The Protective Effect of Neighborhood Composition on Increasing Frailty Among Older Mexican Americans: A Barrio Advantage?

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Abstract

Objective: Little is known about the nature of the frailty syndrome in older Hispanics who are projected to be the largest minority older population by 2050. The authors examine prospectively the relationship between medical, psychosocial, and neighborhood factors and increasing frailty in a community-dwelling sample of Mexican Americans older than 75 years.

Method: Based on a modified version of the Cardiovascular Health Study Frailty Index, the authors examine 2-year follow-up data from the Hispanic

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Established Populations for Epidemiologic Studies of the Elderly (H-EPESE) to ascertain the rates and determinants of increasing frailty among 2,069 Mexican American adults 75+ years of age at baseline. **Results:** Respondents at risk of increasing frailty live in a less ethnically dense Mexican-American neighborhood, are older, do not have private insurance or Medicare, have higher levels of medical conditions, have lower levels of cognitive functioning, and report less positive affect. **Discussion:** Personal as well as neighborhood characteristics confer protective effects on individual health in this representative, well-characterized sample of older Mexican Americans. Potential mechanisms that may be implicated in the protective effect of ethnically homogenous communities are discussed.

**Keywords**

neighborhood context, frailty, disability, cognitive, positive affect, Mexican Americans

**Background**

Frailty is a geriatric syndrome marked by significant decreased reserves in multiple organ systems. Associated with age, frailty is an important health problem affecting 15% of persons aged 65 years to 80% for persons older than 90 years (Hamerman, 1999). Frailty is linked with increased risk for falls, decreased mobility, greater comorbidity, functional impairment, maltreatment, institutionalization, and even death (Ahmed, Mandel, & Fain, 2007; Baker, 2007; Fried, Ferrucci, Darer, Williamson, & Anderson, 2004; Klein, Klein, Knudtson, & Lee, 2005; Newman et al., 2001). With the aging of the U.S. population, and the exponential growth of persons older than 85 years (Administration on Aging, 2009), the number of frail persons is estimated to increase significantly, thus presenting a significant public health concern. Frailty not only affects the older person but is also considered a significant burden on caregiving families (National Alliance for Caregiving and AARP, 2009) and resource utilization in health and long-term care systems in the United States (Baker, 2007; Field & Jette, 2007).

The definition and measurement of frailty has been the source of considerable debate in the last decade (Ahmed et al., 2007; Bandeen-Roche et al., 2006; Fried et al., 2001) and is regarded as distinguishable from disability and age-related declines in health. For the purpose of this study, we base our definition of frailty on work from the Cardiovascular Health Study such that frailty is “... a syndrome of decreased resiliency and reserves, in which a
mutually exacerbating cycle of declines across multiple systems results in negative energy balance, sarcopenia, and diminished strength and tolerance for exertion” (Bandeen-Roche et al., 2006, p. 262; Fried et al., 2001). Fried and her associates (Fried et al., 2001) proposed that frailty follows a continuum or cycle and is based on a multifactorial operational criteria for assessing frailty including (a) unexplained weight loss, (b) poor grip strength, (c) self-reported exhaustion, (d) slow walking speed, and (e) low physical activity. Previous research has shown that pre-frail individuals are more likely to develop the full syndrome than nonfrail persons (Fried et al., 2001) and to exhibit poor health outcomes and institutionalization (Fried et al., 2001; Mitniski, Graham, Mogilner, & Rockwood, 2002) than their nonfrail counterparts. Thus, given the cycle of frailty, identifying persons meeting the pre-frail stage is crucial.

The degree to which frailty can be prevented or reversed is based on a variety of factors, including proper geriatric assessments, lifestyle changes such as physical exercise and strength building, nutritional maintenance and supplementation, maintenance of oral health, environmental modifications, caregiver education, and health care provider training, and so on directed toward prevention and treatment goals (Benefield & Higbee, 2007; Fried et al., 2004). It is important that future efforts to delay the frailty syndrome—or mitigate its effects—include clinical interventions that target specific risk and protective factors early in the continuum of health care. Studies that identify the determinants of frailty are well suited to inform prevention and treatment strategies in older people. Since not all older adults become frail, it is important to examine what factors may trigger frailty or be associated with the increased risk for frailty in older adults, or conversely, which factors may actually be associated with nonfrailty in later life. To date, predictors of frailty include the following factors (see Espinoza & Fried, 2007): (a) physiologic (activated inflammation, decreased immune function, anemia, endocrine system alterations, and musculoskeletal alterations), (b) medical illness/comorbidity (diseases such as cardiovascular disease, stroke, diabetes, obesity, and so on, impaired CNS function, and cognitive impairment), (c) psychological factors (psychological well-being, depressive symptoms), (d) disability and self-reported health, and (e) sociodemographic factors (female gender, lower socioeconomic status, race).

