalence reported in Ensanut was close to that obtained with the MHAS for diabetes, heart attack, and stroke. The most noticeable difference was hypertension, which was almost 11% age points higher for adults aged 50 to 59 years in Ensanut and 17 percentage points higher among adults 60 years and older in Ensanut compared to MHAS. The employment status statistics also differed across studies; both studies showed similar percentages of older adults currently working, but larger differences for other categories: household

work, doesn't work, and other. Finally, the results for BMI measures were quite similar across the two studies. The mean BMI for the younger cohort in Ensanut was 29.5 (standard deviation 5.4) compared to 27.8 (standard deviation 4.9) in MHAS. For the older age group, the mean BMI was 26.9 in MHAS compared to 27.9 in Ensanut. In terms of average weight and height, the two studies yielded close measures. For example, average weight for MHAS (ages 50-59) was 71.7 kilos compared to 73.1 kilos in Ensanut. Regarding these comparisons, it is important to note that height and

Table IV
MHAS 2012 external survey validation: comparisons with Ensanut 2012. Mexico

	MHAS 2012*		Ensanut 2012	
	50-59 %, Mean (SD)	60+ %, Mean (SD)	50-59 %, Mean (SD)	60+ %, Mean (SD)
Health conditions				
Diabetes	16.57	21.83	19.24	24.23
Hypertension	14.47	22.5	25.45	39.85
Heart attack	1.80	4.08	2.22	5.22
Stroke	1.74	2.63	1.97	3.65
Health behaviors				
Current smoker	21.07	14.83	21.76	12.21
Anthropometrics‡				
Body mass index (BMI)	27.83 (4.86)	26.86 (4.92)	29.48 (5.41)	27.93(5.09)
Underweight	0.36	2.19	0.52	1.5
Normal weight	28.29	35.19	18.24	28.2
Overweight	43.32	41.12	42.33	40.2
Obese	28.03	21.51	38.91	30.0
Weight (kg)	71.69 (13.59)	68.12 (13.62)	73.07 (14.63)	66.60 (14.36)
Height (cm)	160.64 (9.20)	159.28 (9.88)	157.36 (9.22)	154.48 (9.88)
Health insurance	85.39	88.32	79.6	83.42
Seguro social (IMSS)	31.13	36.00	35.22	40.82
ISSSTE/ State ISSSTE	10.68	11.58	9.99	10.18
Seguro Popular	32.98	31.04	31.68	29.81
Pemex/Sedena/Semar	2.35	1.98	1.4	1.53
Private medical insurance	4.10	2.92	0.49	0.32
Other	2.93	1.84	0.60	0.59
None	15.83	14.65	20.4	16.58
Employment				
Currently works	58.25	30.55	56.01	25.98
Is looking for job	1.75	0.78	2.8	1.31
Household work	27.55	30.62	32.12	39.32
Doesn't work	6.40	30.94	5.1	16.93
Other	6.05	7.11	3.97	16.46
Total sample (n)	4 702	10 195	6 813	8 894

* Weighted averages and percentages
‡ The BMI results for MHAS are based on self-reported height and weight, while the Ensanut indicators are based on objective measurements of height and weight

Source: References 5 and 15

ISSSTE: Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado
IMSS: Instituto Mexicano del Seguro Social

weight measures were self-reported in MHAS and objective measures used in Ensanut.

In addition, the external validation exercise included a comparison of the MHAS 2012 with the 2010 Census (results not shown). The exercise focused on gender, age, and marital status statistics. Overall we found no major discrepancies. For example, for Mexican adults aged 60 and older, while according to the Census 53.5% of the population was female, the percentage is 54.9 in the MHAS. Also, the mean age was 69.9 in the MHAS, while in the Census the mean was 70.8. Finally, regarding marital status, the MHAS reported that 64.1% were married or in union versus 59.6% in the Census. Some of these differences could be explained by the 2-year difference between the collection of the Census data and the MHAS.

