Comorbidity and Disability in Elderly Mexican and Mexican American Adults

Findings From Mexico and the Southwestern United States

KUSHANG V. PATEL
National Institute on Aging
M. KRISTEN PEEK
University of Texas Medical Branch
REBECA WONG
University of Maryland
KYRIAKOS S. MARKIDES
University of Texas Medical Branch

This article aims to compare the effects of morbid and comorbid medical conditions on disability in elderly Mexican and Mexican American adults. Data from the 2001 Mexican Health and Aging Study ($N = 4,872$) and 1993 to 1994 Hispanic Established Population for Epidemiologic Studies of the Elderly ($N = 3,050$) were analyzed. Prevalence of medical conditions and disability in activities of daily living were calculated and logistic models were used to test associations. Prevalence of disability in older Mexicans was 16.3% while it was slightly lower in Mexican Americans (13.1%). Prevalence of arthritis, cancer, diabetes, heart attack, and stroke were substantially higher in Mexican Americans than in older adults living in Mexico. Diabetes, stroke, and heart attack were comorbid conditions that raised the likelihood of disability in both populations among subjects with other medical conditions. Despite differences in prevalence, the associations of morbidity and comorbidity with disability had similar magnitudes in both populations.

Keywords: *comorbidity; aging; chronic disease; disability*

As populations in Latin America experience aging, the prevalence of chronic medical conditions and disability will likely rise, whereas the

JOURNAL OF AGING AND HEALTH, Vol. 18 No. 2, April 2006 315-329
DOI: 10.1177/0898264305285653

incidence of childhood infectious diseases will continue to decline—that is, Latin American countries to various degrees are undergoing demographic transitions as well as epidemiologic transitions (Albala, Vio, & Yanez, 1997). Mexico is an example where the total fertility rate has declined by approximately 50% during the past two decades (from 6.2 births per woman in 1974 to 2.7 in 1996), and life expectancy has increased by 7.9 years (Population Division, Department of Economic and Social Affairs of the United Nations, 2004). However, a recent analysis by Palloni, Pinto-Augirre, and Pelaez (2002) indicates that growth of the elderly population in Latin America is largely a function of declines in mortality than in fertility. The region experienced massive survival gains between 1930 and 1990, especially in childhood ages, as a result of improved medical care and public health practice (Palloni et al., 2002). Improvements in technology, however, were generally not paralleled by improvements in standards of living (Palloni & Wyrick, 1981). So although population cohorts in Latin America are surviving longer, health status in old age may suffer from illness and injury experienced earlier in life. Indeed, Palloni et al. reported higher prevalence of disability and poor-self ratings of health among elderly Latin Americans than compared to their counterparts in North America and Europe. Unfortunately, few, if any, population-based studies have investigated these health disparities.

To help fill this gap, the current study capitalizes on epidemiologic data from Mexico and the United States to compare the health status of older Mexicans and Mexican Americans, populations with similar cultural backgrounds yet contrasting living environments. An outcome with substantial importance for quality of life and need for support services in older adults is disability (Guralnik, Fried, & Salive, 1996). Considering that disability in old age by and large reflects the functional consequences of disease, this study compares the effects of morbid and comorbid medical conditions on disability across the two populations.

AUTHORS' NOTE: Support for this study was provided by grants from the National Institute on Aging (F31 AG021872 and R01 AG10939). Please address correspondence concerning this article to Kushang V. Patel, Laboratory of Epidemiology, Demography, and Biometry, National Institute on Aging, 7201 Wisconsin Avenue, Suite 3C309, Bethesda, MD 20892-9205; e-mail: patelku@mail.nih.gov.