Previous work has shown a higher prevalence of frailty in non-White populations (Fried, 2001; Hirsch et al., 2006; Woods et al., 2005), yet little is known about the nature of the frailty syndrome in older Hispanics who are projected to be the largest minority older population by 2050, comprising approximately 18% of the population above age 65 (Congressional Budget Office, 1999; U.S.
Census Bureau, 2002). What is largely known to date about frailty using standardized measures in older U.S. Hispanics is drawn from an emerging literature based on data from two studies: the Hispanic Established Populations for the Epidemiologic Studies of the Elderly (H-EPESE), a longitudinal population-based study of community dwelling U.S. Mexican Americans aged 65 years or older (Markides, Rudkin, Angel, & Espino, 1997), and the San Antonio Longitudinal Study of Aging (SALSA; Stern, Pugh, Gaskill et al., 1982), a bi-ethnic cohort study of Mexican Americans and Euro-Americans in San Antonio, Texas. The state of the knowledge is summarized here: (a) Frailty status is associated with increased 10-year mortality in older men and women of Mexican American descent (Berges, Graham, Ostir, Markides, & Ottenbacher, 2009; Graham et al., 2009; Ottenbacher et al., 2009); (b) frailty is also associated with 10-year disability (Al Snih et al., 2009); (c) correlates of frailty status include gender, baseline frailty age, diabetes, arthritis, smoking status, body mass index (BMI), poor cognitive functioning, negative affect, lower muscle strength, functional impairment, number of comorbid conditions, and obesity (Ottenbacher et al., 2009, 2005); (d) frailty status is linked to subsequent cognitive decline (Samper-Ternent, Al Snih, Raji, Markides, & Ottenbacher, 2008); (e) cognitive impairment is independently associated with frailty over a 10-year period (Raji, Al Snih, Ostir, Markides, & Ottenbacher, 2010); (f) when compared to persons who are not frail, individuals identified as frail and pre-frail exhibit significantly lower health-related quality-of-life scores (Masel, Graham, Reistetter, Markides, & Ottenbacher, 2009), which may partly attenuate odds of mortality (Masel, Ostir, & Ottenbacher, 2010); (g) using ethnic-specific criteria to characterize frailty in a bi-ethnic cohort results in no difference in frailty prevalence between Mexican Americans versus European Americans (Espinoza & Hazuda, 2008); and lastly, (h) the odds of incident frailty (average 9.9 years) is significantly lower for Mexican Americans than European Americans after covariate adjustments (Espinoza, Jung, & Hazuda, 2010).

Taking what is known about the determinants of frailty in the non-Hispanic White population (Espinoza & Fried, 2007), there are several factors that are known to differ in older U.S. Mexican Americans compared to their non-Hispanic White counterparts. For example, compared to non-Hispanic Whites, older Mexican Americans have a high incidence of diabetes and obesity (Ostir, Markides, Freeman, & Goodwin, 2000; Stern, Patterson, Mitchell, Haffner, & Hazuda, 1990), low access to primary care services (Gornick et al., 1996), are more functionally impaired (Berkman & Gurland, 1998), and have low rates of physical activity and report more disabilities than non-Hispanic Whites (see Markides, 2007). Other factors related to frailty may differ;
namely, Hispanic older adults have significantly higher rates of depressive symptomatology (Black, Markides, & Miller, 1998; Blazer, Hughes, & George, 1987; Gonzalez, Haan, & Hinton, 2001; White, Kohout, Evans, Cornoni-Huntley, & Ostfeld, 1986) and major depressive disorder (Jimenez, Alegria, Chen, Chan, & Laderman, 2010), receive significantly more hours of informal care (Weiss, Gonzalez, Kabeto, & Lange, 2005), and report higher number of risk factors for impaired cognitive functioning (Alzheimer’s Association, 2004). Taken together, these factors may influence the frailty onset, nature, trajectory, and outcomes in this older minority population. Addressing these factors can assist in the development of intervention targets specifically tailored to the individual, family, and environmental systems that together combine to help older adults age successfully.

Mounting evidence indicates that neighborhood context has significant effects on individuals over and beyond individual factors. The major finding from these studies underscores the relationship between socioeconomically disadvantaged neighborhoods and less favorable mortality and morbidity outcomes (Pickett & Pearl, 2001). Data from the H-EPESE have shown that older Mexican Americans living in census tracks with high Mexican American density have better self-rated health, higher cognitive functioning, lower medical morbidity, and lower mortality rates (Eschbach, Ostir, Patel, Markides, & Goodwin, 2004; Patel, Eschbach, Rudkin, Peek, & Markides, 2003; Sheffield & Peck, 2009) independent of individual characteristics. Thus, at least for Hispanics of Mexican American descent, living in a relatively ethnically homogenous neighborhood may afford certain health benefits despite the socioeconomic disadvantages found in such homogenous neighborhoods.