Objective markers sub-sample

Most health conditions in the survey are measured with self-reports from the respondents. However, limited contact with the health system could lead to under-detection and under-report of major chronic conditions and could therefore influence self-report.[26] Thus, for MHAS 2012, a sub-sample was selected for additional data collection to foster research that takes into account the possible bias introduced by self-reports.

The objective markers collected included anthropometric measures (weight, height, waist, hip and calf circumference, knee length), timed one-leg stands, blood pressure readings, and performance tests (grip strength and timed walk). Blood samples were taken to obtain the following biomarkers with venous blood: C-reactive protein (CRP), a biomarker related to immune system function, a common marker of inflammation and infection; total and high-density lipoprotein (HDL) cholesterol, recognized risk factors for cardiovascular disease; thyroid-stimulating hormone (TSH), a biomarker used to diagnose a thyroid disorder; and vitamin D, a common antioxidant. In addition, markers of anemia and diabetes –hemoglobin and glycosylated hemoglobin (HbA1c) tests– were completed with capillary blood. The combination of the anthropometric measures such as waist to hip ratios, and biomarkers, including glucose, blood pressure and lipids, will help researchers assess the extent to which this population has metabolic syndrome. Also, some biomarkers, such as CRP, in combination with anthropometric assessment, such as leg length, can be used to assess the validity of conjectures linking early exposure and adult disease. These biomarkers were selected because they addressed important research concerns for the Mexican population and because the blood tests require no fasting and are stable tests given that the blood samples

were obtained in households distributed across urban and rural areas.

The sub-sample was limited to four states to maximize the standardization of collection procedures. The sub-sample included the full sample of completed direct interviews in four selected states (n=2 086), including a relatively poor state, a highly urban state, a high US-migration state and a high-diabetes state. The health visit for this sub-sample was completed by trained INSP personnel about 1-2 weeks after the main MHAS survey interview conducted by INEGI. The blood was centrifuged, covered, and stored in special refrigeration containers, and shipped to the INSP laboratories in Cuernavaca, Mexico.

Table V provides select results comparing the sub-sample for objective markers with the rest of the interviewed sample (including proxy interviews). In general, the findings indicate no significant differences between the two groups in demographic and health characteristics. However, while the mean age of the sub-sample was 62.1 years, it was 64.7 for the rest of the sample; the age difference was significant (*p*-value=0.000). Also, participants from the sub-sample were slightly more likely to report fair or poor health compared to the rest of the sample (63.3% compared to 61.2%, *p*-value=0.002). On the other hand, the results did not indicate significant gender or rural/urban location differences, or differences in main self-reported health conditions such as diabetes, high blood pressure, or self-reported BMI.

Discussion

The MHAS is a national longitudinal study that includes adults aged 50 and older, to examine the aging process in populations that survived infectious diseases during their childhood, with large socioeconomic disparities and low institutional support over their life cycle. Support of both the family and the social network are particularly important for old-age security and care in this context. Thus, databases that support these areas of research provide valuable information to inform the design of policies and to examine the impact of reforms addressing the needs of the rapidly aging population of countries like Mexico. With wave 1 as the baseline in 2001 and the completion of wave 3 in 2012, the MHAS established itself as a powerful analytical tool, a longitudinal study of older adults that spans 11 years. The study design follows a life course approach for the study of health and its trajectory over time among older adults, and now the analysis of mortality is statistically powered in the MHAS as well. As with all longitudinal studies, the losses to follow-up represent an important limitation for researchers.[27,28] Despite the relatively high