Methods

DATA

Baseline data from the 2001 Mexican Health and Aging Study (MHAS) and 1993/1994 Hispanic Established Population for the Epidemiologic Study of the Elderly (EPESE) were analyzed. The 2001 MHAS is a probability sample of 15,186 Mexican adults aged 50 years and older living in Mexico. Among those originally sampled, 90% participated in the survey. The sample is nationally representative of approximately 13 million elderly Mexican adults. Data analysis was performed on 4,872 MHAS subjects who were at least 65 years old. The 1993/1994 Hispanic EPESE is also a probability sample of 3,050 Mexican Americans aged 65 years and older living in the southwestern region of the United States. With 83% of potential subjects participating, the sample generalizes to approximately 500,000 elderly Mexican Americans. Data were collected in both studies through in-home interviews with subjects or proxy-informants if subjects were physically or mentally unable to respond to questionnaire items. Both studies provide comparable survey data for parallel analyses of morbidity and disability.

MEASURES

In this study, disability refers to an elderly person's dependence on others to perform self-care tasks. The MHAS and Hispanic EPESE surveys share five items in common from a modified version of Katz's Activities of Daily Living scale (ADL; Branch, Katz, Kniepmann, & Papsidero, 1984). Subjects were asked if they could independently perform the following tasks: walk across a small room, bathe or shower, eat, get into or out of a bed, and use a toilet. If a subject reported he or she was unable to perform any of these ADLs without help, then the subject was considered disabled. This measure of ADL disability is used commonly in aging research and has been reported to be reliable over time (Smith et al., 1990).

In addition to asking the same ADL items, the MHAS and Hispanic EPESE assess subject's history of major medical conditions similarly

as well. Subjects were asked if a doctor or medical personnel ever told them that they have or had the following medical conditions: diabetes, cancer, heart attack, stroke, and arthritis. Two other medical conditions measured somewhat differently in each survey include bone fractures and respiratory illness. In the MHAS, subjects were asked, "Since your 50th birthday, have you fractured any bone including your hip?" The Hispanic EPESE used this same question stem to ask specifically about hip fracture first followed by a second question on other bone fractures. To have a comparable measure of bone fractures across the two surveys, an affirmative response to either question in the Hispanic EPESE was used to define a positive history of bone fracture. For respiratory illness, MHAS subjects were asked specifically whether medical personnel had told the subject that he or she has a respiratory illness, whereas in the Hispanic EPESE, respiratory illness was self-reported when asked about other medical conditions the subject has experienced.

Generally, self-reported medical conditions have been shown to be reliable with medical records (Katz, Chang, Sangha, Fossel, & Bates, 1996). This set of seven medical conditions is used specifically because each condition has potential to influence physical function and disability (Guralnik et al., 1996; Markides et al., 1996). In addition to estimating the effects of individual medical conditions, a total count of the seven medical conditions was used as a measure of morbidity as well. This summary variable was categorized into the following four groups: zero, one, two, and three or more medical conditions.

Age, *sex*, and *highest grade of education completed* are other variables included in the data analysis. Although measures of health care use during the past year were originally specified in the statistical models, confounding effects were not observed, and therefore, these measures were excluded for parsimony. Similarly, nativity in the Hispanic EPESE and immigration experience in the MHAS were also ultimately excluded from data analysis because they did not confound the effects of morbidity on disability.

DATA ANALYSIS

Prevalence was estimated for all conditions by dividing the total number of cases of a condition by the total population and multiplying

this proportion by 100. Comparisons of the distributions of demographic factors and medical conditions across disability status were made using chi-square and student's *t* tests. Multivariable logistic regression models were then used to examine the effects of the total number of medical conditions and individual medical conditions on prevalent disability while adjusting for demographic factors. Logistic regression models were also used to examine the effects of specific combinations of comorbidity on prevalent disability by stratifying on a given medical condition. All of the logistic regression models in this study fit the data according to the Hosmer-Lemeshow goodness-of-fit test ($p > .30$; Hosmer & Lemeshow, 1980).

