A life course approach to mortality in Mexico

Joseph L Saenz, BS,[1,2] Rebeca Wong, PhD.[1,2]

Saenz JL, Wong R.
A life course approach to mortality in Mexico.
Salud Publica Mex 2015;57 suppl 1:S46-S53.

Abstract

Objective. Research on early life socioeconomic status (SES), education and mortality is less established in developing countries. This analysis aims to determine how SES and education are patterned across the life course and associated with adult mortality in Mexico. **Materials and methods.** Data comes from 2001-2012 Mexican Health & Aging Study (Mexican adults age 50+, n=11 222). Cox proportional hazard models predict mortality using baseline covariates. **Results.** In unadjusted analyses, similar mortality was seen across levels of early life SES. Lower early life SES was associated with better survival after accounting for education in the younger cohort. Lower education was only associated with mortality in the younger cohort. **Conclusions.** Early life SES was associated with education but the relationship between education and mortality differed across cohorts in Mexico. Selective survival and differential returns to education may explain differences.

Key words: life-course; early life; education; mortality; Mexico

Saenz JL, Wong R.
Un enfoque de ciclo de vida para la mortalidad en México.
Salud Publica Mex 2015;57 supl 1:S46-S53.

Resumen

Objetivo. Determinar cómo el estatus socioeconómico (ES) en la vida temprana y la educación alcanzada están asociados con la mortalidad adulta en México. **Material y métodos.** Se usaron datos longitudinales del Estudio Nacional de Salud y Envejecimiento en México 2001-2012 sobre adultos de 50 años o más (n=11 222), por cohortes de edad. Para predecir la mortalidad, se utilizaron modelos proporcionales de Cox con covariables en la encuesta basal. **Resultados.** Con datos no ajustados, la mortalidad resultó similar entre niveles de ES en la vida temprana. Después de ajustarlos por educación, se encontró que un bajo ES en la vida temprana está asociado con baja mortalidad y que la educación predice mortalidad solamente en las cohortes de edad joven. **Conclusiones.** El ES temprano está asociado con la educación alcanzada, pero la relación entre educación y mortalidad difiere por cohortes de adultos mayores en México. La selectividad en sobrevivencia y el beneficio diferencial de la educación pueden explicar las diferencias identificadas entre cohortes de edad.

Palabras clave: educación; mortalidad; México

(1) Department of Preventive Medicine and Community Health, University of Texas Medical Branch. Galveston, Texas, USA.
(2) Sealy Center on Aging, University of Texas Medical Branch. Galveston, Texas, USA.

Received on: November 27, 2013 • **Accepted on:** July 16, 2014
Corresponding author: Joseph L Saenz. Preventive Medicine and Community Health, University of Texas Medical Branch.
301 University Boulevard. 77555 Galveston, Texas, USA.
E-mail: jlsaenz@utmb.edu.

While much research has addressed the relationship between adulthood socioeconomic status (SES) and health outcomes, less of it has examined how early life risk factors, including SES and education, shape late life outcomes and even less research has done so in developing countries such as Mexico. Indeed, aging is a lifelong process which, as Kierkegaard once stated "can only be understood backwards, but... lived forwards".[1] Understanding late life health often necessitates the use of a life course perspective. Conditions throughout the course of life can shape exposure to later risk factors and many factors including early life SES, education, migration and employment are patterned across the life course. Previous research has shown early life SES to be associated with health conditions, including mental health,[2] coronary heart disease,[3] mortality from stroke events,[4] and cardiovascular diseases and related risk factors.[5] Applying a life course perspective to the study of late life health outcomes is an important step towards understanding population aging.

The relationship between early life SES and mortality has frequently been addressed[6-14] in developed countries. Many studies acknowledge the importance of mediating variables which may connect early life exposures to late life outcomes[15] and have noted the need to examine education as a mediating variable, as education is an important risk factor for mortality in multiple countries.[16] Given the well-established relationship between education and mortality, one cannot describe the relationship between early life SES and mortality without considering the role of educational achievement. However, research on the relationships between early life SES, education and mortality are not common in developing countries.