Table V

MHAS 2012 CHARACTERISTICS OF SUB-SAMPLE COMPARED TO THE REST OF THE SAMPLE.* MEXICO

	Sub-sample‡ %, Mean (SD)	Rest of sample %, Mean (SD)	p-values§ %, Mean (SD)
Age	62.13 (10.61)	64.67 (10.76)	0.000
Gender			
Male	43.47	45.35	
Female	56.53	54.65	0.077
Size of location			
100 000+ people	52.70	46.58	
15 000-99 999	11.36	15.00	
2 500-14 999	11.54	14.43	0.748
<2 500	24.39	23.98	
Self-reported health			
Excellent	1.37	3.57	
Very good	3.05	4.59	
Good	32.27	30.65	0.002
Fair	51.66	49.04	
Poor	11.65	12.14	
Self-reported diabetes			
Yes	17.96	18.97	0.213
Self-reported high blood pressure			
Yes	17.07	18.50	0.148
Body mass index			
Self-reported	27.48 (4.93)	27.50 (5.02)	0.868
Measured (sub-sample only)	28.89 (5.28)	-	-
Total sample	2 086	13 673	

* Percentages, mean, and standard deviations are weighted statistics; sample sizes may vary due to missing values

‡ Sub-sample refers to the sub-sample that was selected for objective measures (anthropometrics, blood pressure, performance measures, and blood samples). The rest of sample refers to those that were not selected for objective measures

§ p-values indicate significance of the difference across the two sample groups using Chi-squared tests for categorical variables and T-tests for continuous variables

Source: Reference 5

response rates that the MHAS has enjoyed, researchers using the data need to understand the consequences and possible biases introduced by losses when conducting longitudinal analyses with the MHAS. Another area to consider is item non-response and the nature of the data collection, based mostly on self-reports by the target individuals. In this regard, the sub-samples in which objective measures were gathered in each wave of the study have the main purpose of supporting methodological enquires about issues such as self-report, by enabling the comparison of self-reported data with the objective measures (anthropometric measures, performance tests, and blood samples). While the sub-samples are not representative of the national population, they enable studies of associations and covariates.

In conclusion, the MHAS 2012 wave, with the companion 2001 and 2003 waves, offers a unique opportunity to examine the dynamics of aging in Mexico and more generally in developing societies that are aging fast, enabling cross-national comparisons with similar studies such as the Health and Retirement Study in the United States.*

Acknowledgments

References

1. Mirkin B, Weinberger M. The demography of population ageing. United Nations Population Bulletin, special Issue Nos. 42/43, 2001. [online document]. [accessed: October 2014]. Available at: http://www.un.org/esa/population/publications/bulletin42_43/weinbergermirkin.pdf
2. Shamah-Levy T, Cuevas-Nasu L, Mundo-Rosas V, Morales-Ruán C, Cervantes-Turrubiates L, Villalpando-Hernández S. Estado de salud y nutrición de los adultos mayores en México: resultados de una encuesta probabilística nacional. Salud Publica Mex 2008;50:383-389.

* The MHAS study databases and documentation can be accessed free-of-charge from the MHAS study website, a platform both in English (www.mhasweb.org) and in Spanish (www.enasem.org). The website is a user-friendly environment designed to enhance the usability of the data files and enhance access to the study products, including a searchable database of publications using MHAS data and a Discussion Forum for questions and answers from users of the data.[5]

3. Palloni A, Pinto-Aguirre G, Pelaez M. Demographic and health conditions of ageing in Latin America and the Caribbean. Int J Epidemiol 2002;31:762-771.

4. Wong R, Palloni A. Aging in Mexico and Latin America. In: Uhlenberg P, ed. International handbook of population aging. Netherlands: Springer, 2009:231-252.

5. MHAS. Mexican Health and Aging Study (MHAS) 2012 Data files [online files]. December 2013 [accesed: October 2014]. Available at: www.MHASweb.org

6. Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JWR, Weir DR. Cohort profile: the Health and Retirement Study (HRS). Int J Epidemiol 2014;43:576-585.

7. Steptoe A, Breeze E, Banks J, Nazroo J. Cohort profile: the English Longitudinal Study of Ageing. Int J Epidemiol 2013;42:1640-1648.