Generally speaking, potential mechanisms that may protect against low socioeconomic status and economic distress present in Mexican American neighborhoods are high levels of social cohesion and support based on dense exchanges of material and emotional resources, intact family structures, normative socialization and social regulation, high labor force participation, residential stability, home ownership, and community institutions that provide support to residents (Blank & Torrecilha, 1998; Eschbach et al., 2004; Moore & Vigil, 1993; Patel et al., 2003; Rodriguez, 1993; Vega et al., 2011; Vélez-Ibáñez, 1993). These factors may translate into overall health-related benefits at the individual level, including preventing or mitigating frailty. The mechanisms by which the main effects of ethnically homogenous neighborhoods and better physical outcomes in this population is unknown, but several factors may be implicated: the population density of Hispanic immigrants who generally report more favorable health outcomes than U.S.-born
Mexican Americans (Morales, Lara, Kington, Valdez, & Escarce, 2002), the fact that ethnic Hispanic enclaves or barrios do not necessarily result in an underclass status (see Moore & Pinderhughes, 1993), and physical “built” environment characteristics that promote healthy behaviors such as walking and extended social networks (Clark & George, 2005; Verbrugge & Jette, 1994).

Taken together, we sought to examine prospectively the relationship between medical, psychosocial, and neighborhood factors and increasing frailty in a community-dwelling sample of nonfrail older Mexican Americans aged more than 75 years. Our efforts are the first to test prospectively both individual and neighborhood factors as determinants of frailty status in a well-characterized sample of old-old persons. To our knowledge, this is the first study to respond to the call for a broader approach to studying frailty from the perspective of medical, psychosocial, and environmental factors (Fillit & Butler, 2009; Markle-Reid & Browne, 2003).

Method

Data

We obtained our sample from the Hispanic Established Populations for Epidemiologic Studies of the Elderly (H-EPESE), a longitudinal study of Mexican Americans 65 years and older residing in Texas, New Mexico, Colorado, Arizona, and California (Markides et al., 1997). These states included 85% of the Mexican American population aged 65 and above living in the United States when the survey began in 1993 and was representative of approximately 500,000 older Mexicans Americans living in the Southwest in the mid-1990s. A multistage area probability cluster design was used involving systematic selection of counties, census tracts, and households. Follow-up surveys were conducted every 2 to 3 years with the present study drawing from 2-year follow-up data obtained at the fifth and sixth waves (2004/2005 to 2007). Individual-level data from these two waves were used because they included all the measures necessary to compute the Frailty Index. At the fifth wave, an additional probability sample of 902 Mexican Americans were added resulting in a combined sample of 2,069 all of whom were at least aged 75 and older (Beard, Ghatrif, Samper-Tement, Gerst, & Markides, 2009). The University of Texas Medical Branch (UTMB) Institutional Review Board (IRB) approved the initial study in 1993 and annual continuing review applications since then.
A total of 153 were removed from the analyses because they were already frail at baseline. We conducted additional bivariate analysis (table not shown) and found the following: Wave 5 frail persons who were excluded from the analysis were more likely than the nonfrail included persons to have difficulty paying bills, more likely to have hip fracture, have low BMI, have less education, have low positive affect, score lower in cognitive functioning, report more ADL and IADL limitations, report more exhaustion and weight loss, and had less favorable performance on the hand grip and walk tests.

At the end of the sixth wave follow-up in 2007, 1,447 persons were reinterviewed in person, 275 were confirmed dead through the National Death Index, the Social Security Death Index, and reports from relatives. An additional 164 were lost to follow-up, and 97 refused to be reinterviewed. The final sample in this analysis consisted of 963 nonfrail individuals who had complete data on relevant variables under study.

Measures

**Frailty Index.** Our frailty status measure was based on a modified version of criteria developed by Fried and Walston (Fried et al., 2001) and included weight loss, exhaustion, walking speed, and grip strength. Physical activity was not measured during these two waves of the study, and therefore, this component was not used. The four components and how they were measured are described in detail elsewhere based on the H-EPESE sample (Al Snih et al., 2009; Graham et al., 2009; Ottenbacher et al., 2009; Samper-Ternent et al., 2008). Participants with two or three components present were considered frail, participants with one component were considered pre-frail, and those with no components were considered not frail.

**Health-related variables.** Medical illnesses/comorbidity: Specific medical conditions were included and coded dichotomously with 0 = “no” and 1 = “yes” and summed for a total medical conditions score. Included were self-reported physician diagnoses of arthritis, diabetes, cancer, heart attack, hip fracture, stroke, and hypertension. Smoking status was measured by lifetime history of smoking (“ever smoked”) and coded similarly. Body mass index (BMI) was calculated in the standard manner by dividing weight in kilograms divided by height in meters squared and stratified by gender with ≤18.5 considered underweight and coded dichotomously (1 = yes, 0 = no).