Results

The prevalence of ADL disability in older Mexicans was 16.3%, whereas it was slightly lower in Mexican Americans (13.1%), prevalence ratio: 1.24 (95% CI: 0.92, 1.64). Table 1 shows the distributions of demographic factors and medical conditions in each sample as well as across disability status. The mean age of both samples was approximately 73 years. Also in both samples, the mean age and proportion of women were significantly higher among those with ADL disability compared to those without disability. Highest grade of education completed was also distributed similarly across disability status in each study, although the mean education level was higher in the Hispanic EPESE sample than in the MHAS. In terms of morbidity, higher levels were observed for those with disability than those without disability in each study; however, the prevalence of comorbidity varied between the two samples. The prevalence of two or more medical conditions (comorbidity) was 19.2% in the MHAS, whereas in the Hispanic EPESE, it was 29.9%. There were also differences in the prevalence of medical conditions between the two studies. The prevalence of self-reported diabetes, cancer, heart attack, stroke, and arthritis were substantially higher in Mexican Americans than in older adults living in Mexico. Bone fractures had similar distributions across the two studies, whereas respiratory illness was more prevalent in the MHAS than in the Hispanic EPESE, which could reflect differences in measurement.

Table 1
Prevalence of Disability and Medical Conditions in Mexican and Mexican American Adults Aged 65 Years and Older

	Mexican Health and Aging Study				*Hispanic Established Population for the Epidemiologic Study of the Elderly*			
Characteristic	*With Activities of Daily Living Disability* (n = *785*)	*Without Activities of Daily Living Disability* (n = *4,026*)	*Total* (n = *4,811*)	p *Value*	*With Activities of Daily Living Disability* (n = *399*)	*Without Activities of Daily Living Disability* (n = *2,642*)	*Total* (n = *3,041*)	p *Value*
Mean Age *(SD)*	77.1 (8.3)	72.2 (6.1)	73.0 (6.7)	< 0.01	78.6 (8.2)	72.2 (6.1)	73.1 (6.8)	< 0.01
Female	60.6	50.8	52.4	< 0.01	64.4	56.7	57.7	< 0.01
Mean Education *(SD)*	2.8 (5.9)	3.5 (5.7)	3.4 (5.9)	0.27	4.3 (3.7)	4.9 (3.9)	4.8 (3.9)	0.11
Medical Conditions								
None	23.3	49.8	45.4		14.8	35.9	33.1	
One	39.9	34.6	35.4		30.8	38.0	37.0	
Two	26.2	12.3	14.6		27.1	18.8	19.9	
Three or more	10.6	3.4	4.6	< 0.01	27.3	7.4	10.0	< 0.01
Diabetes	25.1	15.8	17.4	< 0.01	37.8	26.3	27.8	< 0.01
Cancer	2.9	1.8	2.0	< 0.05	10.0	5.0	5.6	< 0.01
Respiratory illness	13.1	7.2	8.2	< 0.01	4.5	2.2	2.5	< 0.01
Heart attack	9.5	4.2	5.1	< 0.01	22.2	9.3	11.0	< 0.01
Stroke	11.0	3.1	4.4	< 0.01	21.5	4.5	6.7	< 0.01
Arthritis	40.6	23.3	26.2	< 0.01	54.2	37.8	39.9	< 0.01
Bone fracture	27.3	16.4	18.2	< 0.01	27.9	14.6	16.3	< 0.01

Table 2
Multivariable Logistic Regression Models of Prevalent Activities of Daily Living Disability on Demographic Factors and Level of Morbidity

	Mexican Health and Aging Study (n = *4,811*)		*Hispanic Established Population for the Epidemiologic Study of the Elderly* (n = *2,993*)	
	OR	*95% CI*	OR	*95% CI*
Age (in years)	1.11	1.09, 1.12	1.13	1.11, 1.15
Female (vs. Male)	1.31	1.11, 1.55	1.22	0.96, 1.56
Education (in years)	0.98	0.97, 1.00	0.98	0.95, 1.01
One medical condition (vs. none)	2.53	2.06, 3.10	1.90	1.35, 269
Two medical conditions (vs. none)	4.79	3.79, 6.06	3.67	2.56, 6.09
Three or more medical conditions (vs. none)	7.33	5.27, 10.2	9.54	6.49, 14.0

Note. OR = Odds Ratio; CI = Confidence Interval.