While SES and mortality are consistently associated in developed countries, research on SES and mortality in developing countries is infrequent and conflicting. Research in Taiwan has demonstrated lower mortality among the higher educated.[17] Additionally, research in China has shown marginally significant associations between early life SES and late life mortality and significant associations between higher education and lower mortality.[18] Previous research in Wuhan, China, had found similar education and mortality trends.[19] Finally, Costa Rica presents an interesting point of comparison for Mexico as both are located within Latin America, contain an older population which aged during epidemiologic transitions prior to infectious disease eradication[20] and are experiencing population aging.[21] Research in Costa Rica has found education to predict lower self-rated health but not mortality.[20] However, Costa Rica differs from other developing countries in many ways. For this reason, it is important to examine Mexico as a unique case.

Research in life course epidemiology has suggested multiple frameworks through which early life SES may be related to late life outcomes, including frameworks which allow risk factors to be patterned across the life course.[15] Using such frameworks, conditions in early life are hypothesized to predict future risk factors which predict outcomes. Likewise, we suggest a theoretical model which addresses the importance of mediating variables connecting early life SES to late life mortality risk in which early life SES predicts educational achievement, which in turn predicts late life health behaviors, late life financial standing, chronic conditions and access to health care, all of which ultimately predict mortality. The use of this framework allows researchers to understand the process through which early life factors shape late life outcomes through both direct and indirect effects. Results will suggest where research and policy changes should be applied.

Understanding how early life SES and education influence mortality is an important step towards improving population health. However, it is insufficient to address this question without considering demographic changes in the context in which aging takes place. Mexico is experiencing an epidemiologic transition evidenced by decreases in communicable disease and increases in mortality from myocardial infarctions and diabetes.[22] Studies of late life mortality risk are becoming increasingly important as the Mexican population is aging quickly.[23] Additionally, Mexico has experienced urbanization[24] and increases in education[25] at the population level. Given these demographic changes, differences across birth cohorts must be examined and explicitly modeled.

Thus, the aim of this analysis is to determine how predictors of mortality throughout the life course (early life SES, educational achievement, health behaviors, late life SES and access to health care) are associated with mortality and related throughout the life course. Additionally, we aim to document differences across cohorts of older Mexicans in the relationship between early life SES and mortality. The importance of this research hinges on understanding late life mortality and how future birth cohorts are likely to differ in developing societies that are aging rapidly such as Mexico.

Materials and methods

Data for this analysis comes from all three waves of the Mexican Health and Aging Study (MHAS),[26] a longitudinal, household based sample of older Mexicans (age 50+) and spouses. Interviews were completed in 2001, 2003, and 2012, providing eleven years of follow-up. The baseline sample consisted of approximately 11 000

households with a sample size of 15 186. The study was approved by the Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch in the United States, and the Instituto Nacional de Estadística y Geografía (INEGI) and the Instituto Nacional de Salud Pública (INSP) in Mexico. The MHAS is partly sponsored by the National Institutes of Health/National Institute on Aging (grant number NIH R01AG018016).* The MHAS has had low attrition with response rates of 88% in wave 3 (2012), nine years after the previous wave (2003).[27] Due to the focus on older adults in this analysis, respondents and spouses age 50+ are kept. Respondents were eliminated if they had no follow up time, if respondents had missing data on covariates or if the mortality month could not be determined (n=115). After exclusions, the sample size became 11 222 with 2 589 mortality events.

Covariates

While analyses of mortality typically use vital registration records, an innovative feature of this analysis is the use of longitudinal survey data with long term follow up. This provides the opportunity to take advantage of the rich detailed covariates necessary for life course research. Covariates throughout the life course are described next. Educational achievement (years of formal education) is categorized as none, 1-5 years, 6 or 7 or more years. Late life SES is operationalized as self-reported financial standing. Those who report "good," "very good," or "excellent" financial standing are collapsed into one category. To examine mortality across birth cohorts, the sample is divided into two cohorts: those who were born before 1940 and those born in 1940 and after. Early life SES is proxied as self-reported presence of a toilet in the household prior to age 10.