8. Zhao Y, Hu Y, Smith JP, Strauss J, Yang G. Cohort profile: the China Health and Retirement Longitudinal Study (CHARLS). Int J Epidemiol 2014;43:61-68.

9. Kearney PM, Cronin H, O'Regan C, Kamiya Y, Savva GM, Whelan B, Kenny R. Cohort profile: the Irish Longitudinal Study on Ageing. Int J Epidemiol 2011;40:877-884.

10. Wong R, Espinoza M, Palloni A. Mexican older adults with a wide socioeconomic perspective: health and aging. Salud Publica Mex 2007;49:s436-s447.

11. Wong R, Michaels-Obregon A, Palloni A. Cohort profile: the Mexican Health and Aging Study (MHAS). Int J Epidemiol. First published online: January 27, 2005. doi: 10.1093/ijeldyu263

12. MHAS. Mexican Health and Aging Study (MHAS) 2012 - Sample design [online document]. [Accessed: October, 2014]. Available at: http://mhasweb.org/Resources/DOCUMENTS/2012/Methodological_Document_2012–SEC.pdf

13. Knaul FM, Frenk J. Health insurance in Mexico: achieving universal coverage through structural reform. Health Aff 2005;24:1467-1476.

14. Instituto Nacional de Estadística y Geografía (Inegi) [online files]. Censo de Población y Vivienda 2010 [accessed: October 2014]. Available at: http://www.inegi.org.mx.

15. Instituto Nacional de Salud Pública (INSP) [online files]. Encuesta Nacional de Salud y Nutrición 2012 [accessed: October 2014]. Available at: http://ensanut.insp.mx.

16. Riosmena F, Wong R, Palloni A. Migration selection, protection and acculturation in health: a binational perspective on older adults. Demography 2013;50:1039-1064.

17. Riosmena F, Gonzalez-Gonzalez C, Wong R. Recent returns from the United States: health, wellbeing and vulnerability of older adults. Coyuntura Demografica 2012;2:63-67.

18. Pagan JA, Puig A, Soldo BJ. Health insurance coverage and the use of preventive services. Health Econ 2007;12:1359-1369.

19. Wong R, Diaz JJ, Higgins M. Health care use among elderly Mexicans in the United States and Mexico the role of health insurance. Res Aging 2006;28:393-408.

20. Wong R. La relación entre salud y nivel socioeconómico entre adultos mayores: diferencias por género. En: Envejeciendo en la pobreza: género, salud y calidad de vida. Mexico: INSP, 2003:97-122.

21. Katz S, Ford A, Moskowitz R, Jackson B, Jaffe M. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. JAMA 1963;185:914-919.

22. Avila-Funes JA, Gutierrez-Robledo LM, Ponce de Leon-Rosales S. Validity of height and weight self-report in Mexican adults: results from the National Health and Aging Study. J Nutr Health Aging 2004;8:355-361.

23. Ruiz-Arregui L, Castillo-Martinez L, Orea-Tejeda A, Mejia-Arango S, Miguel-Jaimes A. Prevalence of self-reported overweight-obesity and its association with socioeconomic and health factors among older Mexican adults. Salud Publica Mex 2007;49:s482-s487.

24. World Health Organization. Body mass index - BMI classification 2006 [online document]. [accessed: February, 2015]. Available at: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

25. Wong R, Ostedal MB, Yount K, Agree EM. Unhealthy lifestyles among older adults: exploring transitions in Mexico and the US. Eur J Ageing 2008;5:311-326.

26. Angel RJ, Angel JL, Hill TD. A comparison of the health of older Hispanics in the United States and Mexico methodological challenges. J Aging Health 2008;20:3-31.

27. Ferraro KF, Kelley-Moore JA. A half century of longitudinal methods in social gerontology: evidence of change in the journal. J Gerontol B Psychol Sci Soc Sci 2003;58:s264-s270.

28. Marcellus L. Are we missing anything? Pursuing research on attrition. Can J Nurs Res 2004;36:82-98.