Table 2 presents logistic models of prevalent ADL disability regressed on demographic factors and morbidity level. Age, sex, and highest grade of education completed display the expected direction of effect on disability and have very similar magnitudes of association in each study. Also, the likelihood of disability increases significantly with greater levels of morbidity in elderly Mexicans and Mexican Americans. Although the odds ratios have different magnitudes, the overall effect of total number of medical conditions on ADL disability has a similar pattern in the MHAS and Hispanic EPESE. The effects of specific medical conditions on the likelihood of ADL disability are presented in Table 3. After adjusting for demographics and other medical conditions, subjects with diabetes in both studies were twice as likely to have ADL disability as subjects without diabetes. Similarly, subjects with a history of stroke were three to four times more likely to have disability than those who had not experienced a stroke. Other medical conditions—including cancer, heart attack, arthritis, and bone fractures—also increased the likelihood of ADL disability in older Mexicans and Mexican Americans, although cancer was not a significant predictor in either sample. Respiratory illness was significantly associated with disability in the MHAS sample, whereas it was not in the Hispanic EPESE, which again likely reflects differences in

Table 3
*Multivariable Logistic Regression Models of Prevalent Activities of Daily Living Disability on Medical Conditions**

	Mexican Health and Aging Study (n = 4,628)		*Hispanic Established Population for the Epidemiologic Study of the Elderly (n = 2,934)*	
	OR	*95% CI*	OR	*95% CI*
Diabetes	2.07	1.69, 2.54	1.98	1.53, 2.56
Cancer	1.51	0.87, 2.60	1.52	0.97, 2.39
Respiratory illness	1.80	1.38, 2.35	1.49	0.77, 2.89
Heart Attack	1.67	1.20, 2.31	1.86	1.36, 2.56
Stroke	3.43	1.79, 4.76	4.10	2.79, 5.70
Arthritis	2.13	1.79, 2.55	1.62	1.26, 2.08
Bone Fracture	1.63	1.34, 1.99	1.93	1.45, 2.56

Note. OR = Odds Ratio; CI = Confidence Interval.
* Models are adjusted for age, sex, and highest grade of education completed

how respiratory illness was measured. Nonetheless, the direction of effect for respiratory illness was the same in the two studies.

To examine the effects of specific comorbid medical conditions on ADL disability in the MHAS and Hispanic EPESE, logistic regression models were stratified by an index medical condition. Results are shown in Table 4 for the MHAS sample and Table 5 for the Hispanic EPESE sample. Among subjects with diabetes, comorbid heart attack, stroke, and arthritis were conditions that significantly increased the likelihood of ADL disability in both samples (Figure 1). Comorbid bone fracture was also associated with disability among diabetics but only in elderly Mexican Americans. In fact, in older Mexicans (in MHAS), bone fracture was not a comorbid condition that significantly increased the likelihood of disability for any of the index medical conditions (Table 4), but bone fracture was a significant contributor toward disability in Mexican American subjects with heart attack, arthritis, or diabetes (Table 5). Conversely, stroke was a comorbid condition that universally increased the probability of ADL disability for all of the index medical conditions in the MHAS and Hispanic EPESE. Similar comorbid effects were observed for the following index conditions in both studies: heart attack, stroke, arthritis, and bone fracture, although statistical significance may vary slightly in each study.