Functional status/disability: Activities of daily living (ADL) were assessed through self-reports of needing help performing seven distinct ADL (Hughes, Edelman, Singer, & Chang, 1993). If the
participant was unable to complete an ADL, the item was coded 1 = “unable to perform.” Conversely, if the participant was able to perform the task, the item was coded 0. A total ADL summary score was constructed ranging from 0 to 7.

**Psychosocial measures.**

Cognitive performance: We included the scores from the 30-item version of the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975; Nguyen, Black, Ray, Espino, & Markides, 2002; Samper-Ternent et al., 2008) with higher scores indicating more favorable cognitive performance.

Positive affect: A positive affect scale was created from four items of the CES-D scale (Radloff, 1977): “I felt that I was just as good as other people,” “I felt hopeful about the future,” “I was happy,” and “I enjoyed life.” Responses to the four items were scored on a 4-point scale: 0 = rarely or none of the time (<1 day), 1 = some or a little of the time (1-2 days), 2 = a moderate amount of the time (3-4 days), or 3= most of the time (5-7 days). Higher values indicate higher levels of positive affect.

Emotional support: To measure the availability of perceived emotional support, we created an index consisting of two items. Participants were asked whether they could (a) rely on someone in times of trouble, and (b) could talk about their deepest problems with family or friends. Having someone available “most or all of the time” was coded as 1, and responses indicating “not at all” were coded as 0.

**Neighborhood context.** We measured neighborhood percent Mexican American based on the percent of Mexican Americans living in census tracts of residence as coded by the 2000 U.S. Census (Eschbach et al., 2004; Patel et al., 2003). The analyses included data on 386 census tracts across the same five Southwestern states in the baseline wave. The percentage of the population of the census tract that was Hispanic was determined at the census tract level; thus, the percentage was calculated as the total number of Hispanic cases in the tract divided by the total population in the census tract. All individual-level data were linked to their associated census tract of residence by the respondents’ zip codes. Sampling weights for each wave were raked to population totals from Census 2000 5% public use file and Census Summary files 1 and 4 using Izrael’s enhanced raking macro, a procedure that reduces nonresponse and noncoverage biases in order to improve the relationship between the sample and the population.
by adjusting the sampling weights of the cases (Izrael, Hoaglin, & Battaglia, 2000, 2004). Raking variables were age, gender, state of residence, education by immigrant status, and percentage Mexican American in census tract of residence. We computed a high-density Mexican American neighborhood variable by dichotomizing the neighborhood census track data at the 60th Hispanic density percentile: 1 = ≥60% = “high” Mexican American neighborhood census tract density, and 0 = <60% = “low” Mexican American neighborhood census tract density. Although this threshold is somewhat arbitrary, we based the dichotomization at the selected upper threshold cutoff point of 60% as done by Eschbach and his associates (Eschbach, Mahnken, & Goodwin, 2005) with respect to their work on Hispanic cancer surveillance and neighborhood composition. We use the “high” Mexican American category as the reference category, given that high concentration Mexican American neighborhoods may afford potentially protective mechanisms on health as cited above. Proximity to the U.S.-Mexico border was measured as a continuous variable based on U.S. Census tract information on distance from an official port of entry on the U.S.-Mexico border.

**Covariates.** Sociodemographic factors included age (in years), gender (1 = female, 0 = male), education, nativity (1 = U.S. born, 0 = foreign born), language of interview (1 = Spanish, 0 = English), lives alone (1 = yes, 0 = no), financial strain (1 = having trouble paying bills, 0 = not having trouble), and having private insurance or Medicare (1 = yes, 0 = no). Education was reported with respect to highest grade of schooling completed and treated as a continuous variable.

**Data Analyses**

Our analyses used descriptive and univariate statistics (t tests) for continuous variables and contingency tables ($\chi^2$) for categorical variables using SAS® 9.2 (SAS Institute, Inc., 2010) to adjust for complex sample design. Given that frailty has an ordinal response scale, the proportional odds assumption was tested and supported using the score test, $\chi^2 = 7.7$, $df = 13$, $p = .862$ (Stokes, Davis, & Koch, 2000). We therefore used ordinal logistic regression to examine the association of variables collected in Wave 5 (2004/2005) with frailty status in Wave 6 (2007). Cumulative logits were modeled based on predicting increasing frailty from nonfrailty to pre-frailty and frailty status as the outcome, and therefore, the odds ratios we present are estimates of the likelihood of rating increasing frailty from no frailty to pre-frailty and frailty status. We computed four models with the Frailty Index rating in 2007 as the outcome variable in each model. Model 1 consisted of sociodemographic variables as predictors (age, gender, education, language of interview, financial strain, and private insurance or Medicare). In the second model, we
added health-related variables such as number of medical conditions, being underweight, and total ADL impairment. For the third model, we added psychosocial variables, namely, cognitive performance, positive affect, living alone, and emotional support. And lastly, we added high-density Mexican American neighborhood in our fourth model. IADL impairment and proximity to U.S.-Mexico border were not included in the multivariate modeling due to high collinearity with ADL impairment and Mexican American neighborhood density, respectively.