Rural/urban residence is operationalized as whether the community in which the respondent lived at baseline had more or fewer than 100 000 persons. Marital status is categorized as married or in a consensual union, widowed, and other. Smoking is categorized as current, former, and never smoker. Alcohol consumption is a binary variable, inquiring whether the respondent has consumed four or more alcoholic beverages in a day during the past three months. Exercise is a binary variable, wich finds out whether the respondent has exercised or done hard physical work at least three times a week on average in the previous two years. Also, depressive symptoms are included in the analysis using a nine item Center for Epidemiologic Studies Depression (CES-D)[28] scale in which respondents report experiencing symptoms of depression during the previous week. Respondents with more than three depressive symptoms are considered more depressed. Body mass index (BMI) is calculated using self-reported heights and weights and classified as non-obese and obese. The validity of self-reported height and weight has been demonstrated in previous work.[29] Dummy variables are created for respondents who have missing values on the CES-D scale or BMI to keep respondents in the analysis.

Statistical analysis

The outcome, all-cause mortality, is determined through next of kin interviews. If respondents die between survey waves, next of kin interviews are conducted in which a mortality month is reported. This is used to calculate a time-to-event for mortality (time in months between respondents' baseline interviews and mortality months). Respondents who are lost to follow up or still alive at the end of the study are censored at their last successful interview. Time-to-censor is calculated as months between a respondent's baseline interview and last successful interview. Respondents who contribute no follow-up time are not included. Data is analyzed using Cox proportional hazard models fit with SAS 9.3. The proportionality assumption is tested using Schoenfeld residuals. Models are stratified by non-proportional predictors, allowing the baseline hazard function to differ between levels of non-proportional predictors.

Statistical models are organized to reflect stages of the life course and establish direct and indirect effects of variables. Model 1 contains characteristics of the respondent in early life or birth (age, sex and early life SES). Model 2 includes covariates between early life and the survey (educational achievement, marital status, and United States migration history). Model 3 adds characteristics from the time of the interview (rural/urban location, tobacco/alcohol consumption, physical activity, health service access, self-reported financial standing, obesity and depressive symptoms). Models are fit separately by birth cohort.

Results

Descriptive results by birth cohort and levels of early life SES are shown in table I. Both cohorts had more females. The average age across cohorts was 62. Approximately two-thirds of the sample lived in an urban area at baseline. Approximately two-thirds of the sample did not have a toilet in the household prior to age 10. Given this large percentage, this group is referred to as the "lower

* Data files and documentation are public use and available at reference 26

Table I

DISTRIBUTION OF CHARACTERISTICS OF OLDER MEXICAN ADULTS BY EARLY LIFE SOCIOECONOMIC STATUS AND BIRTH COHORT AGE 50+ FROM THE MEXICAN HEALTH AND AGING STUDY (MHAS), WAVE I (2001)*

	Lower early life SES (n=7 515)	*Higher early life SES (n=3 707)*	*Born before 1940 (n=5 505)*	*Born 1940 or after (n=5 717)*
Age				
Mean age (standard deviation)	63.02 (9.55)	60.09 (8.49)	69.77 (7.08)	54.63 (3.12)
Sex				
Female %	53.5	57.8	53.8	56.0
Area of residence				
Urban %	56.9	86.0	64.3	68.6
Educational achievement				
No education %	32.4	8.5	32.1	17.2
1-5 years %	41.7	22.6	38.4	33.2
6 years %	16.1	23.0	15.2	21.4
7+ years %	9.8	45.0	14.4	28.2
Marital status				
Married %	70.1	68.2	60.8	77.7
Widowed %	18.9	17.4	28.4	8.8
Other %	11.0	14.5	10.8	13.5
US migration history				
US return migrant %	10.1	7.4	11.5	7.0
Health behaviors				
Current smoker %	16.2	18.1	14.2	19.4
Former smoker %	28.1	26.0	31.3	26.6
Never smoker %	55.7	55.8	54.4	56.9
4+ drinks, past 3 months %	7.9	8.6	5.8	10.5
Exercise %	33.7	32.3	27.9	38.5
Health care access				
Any access %	57.0	75.2	63.8	62.3
Self-assessed financial standing				
Good %	14.5	32.1	18.5	22.0
Fair %	66.1	57.6	62.6	63.9
Poor %	19.4	10.3	18.9	14.1
Chronic conditions				
Diabetic %	16.3	16.0	17.5	15.0
Hypertensive %	39.2	38.4	42.4	35.5
BMI				
Obese %	16.5	21.4	13.9	22.2
Not obese %	53.1	64.8	56.8	57.1
Missing %	30.4	13.8	29.3	20.7
Depressive symptoms				
High %	60.4	48.7	60.8	52.5
Low %	36.9	49.2	36.2	45.5
Missing %	2.7	2.1	3.1	2.0