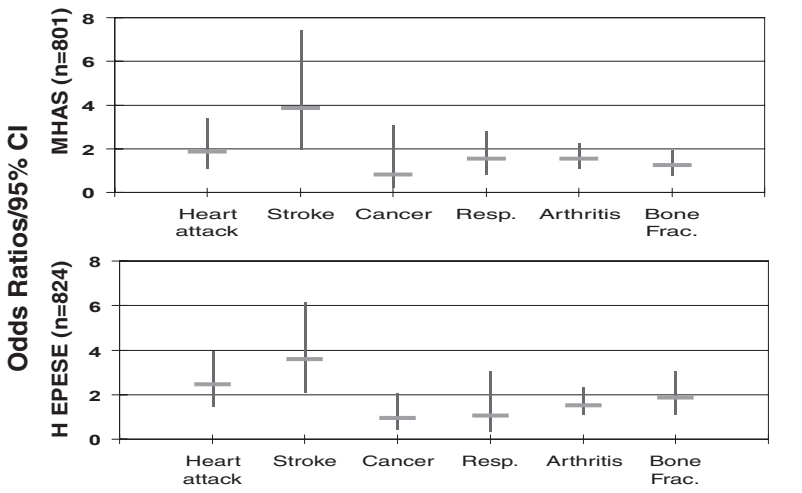

Figure 1. **Effect of comorbid medical conditions on prevalent ADL disability among subject with diabetes**

Discussion

Based on large representative samples in Mexico and the United States, this study finds the prevalence of ADL disability is slightly higher in community dwelling elderly Mexicans than in Mexican Americans. Although compared to older non-Hispanic Whites in the United States, prevalence of disability among older Mexicans and Mexican Americans is higher (Markides, Rudkin, Angel, & Espino, 1997). The high level of disability in both populations likely reflects lower propensity of institutionalization but possibly for different reasons. Although culturally both populations are unlikely to institutionalize older family members, long-term care facilities are not commonly available in Mexico, whereas institutionalization in the United States is prohibitively expensive for typical Mexican American families (Markides & Wallace, 1996).

Despite the high prevalence of disability, the prevalence of diabetes, cancer, heart attack, stroke, and arthritis were substantially lower in the elderly population of Mexico than in older Mexican Americans from the southwestern United States. The lower prevalence of medical conditions could be a selection effect with very hearty Mexican adults

Table 4
*OR and 95% CI From Stratified Multivariable Logistic Regression Models of Prevalent Activities of Daily Living Disability on Comorbid Medical Conditions: Mexican Health and Aging Study (2001)**

	Diabetes (n = *801)*		*Heart Attack* (n = *234)*		*Stroke* (n = *199)*		*Arthritis* (n = *1,215)*		*Bond Fracture* (n = *850)*		*Respiratory* (n = *382)*	
	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*
Diabetes		—	2.10	1.08, 4.09	2.88	1.37, 6.07	1.51	1.08, 2.12	1.41	0.94, 2.12	1.95	1.02, 3.72
Cancer	0.82	0.22, 3.05	1.14	0.51, 8.53	2.44	0.43, 13.9	0.63	0.21, 1.86	1.60	0.54, 4.79	2.68	0.73, 9.88
Respiratory	1.53	0.84, 2.78	1.89	0.90, 3.96	3.40	1.37, 8.40	1.24	0.81, 1.92	1.30	0.75, 2.25		—
Heart attack	1.86	1.03, 3.35		—	1.26	0.55, 2.88	1.42	0.84, 2.39	1.83	1.04, 3.23	1.90	0.91, 4.00
Stroke	3.85	2.00, 7.40	2.70	1.20, 6.08		—	2.55	1.43, 4.53	2.24	1.21, 4.13	5.15	2.16, 12.3
Arthritis	1.53	1.05, 2.23	1.34	0.71, 2.53	1.23	0.62, 2.43		—	1.64	1.16, 2.31	1.34	0.78, 2.31
Bone fracture	1.25	0.82, 1.91	1.41	0.73, 2.73	1.01	0.50, 2.06	1.36	0.99, 1.87		—	1.11	0.59, 2.08

Note. OR = Odds Ratio; CI = Confidence Interval.
* Models are stratified by an index medical condition and adjusted for age, sex, and highest grade of education completed; there were too few cases for analysis of cancer as an index medical condition.