Results

A description of the sample characteristics at baseline by frailty status at the 2-year follow-up is presented in Table 1. The sample was divided into three frailty-specific groups at follow-up: not frail \((n = 285, 29.6\%)\), pre-frail \((n = 321, 33.3\%)\), and frail \((n = 357, 37.1\%)\). On average, frail respondents were significantly more likely to be older, live further from the U.S.-Mexico border, live in high-density Mexican American neighborhoods, and less likely to have private insurance or Medicare. Furthermore, frailty respondents were significantly more likely to report more medical conditions; to have arthritis, diabetes, and history of heart attack; be underweight; report more ADL and IADL impairment, and have less cognitive functioning as well as lower levels of positive affect.

We also conducted additional bivariate analysis (table not shown) and found that the sample characteristics differed by the dichotomous neighborhood composition variable in the following ways: Compared to respondents who live in <60% low-density Mexican American areas, those who live in ≥60% high-density Mexican American areas were significantly more likely to have private insurance, have difficulty paying bills, less likely to live near the border, more likely to be foreign born, less likely to report heart attack, and lastly, more likely to be interviewed in Spanish.

Results from our four ordinal logit models predicting nonfrailty versus increasing level of frailty status (i.e., pre-frailty or frailty status) are presented in Table 2. Our first model in which we entered the demographic covariates we found that older age, Spanish-language interview, and private insurance/Medicare were significantly associated with increasing frailty. The odds of increasing frailty are 8% higher for every 1-year increase in age, whereas the odds of increasing frailty are 32% lower for persons who interviewed in English. The odds of increasing frailty were 36% lower for respondents with private insurance or Medicare than without these types of insurance.