* n=11 222

early life SES" group and interpreted in relative terms to the "higher early life SES" group. In the full sample, the most common response for years of education was 1-5 years with higher education in the younger cohort and the higher early life SES groups. The majority of both cohorts were married and the majority of both cohorts were never smokers with little difference across cohorts or levels of early life SES. The majority of the full sample had access to health care with less access among the lower early life SES groups. The most common assessment of current financial standing was "fair", but the lower early life SES group assessed their financial standing lower in both cohorts. Of the full sample, approximately 16% were diabetic and approximately 39% were hypertensive at baseline.

Regression models include risk factors throughout the life course including late life to determine whether the relationship between early life factors such as SES and education are mediated by factors later in the life course. Regression results for the cohort born before 1940 are shown in table II. Tests of Schoenfeld residuals showed non-proportionality of two variables: age and regular exercise. A variable is created for age which is 0 if the respondent is below age 70 and 1 if the respondent is age 70+. Models are stratified by the binary age and regular exercise variables to account for predictor non-proportionality. The associations between age, exercise and mortality cannot be shown as the models are stratified by these predictors. In the older cohort, age-adjusted survival did not differ by levels of early life SES. In model 1, being male was associated with higher mortality. Education, marital status, and US migration history were added in model 2. Marital status predicted mortality with greater risk among widowed and other (divorced/separated/never married) compared to married respondents. In model 3, rural/urban location, health behaviors, health care access, self-assessed financial standing, chronic conditions and depressive symptoms are added. In the full model, being male, not being married, being a current or former smoker compared to never smoker, reporting a financial standing of "poor" compared to "good," being diabetic, being hypertensive and having higher or missing levels of depressive symptoms at baseline were associated with higher mortality.

Regression results for the cohort born 1940 or after are shown in table II. Tests of Schoenfeld residuals showed that obesity violated the proportionality assumption. Models were stratified by obesity to account for non-proportionality. In this younger cohort, early life SES was not associated with mortality in model 1 (hazard ratio [HR]: 0.89) while higher age and being male were associated with mortality. When education, marital status and US migration history are added in model 2, important differences appear across cohorts. Lower education was not associated with mortality in the older cohort but was associated with mortality risk in the younger cohort. After adding education to the model, a protective association of lower early life SES emerges. The lower early life SES group showed better survival given their lower educational levels. When covariates are added in model 3, education-mortality associations are attenuated suggesting education impacts mortality indirectly through health behaviors and chronic conditions. A direct effect of education on mortality remained with a significant HR for the 1-5 years of education group compared to 7+ years. Other education variable HRs remained above 1. Being a current versus never smoker, not exercising regularly, being diabetic, being hypertensive and having more depressive symptoms at baseline were associated with higher mortality.

Sensitivity analysis

While only 115 cases for whom a mortality month was not possible to be determined were excluded from the analysis, to account for possible biases, respondents with missing mortality months who had died during follow up were assigned a mortality month by randomly selecting an individual within their early life SES group who had experienced mortality and assigning the randomly selected respondent's mortality month to the respondent with a missing event time. This process was conducted to generate 10 sets of randomly assigned mortality months. After refitting the model with the missing observations, no model differed substantially from models excluding those missing on mortality month. Additionally, as the presence of toilets in households in childhood likely differs across rural/urban areas, we take advantage of a variable from the second wave (2003) of the MHAS: whether the respondent's area of residence when living with parents was in a rural or urban area. This variable was included in a model with only respondents present in 2003. The inclusion of the early life residence variable did not impact interpretations of key parameters.