Table 5
*OR and 95% CI From Stratified Multivariable Logistic Regression Models of Prevalent Activities of Daily Living Disability on Comorbid Medical Conditions: Hispanic Established Population for the Epidemiologic Study of the Elderly (1993 to 1994)**

	Diabetes (n = *824*)		*Heart Attack* (n = *325*)		*Stroke* (n = *191*)		*Arthritis* (n = *1,183*)		*Bone Fracture* (n = *482*)**		*Cancer* (n = *168*)	
	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*	OR	*95% CI*
Diabetes		—	2.79	1.54, 5.05	1.91	0.96, 3.78	2.00	1.39, 2.87	1.86	1.08, 3.23	0.85	0.34, 2.12
Cancer	0.94	0.44, 2.02	1.32	0.50, 3.47	1.11	0.33, 3.66	1.60	0.89, 2.88	1.26	0.49, 3.25		—
Respiratory	1.04	0.36, 3.02	1.18	0.27, 5.14	0.48	0.08, 2.84	1.02	0.38, 2.76		—	5.57	0.97, 31.8
Heart attack	2.44	1.52, 3.92		—	2.39	1.17, 4.89	1.72	1.13, 2.62	2.70	1.51, 4.85	1.36	0.48, 3.84
Stroke	3.59	2.10, 6.12	4.63	2.38, 9.01		—	2.67	1.61, 4.43	3.17	1.54, 6.53	5.08	1.37, 18.9
Arthritis	1.52	1.01, 2.30	1.23	0.68, 2.25	0.69	0.34, 1.39		—	1.54	0.92, 2.56	2.21	0.86, 5.69
Bone fracture	1.86	1.14, 3.04	2.82	1.53, 5.18	1.57	0.71, 3.46	1.99	1.34, 2.95		—	1.31	0.45, 3.79

Note. OR = Odds Ratio; CI = Confidence Interval.
* Models are stratified by an index medical condition and adjusted for age, sex, and highest grade of education completed; there were too few cases for analysis of respiratory illness as an index medical condition.
** Cell sizes were too small for including respiratory illness in the model.

surviving into older ages. This has been one explanation advanced for the African American mortality crossover effect with non-Hispanic Whites whereby the most robust members of African American cohorts survive high mortality and adverse conditions at younger ages (Elo & Preston, 1997; Markides & Mindel, 1987; Manton, Stallard, & Wing, 1991). Alternatively, higher case fatality rates for these conditions, such as heart attack (Chavez Dominguez, Ramirez Hernandez, & Casanova Garces, 2003), in Mexico than in the United States could also explain the differential in prevalence estimates. Also, lower prevalence of medical conditions may be a function of lower rates of diagnosis in Mexico than in the United States. It is plausible that some combination of the above explanations contributes to lower prevalence of various medical conditions in Mexico.

Nevertheless, morbid and comorbid medical conditions were just as disabling in older Mexicans than in Mexican Americans. The total number of medical conditions had a similar effect on ADL disability in both samples (Table 2). Although there are limitations to this measure of comorbidity, such as disease heterogeneity and equal weighting of diseases (Guralnik, 1996), a stepwise effect on disability was observed in both studies demonstrating similarity in the global impact of disease burden on self-care ability. In addition to the summary measure of comorbidity, individual medical conditions had similar effects on disability as well (Table 3). It was surprising to find similar strengths of association between the two studies given the prevalence of medical conditions varied. Similarities in the odds ratios may be attributed to higher rates of recovery and rehabilitation in the United States than in Mexico. Follow-up data for both studies will help clarify the similar patterns of association between individual medical conditions and ADL disability.