<table>
<thead>
<tr>
<th></th>
<th>Not frail, n (% or mean + SD)</th>
<th>Pre-frail, n (% or mean + SD)</th>
<th>Frail, n (% or mean + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>285 (29.6)</td>
<td>321 (33.3)</td>
<td>357 (37.1)</td>
</tr>
<tr>
<td>Age (years)****</td>
<td>79.81 (3.5)</td>
<td>80.5 (4.3)</td>
<td>81.7 (4.7)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
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<tr>
<td>Male</td>
<td>113 (29.7)</td>
<td>124 (32.6)</td>
<td>143 (37.6)</td>
</tr>
<tr>
<td>Female</td>
<td>172 (29.5)</td>
<td>197 (33.8)</td>
<td>214 (36.7)</td>
</tr>
<tr>
<td>Education</td>
<td>5.5 (4.3)</td>
<td>5.6 (4.3)</td>
<td>5.2 (3.9)</td>
</tr>
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<td>Nativity</td>
<td></td>
<td></td>
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<td>Born in the United States</td>
<td>164 (30.3)</td>
<td>181 (33.4)</td>
<td>197 (36.4)</td>
</tr>
<tr>
<td>Born in Mexico</td>
<td>121 (28.7)</td>
<td>140 (33.3)</td>
<td>160 (38.0)</td>
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<td>Language of interview</td>
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<tr>
<td>Spanish</td>
<td>247 (82.9)</td>
<td>295 (80.4)</td>
<td>373 (78.5)</td>
</tr>
<tr>
<td>English</td>
<td>236 (30.6)</td>
<td>258 (33.4)</td>
<td>278 (36.0)</td>
</tr>
<tr>
<td>Miles from U.S.-Mexico border****</td>
<td>79.4 (93.3)</td>
<td>86.2 (100.8)</td>
<td>119.7 (140.0)</td>
</tr>
<tr>
<td>Neighborhood composition*</td>
<td></td>
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<tr>
<td>High Mexican American density (≥60% MA)</td>
<td>23 (19.01)</td>
<td>26 (38.0)</td>
<td>52 (43.0)</td>
</tr>
<tr>
<td>Low Mexican American density (&lt;60% MA)</td>
<td>262 (31.1)</td>
<td>275 (32.7)</td>
<td>305 (36.2)</td>
</tr>
<tr>
<td>Living arrangements</td>
<td></td>
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<tr>
<td>Alone</td>
<td>78 (27.4)</td>
<td>94 (33.0)</td>
<td>113 (39.7)</td>
</tr>
<tr>
<td>With others</td>
<td>207 (30.5)</td>
<td>227 (33.5)</td>
<td>244 (36.0)</td>
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<td>Financial strain</td>
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</tr>
<tr>
<td>No difficulties paying bills</td>
<td>57 (13.5)</td>
<td>146 (34.7)</td>
<td>218 (51.8)</td>
</tr>
<tr>
<td>Difficulties paying bills</td>
<td>72 (13.6)</td>
<td>186 (35.2)</td>
<td>271 (51.2)</td>
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(continued)
<table>
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<tr>
<th>Medical Comorbidity</th>
<th>Not frail, n (% or mean + SD)</th>
<th>Pre-frail, n (% or mean + SD)</th>
<th>Frail, n (% or mean + SD)</th>
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<td><strong>Type of insurance</strong></td>
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<tr>
<td>Private/Medicare</td>
<td>172 (33.1)</td>
<td>174 (33.5)</td>
<td>174 (33.5)</td>
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<td>Public/Medicaid</td>
<td>113 (25.5)</td>
<td>147 (33.2)</td>
<td>183 (41.3)</td>
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<td><strong>Smoking status</strong></td>
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<td>Never smoked</td>
<td>154 (30.2)</td>
<td>170 (33.3)</td>
<td>186 (36.5)</td>
</tr>
<tr>
<td>Ever/currently smoke</td>
<td>131 (29.0)</td>
<td>151 (33.5)</td>
<td>169 (37.5)</td>
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<tr>
<td><strong>Emotional support</strong></td>
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<td>Yes</td>
<td>64 (29.0)</td>
<td>80 (36.2)</td>
<td>77 (34.8)</td>
</tr>
<tr>
<td>No</td>
<td>221 (29.8)</td>
<td>241 (32.5)</td>
<td>280 (37.7)</td>
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<tr>
<td><strong>Number of medical conditions</strong></td>
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<td>1.9 (1.0)</td>
<td>2.1 (1.2)</td>
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<td><strong>Medical comorbidity</strong></td>
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<td></td>
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<tr>
<td>Arthritis</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>126 (23.1)</td>
<td>193 (35.4)</td>
<td>226 (41.5)</td>
</tr>
<tr>
<td>No</td>
<td>156 (38.7)</td>
<td>124 (30.8)</td>
<td>123 (30.5)</td>
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<tr>
<td>Diabetes</td>
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<tr>
<td>Yes</td>
<td>64 (21.6)</td>
<td>104 (35.0)</td>
<td>129 (43.4)</td>
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<td>No</td>
<td>220 (33.2)</td>
<td>216 (32.6)</td>
<td>226 (34.2)</td>
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<td>Cancer</td>
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<td>Yes</td>
<td>16 (25.4)</td>
<td>16 (25.4)</td>
<td>31 (49.2)</td>
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<td>No</td>
<td>268 (29.8)</td>
<td>305 (34.0)</td>
<td>325 (36.2)</td>
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<tr>
<td>Heart attack</td>
<td></td>
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<tr>
<td>Yes</td>
<td>28 (22.4)</td>
<td>42 (33.6)</td>
<td>55 (44.0)</td>
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<td>No</td>
<td>257 (30.7)</td>
<td>278 (33.3)</td>
<td>301 (36.0)</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th></th>
<th>Not frail, n (% or mean + SD)</th>
<th>Pre-frail, n (% or mean + SD)</th>
<th>Frail, n (% or mean + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hip fracture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10 (17.9)</td>
<td>19 (33.9)</td>
<td>27 (48.2)</td>
</tr>
<tr>
<td>No</td>
<td>275 (30.3)</td>
<td>302 (33.3)</td>
<td>330 (36.4)</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>29 (29.3)</td>
<td>23 (23.2)</td>
<td>47 (47.5)</td>
</tr>
<tr>
<td>No</td>
<td>256 (29.7)</td>
<td>298 (34.6)</td>
<td>308 (35.7)</td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>183 (28.9)</td>
<td>218 (34.4)</td>
<td>233 (36.8)</td>
</tr>
<tr>
<td>No</td>
<td>100 (31.6)</td>
<td>98 (30.9)</td>
<td>119 (36.8)</td>
</tr>
<tr>
<td><strong>Underweight (BMI &lt; 18.5)</strong></td>
<td>26.9 (4.3)</td>
<td>27.5 (4.8)</td>
<td>28.1 (4.9)</td>
</tr>
<tr>
<td>ADL functional status***</td>
<td>0.2 (0.9)</td>
<td>0.4 (1.3)</td>
<td>0.9 (1.8)</td>
</tr>
<tr>
<td>IADL functional status****</td>
<td>1.1 (1.6)</td>
<td>2.1 (2.4)</td>
<td>3.3 (2.8)</td>
</tr>
<tr>
<td>Cognitive status ****</td>
<td>23.9 (5.1)</td>
<td>22.9 (5.4)</td>
<td>21.9 (5.7)</td>
</tr>
<tr>
<td>Positive affect****</td>
<td>10.4 (2.2)</td>
<td>9.9 (2.6)</td>
<td>9.4 (2.7)</td>
</tr>
</tbody>
</table>