Reliability and validity of proxy variables

To determine the reliability and validity of the presence of a toilet in the household in childhood measure in 2001, we take advantage of the 2003 early life (prior to age 10) conditions battery in which the respondents are asked two years later if they had a toilet in the household in childhood giving the opportunity to establish test-retest reliability. A chi-square test demonstrates test-retest reli-

Table II

COX PROPORTIONAL HAZARD MODELS PREDICTING MORTALITY (ALL CAUSES) IN THE MEXICAN HEALTH AND AGING STUDY (MHAS), BETWEEN WAVES 1 (2001) AND 3 (2012) AMONG OLDER MEXICAN ADULTS (AGE 50+) BY COHORT*

	Born before 1940 (n=5 505)						*Born after 1940 (n=5 717)*					
	Model 1‡		*Model 2*		*Model 3*		*Model 1*		*Model 2*		*Model 3*	
	HR‡	*p*‡	*HR*	*p*	*HR*	*p*	*HR*	*p*	*HR*	*p*	*HR*	*p*
Demographics												
Age	•		•		•		1.09	#	1.08	#	1.08	#
Male	1.35	#	1.48	#	1.68	#	1.21	‡	1.35	#	1.44	#
Early life												
No toilet	1.13		1.09		1.11		0.89		0.78	§	0.76	§
Education												
No education			1.10		1.03				1.49	§	1.34	
1-5 years			1.04		0.96				1.46	§	1.32	‡
6 years			0.94		0.86				1.37	‡	1.22	
7+ years (Ref)												
Marital status												
Widowed			1.27	#	1.28	#			1.29		1.14	
Other			1.19	‡	1.19	‡			1.48	#	1.46	#
Married (Ref)												
Migration												
US return migrant			0.99		1.01				0.87		0.84	
Non US return migrant (Ref)												
Geography												
More urban					1.02						1.15	
Health behaviors												
Former smoker					1.12	‡					1.14	#
Current smoker					1.31	#					1.47	
Never smoker (Ref)												
Binge drinking (Ref= no binge drinking)					1.01						1.16	
Exercise regularly					•						0.68	#
Health care access												
Any access (Ref = no access)					0.92						1.15	
Self assessed financial situation												
Poor					1.26	§					1.26	
Fair					1.09						1.00	
Good (Ref)												
Chronic conditions												
Diabetic					2.07	#					3.44	#
Hypertensive					1.24	#					1.21	‡
BMI: obese					0.96						•	
BMI: missing					1.10						1.08	
BMI: not obese (Ref)												
Depressive symptoms												
High					1.25	#					1.37	#
Missing					1.35	‡					1.19	
Low (Ref)												

HR=Hazard ratio
p=*p*-value (probability of type I error)
* n=11 222
‡ denotes $p \leq 0.05$
§ denotes $p \leq 0.01$
# denotes $p \leq 0.001$
Models are stratified by variables that violate proportionality assumptions (• denotes non-proportional predictors), therefore, parameter estimates cannot be produced for these variables
BMI: Body mass index

ability of the item. To establish validity, we take advantage of the items in the 2003 early life conditions battery including "Did you generally go to bed hungry?", "Did you wear shoes or other types of footwear regularly?", "Did you or any of your brothers/sisters have to drop out of school to help your parents?", "Did you or any member of your family sleep in the same room used for cooking?", and "Did you or your family receive help from any relatives because of economic problems?" Significant chi-square values emerged between all 2003 items and the 2001 toilet item (besides receiving help from relatives).

Discussion

We find that while those with lower early life SES were disadvantaged in terms of education in both birth cohorts and unadjusted mortality was similar across levels of early life SES across cohorts, important differences appeared in mortality risk factors across birth cohorts. While lower education was associated with mortality in the younger cohort, education did not predict mortality in the older cohort. This may reflect several population level phenomena. First, selective survival may explain the differences in the relationship between education and mortality. Selective survival is an ever present issue in studies of aging. Those with lower education may be more likely to experience mortality prior to the study, leaving only the healthiest ones thus distorting the true relationship between independent and dependent variables. Respondents in the older cohort had more time to be selected, and also were exposed to less-developed contexts and fewer medical technologies during the life course. The resulting differences in survival selection between the birth cohorts may explain why education and mortality only showed associations in the younger cohort. Second, differences in the relationship between education and mortality may be explained through differential returns to education across birth cohorts. Given urbanization in Mexico,[24] the younger cohort may be more likely to move to urban areas and have a greater ability to reap the benefits of higher education through employment opportunities in urban areas. This may ultimately lead to better health and lower mortality to a larger extent in younger cohorts than older cohorts.