The effects of comorbid medical conditions on ADL disability were also similar across the two studies. By far, stroke was the most disabling comorbid condition. This is consistent with previous findings that stroke, especially without physical rehabilitation, has a devastating effect on physical functioning despite its low prevalence (Verbrugge, Lepkowski, & Imanaka, 1989; Guccione et al., 1994; Jette, Pinsky, Branch, Wolf, & Feinleib, 1988). The significant comorbid effects of diabetes, heart attack, and stroke on disability likely represent a single causal pathway because of the similar patho-

physiology shared among these diseases (Fillenbaum, Pieper, Cohen, Cornoni-Huntley, & Guralnik, 2000; Fried, Bandeen-Roche, Kasper, & Guralnik, 1999; Verbrugge et al., 1989). Bone fracture and arthritis, conditions known to affect locomotion, had less striking comorbid effects in the two samples. This may be because of the global nature of the measures instead of site-specific measurement (e.g., hip fracture, osteoarthritis of the knee), although in the Hispanic EPESE, bone fracture increased the likelihood of disability in subjects with diabetes, heart attack, or arthritis.

The current study is limited by self-reported measurement of medical conditions. Although survey-based assessment of morbidity has been shown to be reliable with medical records in the United States, there could be significant underreporting of medical conditions in Mexico because of more limited access to medical care. Adjustments for health care use in both studies did not substantively change the effects of morbidity and comorbidity on disability. Another limitation of this study is the cross-sectional design, which limits causal inference on the role of morbidity on disability. However, causal relationships could be implied considering that the probability of subjects visiting a doctor for disability and then get diagnosed with a medical condition seems low (Verbrugge et al., 1989). The time period gap between the two surveys (approximately 7 to 8 years) could potentially limit comparability, but significant shifts in the health status of either of these old age populations has not been reported, and therefore, the overall effects observed in this study are likely robust to the time difference. The major strength of this study is analysis of two large population based samples of older adults with similar cultural backgrounds located in Mexico and the United States. Furthermore, both surveys had similar measures of morbidity and disability, which facilitated comparison of the health status of elderly Mexicans and Mexican Americans.

Overall, this study shows that elderly Mexicans have slightly higher prevalence of disability and lower prevalence of comorbidity and most medical conditions compared to older Mexican Americans. Despite differences in prevalence, the effect sizes of morbidity and comorbidity on ADL disability were remarkably similar in both studies. Diabetes, heart attack, stroke, arthritis, and bone fracture were medical conditions that had disabling effects in older Mexican and Mexican

American adults. Diabetes, stroke, and heart attack were comorbid conditions in both populations that raised the likelihood of disability among those with other medical conditions. Considering that older Mexican and Mexican American populations are projected to grow rapidly, prevention and treatment of medical conditions needs greater priority in these populations to reduce ADL dependence in the community.

REFERENCES

Albala, C., Vio, F., & Yanez, M. (1997). Transición Epidemiológica en América Latina: Una Comparación de Cuatro Países [Epidemiological transition in Latin America: A comparison of four countries]. *Revista Médica de Chile* [*Medical Journal of Chile*], 125, 719-727.

Branch, L. G., Katz, S., Kniepmann, K., & Papsidero, J. A. (1984). A prospective study of functional status among community elders. *American Journal of Public Health*, *74*, 266-268.

Chavez Dominguez, R., Ramirez Hernandez, J. A., & Casanova Garces, J. M. (2003). Enfermedad Cardiaca Coronaria en Méjico y su Relevancia Epidemiológica y Preventiva [Coronary heart disease in Mexico and the clinical epidemiological and preventive relevance]. *Archivos de Cardiología de México* [*Archives of Cardiology of Mexico*], *73*, 105-114.

Elo, I. T., & Preston, S. H. (1997). Racial and ethnic differences in American mortality at older ages. In L. Martin & B. Soldo (Eds.), *Racial and ethnic differences in the health of older Americans* (pp. 10-42). Washington, DC: National Academy.