**Note.** N = 963. BMI = body mass index; ADL = activities of daily living; IADL = instrumental ADL; H-EPESE = Hispanic Established Populations for Epidemiologic Studies of the Elderly. Not frail was defined as a score of 0 on the Frailty Index, pre-frail as a score of 1, and frail as a score of 2 or 3. Chi-square test was used for categorical variables and analysis of variance for continuous variables.

*p < .05. **p = .01. ***p < .001. ****p < .0001.
**Table 2.** Ordinal Logit Models Predicting Increasing Frailty Status: Hispanic Established Populations for Epidemiologic Studies of the Elderly

<table>
<thead>
<tr>
<th></th>
<th>Model 1: Demographics OR (95% CI)</th>
<th>Model 2: Medical OR (95% CI)</th>
<th>Model 3: Psychosocial OR (95% CI)</th>
<th>Model 4: Neighborhood OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>1.08 (1.05,1.11)****</td>
<td>1.08 (1.05,1.11)****</td>
<td>1.08 (1.04,1.11)***</td>
<td>1.08 (1.05,1.12)***</td>
</tr>
<tr>
<td>Female</td>
<td>0.91 (0.71,1.16)</td>
<td>0.81 (0.63,1.04)</td>
<td>0.80 (0.62,1.03)</td>
<td>0.81 (0.63,1.05)</td>
</tr>
<tr>
<td>Education</td>
<td>0.99 (0.97,1.03)</td>
<td>1.00 (0.97,1.04)</td>
<td>1.02 (0.98,1.06)</td>
<td>1.02 (0.98,1.06)</td>
</tr>
<tr>
<td>Spanish-language interview</td>
<td>0.68 (0.50,0.94)*</td>
<td>0.69 (0.50,0.95)*</td>
<td>0.74 (0.53,1.03)</td>
<td>0.79 (0.56,1.10)</td>
</tr>
<tr>
<td>Financial strain</td>
<td>0.99 (0.77,1.27)</td>
<td>0.89 (0.67,1.16)</td>
<td>0.88 (0.68,1.14)</td>
<td>0.91 (0.70,1.19)</td>
</tr>
<tr>
<td>Private insurance or Medicare</td>
<td>0.64 (0.49,0.84)**</td>
<td>0.69 (0.52,0.90)**</td>
<td>0.70 (0.53,0.92)**</td>
<td>0.70 (0.53,0.91)**</td>
</tr>
<tr>
<td>Number of medical conditions</td>
<td>1.33 (1.19,1.49)****</td>
<td>1.32 (1.18,1.48)****</td>
<td>1.32 (1.18,1.48)****</td>
<td>1.32 (1.18,1.48)****</td>
</tr>
<tr>
<td>Underweight (BMI &lt; 18.5)</td>
<td>1.85 (0.91,3.74)</td>
<td>1.42 (0.69,2.93)</td>
<td>1.45 (0.70,3.01)</td>
<td></td>
</tr>
<tr>
<td>ADL functional status</td>
<td>1.27 (1.14,1.41)****</td>
<td>1.24 (1.12,1.38)****</td>
<td>1.20 (1.07,1.35)**</td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td>0.97 (0.94,0.99)*</td>
<td>0.97 (0.94,0.99)*</td>
<td>0.97 (0.94,0.99)*</td>
<td></td>
</tr>
<tr>
<td>Positive affect</td>
<td>0.92 (0.87,0.97)**</td>
<td>0.92 (0.88,0.97)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives alone</td>
<td>1.10 (0.84,1.44)</td>
<td>1.11 (0.84,1.46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional support</td>
<td>0.99 (0.74,1.32)</td>
<td>1.00 (0.75,1.34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-density Mexican American neighborhood (≥60% MA)</td>
<td>0.66 (0.45,0.96)*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. BMI = body mass index; ADL = activities of daily living; IADL = instrumental ADL; OR = odds ratio; 95% CI = 95% confidence interval. Not frail was defined as a score of 0 on the Frailty Index, pre-frail as a score of 1, and frail as a score of 2 or 3.

* p < .05. ** p = .01. *** p < .001. **** p < .0001.
Of the clinical covariate effects entered in Model 2 medical conditions and higher ADL impairment are associated with increasing frailty. We found that higher number of medical conditions and higher ADL impairment are associated with increasing frailty. The odds of increasing frailty are 33% higher for every one-unit increase in total number of medical conditions. The odds of increasing frailty were 27% higher for every one-unit increase in ADL impairment. Age, language of interview, and private insurance/Medicare remained significant. Being overweight was not significant in the model.