The results of the analysis seem to contradict previous literature using the MHAS that has demonstrated associations between SES and health including a study that found lower self-rated health among those of lower SES,[30] while this analysis finds no significant differences in survival by early life SES and conflicting results with other SES measures (education and self-reported financial standing). While this may seem contradictory, the results agree with analyses in Costa Rica which show relationships between SES and self-rated health but not with mortality.[20]

This analysis is not without limitations. First, although we demonstrated reliability and validity of the proxy measure for early life SES, the presence of a toilet in the household prior to age 10 is a proxy for a construct that is difficult to measure. Second, although the number of deaths recorded in the MHAS is similar to the expected numbers of deaths estimated through life tables, the analytic sample may not represent mortality as accurately as the full sample.

This analysis may assist those interested in early life SES, educational achievement and how other features of the life course impact mortality and the aging of the Mexican population. The longitudinal nature and availability of detailed life course variables in the MHAS provide this analysis with a unique ability to address questions regarding aging and old age wellbeing. Epidemiologic research on the Mexican population must continue to explore how aging through the life course may differ across cohorts as our results suggest that key associations seem to differ for successive age cohorts in rapidly aging countries. Indeed, Mexico is experiencing rapid demographic changes and researchers must acknowledge the ever changing context in which aging occurs. Understanding how factors throughout the life course may shape late life mortality risk and aging will have strong public health implications given the rapid aging of Mexico and may assist researchers in other aging countries.

Acknowledgments

This study was conducted with the support of the Sealy Center on Aging at the University of Texas Medical Branch, and by the Health of Older Minorities Award (T32AG00270) from the National Institute of Health/National Institute of Aging.

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

References

1. Settersten RA. Invitation to the life course: toward new understandings of later life [internet document]. New York: Baywood Publishing Company New York, 2003 [consulted on: 2013 Oct 31]. Available at: http://www.baywood.com/books/BooksBuyingOptions.asp?ID=0-89503-269-4
2. Gilman SE, Kawachi I, Fitzmaurice GM, Buka SL. Socioeconomic status in childhood and the lifetime risk of major depression. Int J Epidemiol 2002;31(2):359-367.
3. Gliksman MD, Kawachi I, Hunter D, Colditz GA, Manson JE, Stampfer MJ, *et al*. Childhood socioeconomic status and risk of cardiovascular disease in middle aged US women: a prospective study. J Epidemiol Community Health 1995;49(1):10-15.