Fillenbaum, G. G., Pieper, C. F., Cohen, H. J., Cornoni-Huntley, J. C., & Guralnik, J. M. (2000). Comorbidity of five chronic health conditions in elderly community residents: Determinants and impact on mortality. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *55A*, M84-M89.

Fried, L. P., Bandeen-Roche, K., Kasper, J. D., & Guralnik, J. M. (1999). Association of comorbidity with disability in older women: The women's health and aging study. *Journal of Clinical Epidemiology*, *52*, 27-37.

Guccione, A. A., Felson, D. T., Anderson, J. J., Anthony, J. M., Zhang, Y., Wilson, P.W., et al. (1994). The effects of specific medical conditions on the functional limitations of elders in the Framingham study. *American Journal of Public Health*, *84*, 351-358.

Guralnik, J. M. (1996). Assessing the impact of comorbidity in the older population. *Annals of Epidemiology*, *6*, 376-380.

Guralnik, J. M., Fried L. P., & Salive, M. E. (1996). Disability as a public health outcome in the aging population. *Annual Review of Public Health*, *17*, 25-46.

Hosmer, D. W., & Lemeshow, S. (1980). Goodness of fit tests for the multiple logistic regression model. *Communications in Statistics, Part A—Theory and Methods*, *9*, 1043-1069.

Jette, A. M., Pinsky, J. L., Branch, L. G., Wolf, P. A., & Feinleib, M. (1988). The Framingham disability study: Physical disability among community-dwelling survivors of stroke. *Journal of Clinical Epidemiology*, *41*, 719-726.

Katz, J. N., Chang, L. C., Sangha, O., Fossel, A. H., & Bates, D. W. (1996). Can comorbidity be measured by questionnaire rather than medical record review? *Medical Care*, *34*, 73-84.

Manton, K. G., Stallard, E., & Wing, S. (1991). Analyses of Black and White differentials in the age trajectory of mortality in two closed cohort studies. *Statistics in Medicine*, *10*, 1043-1059.

Markides, K. S., & Mindel, C. H. (1987). *Aging and ethnicity.* Newbury Park, CA: Sage.

Markides, K. S., Rudkin, L., Angel, R. J., & Espino, D. V. (1997). Health status of Hispanic elderly. In L. G. Martin & B. J. Soldo (Eds.), *Racial and ethnic differences in the health of older Americans* (pp. 285-300). Washington, DC: National Academy.

Markides, K. S., Stroup-Benham, C. A., Goodwin, J. S., Perkowski, L. C., Lichtenstein, M., & Ray, L. A. (1996). The effect of medical conditions on the functional limitations of Mexican-American elderly. *Annals of Epidemiology*, *6*, 386-391.??

Markides, K. S., & Wallace, S. (1996). Health and long-term care needs of minority elderly. In J. Romeis, R. Coe, & J. Morley (Eds.), *Applying health services research to long-term care*. New York: Springer.

Palloni, A., Pinto-Aguirre, G., & Pelaez, M. (2002). Demographic and health conditions of ageing in Latin America and the Caribbean. *International Journal of Epidemiology*, *31*, 762-771.

Palloni, A., & Wyrick, R. (2004). Mortality decline in Latin America: Changes in the structure of causes of death, 1950-1975. *Social Biology*, *28*, 187-216.

Population Division, Department of Economic and Social Affairs of the United Nations. (2004). *World fertility report: 2003.* New York: Author.

Smith, L. A., Branch, L. G., Scherr, P. A., Wetle, T., Evans, D. A., Hebert, L., et al. (1990). Short-term variability of measures of physical function in older people. *Journal of the American Geriatrics Society*, *38*, 993-998.

Verbrugge, L. M., Lepkowski, J. M., & Imanaka, Y. (1989). Comorbidity and its impact on disability. *The Milbank Quarterly*, *67*, 450-484.