4. Frankel S, Smith GD, Gunnell D. Childhood socioeconomic position and adult cardiovascular mortality: the Boyd Orr Cohort. Am J Epidemiol 1999;150(10):1081-1084.
5. Pollitt RA, Rose KM, Kaufman JS. Evaluating the evidence for models of life course socioeconomic factors and cardiovascular outcomes: a systematic review. BMC Public Health 2005;5(1):7.
6. Lynch JW, Kaplan GA, Cohen RD, Wilson TW, Smith NL, Kauhanen J, *et al*. Childhood and adult socioeconomic status as predictors of mortality in Finland. Lancet 1994;343(8896):524-527.
7. Galobardes B, Lynch JW, Smith GD. Childhood socioeconomic circumstances and cause-specific mortality in adulthood: systematic review and interpretation. Epidemiol Rev 2004;26(1):7-21.
8. Smith GD, Hart C, Blane D, Gillis C, Hawthorne V. Lifetime socioeconomic position and mortality: prospective observational study. BMJ 1997;314(7080):547.
9. Smith GD, Hart C, Blane D, Hole D. Adverse socioeconomic conditions in childhood and cause specific adult mortality: prospective observational study. BMJ 1998;316(7145):1631.
10. Hayward MD, Gorman BK. The long arm of childhood: the influence of early-life social conditions on men's mortality. Demography 2004;41(1):87-107.
11. Osler M, Andersen AN, Due P, Lund R, Damsgaard MT, Holstein BE. Socioeconomic position in early life, birth weight, childhood cognitive function, and adult mortality. A longitudinal study of Danish men born in 1953. J Epidemiol Community Health 2003;57(9):681-686.
12. Claussen B, Smith GD, Thelle D. Impact of childhood and adulthood socioeconomic position on cause specific mortality: the Oslo Mortality Study. J Epidemiol Community Health 2003;57(1):40-45.
13. Kuh D, Hardy R, Langenberg C, Richards M, Wadsworth ME. Mortality in adults aged 26-54 years related to socioeconomic conditions in childhood and adulthood: post war birth cohort study. BMJ 2002;325(7372):1076-1080.
14. Power C, Hyppönen E, Davey-Smith G. Socioeconomic position in childhood and early adult life and risk of mortality: a prospective study of the mothers of the 1958 British birth cohort. Am J Public Health 2005;95(8):1396-1402.
15. Kuh D, Shlomo YB. A life course approach to chronic disease epidemiology [internet document]. Oxford University Press, 2004 [consulted on: 2013 Nov 1]. Available at: http://books.google.com/books?hl=en&lr=&id=o_CFOTYglHsC&oi=fnd&pg=PR17&dq=A+Life+Course+Approach+to+Chronic+Disease+Epidemiology&ots=gJxw-xeh8n&sig=btEZ6DZERGPIThmZS05CQA9moPc
16. Kunst AE, Mackenbach JP. The size of mortality differences associated with educational level in nine industrialized countries. Am J Public Health 1994;84(6):932-937.
17. Zimmer Z, Martin LG, Lin H-S. Determinants of old-age mortality in Taiwan. Soc Sci Med 2005;60(3):457-470.
18. Huang C, Elo IT. Mortality of the oldest old Chinese: the role of early-life nutritional status, socio-economic conditions, and sibling sex-composition. Popul Stud (Camb) 2009;63(1):7-20.
19. Liang J, McCarthy JF, Jain A, Krause N, Bennett JM, Gu S. Socioeconomic gradient in old age mortality in Wuhan, China. J Gerontol B Psychol Sci Soc Sci 2000;55(4):S222-S233.
20. Rosero-Bixby L. The exceptionally high life expectancy of Costa Rican nonagenarians. Demography 2008;45(3):673-691.
21. Instituto Nacional de Estadística y Censos, Centro Centroamericano de Población. Costa Rica estimaciones y proyecciones de población 1970-2100 actualizadas al año 2000 y Evaluación del Censo 2000 y otras fuentes de información [internet document]. 2002 [consulted on: 2013 Nov 1]. Available at: http://www.hacienda.go.cr/centro/datos/Articulo/Estimaciones%20y%20proyecciones%20de%20poblacion-CR.pdf
22. Rivera JA, Barquera S, Campirano F, Campos I, Safdie M, Tovar V. Epidemiological and nutritional transition in Mexico: rapid increase of non-communicable chronic diseases and obesity. Public Health Nutr 2002;5(1A):113-122.
23. Zúñiga E, Vega D, Mendoza ME. Envejecimiento de la población de México: reto del siglo XXI [internet document]. México: Conapo, 2004 [consulted on: 2013 Nov 1]. Available at: http://portal.conapo.gob.mx/publicaciones/enveje2005/enveje00.pdf
24. Garza G. Global economy, metropolitan dynamics and urban policies in Mexico. Cities 1999;16(3):149-170.
25. Wong R, Palloni A. Aging in Mexico and Latin America. International handbook of population aging [internet document]. Springer, 2009 [consulted on: 2013 Nov 1]. 231-252. Available at: http://link.springer.com/chapter/10.1007/978-1-4020-8356-3_11
26. Mexican Health and Aging Study. Data files and documentation (public use) [internet documents]. 2001, 2003, 2012 [consulted on: 2013 Jun 11]. Available at: www.mhasweb.org
27. Estudio Nacional de Salud y Envejecimiento en México. Estudio Nacional de Salud y Envejecimiento en México (Ensaem): descripción de los archivos de datos, versión 1. México: Ensaem, 2013.
28. Radloff LS. The CES-D scale a self-report depression scale for research in the general population. Applied psychological measurement 1977;1(3):38-401.
29. Ávila-Funes JA, Gutiérrez-Robledo LM. Validity of height and weight self-report in Mexican adults: results from the national health and aging study. J Nutr Health Aging 2004;8(5):355.
30. Smith KV, Goldman N. Socioeconomic differences in health among older adults in Mexico. Soc Sci Med 2007;65(7):1372-1385.