In our third model, we entered psychosocial covariates, including cognitive functioning, positive affect, living alone, and emotional support. Language of interview was no longer significantly associated with increasing frailty. Only cognitive functioning and positive affect were significant and in the expected direction. The odds of increasing frailty are 3% lower for one-unit increase in cognitive functioning as well as 8% lower risk for every one-unit increase in positive affect. None of the social support variables emerged as significant predictors. Age, private insurance/Medicare, medical conditions, and ADL impairment remained significant in the model.

Lastly, in our fourth and final model, we added ethnic neighborhood density, which was significantly associated with increasing frailty after controlling for demographic, clinical, and psychosocial variables. Participants living in an ethnically dense Mexican American neighborhood are at 34% decreased risk for increasing frailty than those who did not. The following variables remained significant in the fourth model: age, private insurance/Medicare, number of medical conditions, ADL impairment, cognitive functioning, and positive affect. In sum, the odds of increasing frailty in this sample of older Mexican Americans are the following: (a) 8% higher for every 1-year increase in age; (b) 30% lower for respondents with private insurance or Medicare; (c) 32% higher for every one-unit increase in number of medical conditions; (d) 20% higher for every one-unit increase in ADL impairment; (e) 3% lower for one-unit increase in cognitive functioning; (f) 8% lower risk for every one-unit increase in positive affect; and (g) 34% lower risk for respondents living in ethnically dense Mexican American neighborhoods.

Discussion

Drawing from H-EPESE longitudinal data of Mexican Americans older than 75 years, we sought to examine the relationship between medical, psychosocial, and neighborhood factors and increasing frailty. Although our study is not the first to show a link between neighborhood context and health outcomes in older Mexican Americans, our study is the first to examine clinical
and environmental determinants of frailty over time and in a well-characterized sample of nonfrail, old-old Mexican Americans with significant medical comorbidity and functional impairment. Our findings show the predictive validity of the modified frailty measure among our respondents; our multivariable results indicate that respondents at risk of increasing frailty were older, did not have private insurance or Medicare, had higher levels of medical conditions, had lower levels of cognitive functioning, reported less positive affect, and lived in a less ethnically dense Mexican American neighborhood. Given our results, several potentially important findings emerged from the data, which we will discuss here.

First, the data point to a protective neighborhood effect, namely, that ethnic homogeneity protects against increasing frailty status and that the effects are independent of individual-level risk factors. In fact, the heightened risk of increasing frailty afforded to those who lived in less ethnic homogeneous neighborhoods was higher than the clinical and functional variables known for their putative effect on poor health outcomes. Our results parallel previous studies that indicate a salubrious health effect of greater proportion of Hispanics living in the neighborhood (Eschbach et al., 2004; Patel et al., 2003; Sheffield & Peek, 2009).

Do our findings support a possible “barrio advantage” (Eschbach et al., 2004)? Although Mexican American neighborhoods are typically characterized as places with high poverty rates, low socioeconomic attainment, low access to health care, and high numbers of residents reporting unskilled manual and service occupations (Morales et al., 2002), we found a barrio advantage against increasing frailty in this representative sample of older Mexican Americans. As paradoxical as this may appear, several explanations may help us understand the paradox. Drawing from debates on Hispanic neighborhood poverty and the “barrio effect” (see Enchautegui, 1997; Moore & Pinderhughes, 1993) as well as social capital theory (Beard, Blaney et al., 2009), we can surmise that ethnically homogeneous neighborhoods afford several potentially protective attributes in Mexican American neighborhoods even in the face of factors that are associated with disability, for example, low neighborhood socioeconomic status, residential instability. Living in neighborhoods with other Hispanics appears to provide a health-related advantage as seen in previous work with cardiovascular health and mortality (LeClere, Rogers, & Peters, 1998; Lee & Cubbin, 2002), birth weight and infant health (Jenny, Schoendorf, & Parker, 2001; Pearl, Braveman, & Abrams, 2001), mental health (Aneshensel & Sucoff, 1996; Vega et al., 2011), sex practice risks (Parrado & Flippen, 2010), and fall risk (Landy, Mintzer, Silva, Dearwater, & Schulman, 2011).
Although the mechanisms that undergird this link cannot be ascertained with the current data, we offer potential alternative explanations of why this relationship may exist. First, living in areas with others of like identities may afford higher exchanges of social capital (Kandel & Massey, 2002) and health-related advantages associated with the Hispanic health paradox (Franzini, Ribble, & Keddie, 2001; Markides & Coreil, 1986). According to Patel and his associates (2003), “One of the oldest and most robust propositions about ethnic relationships is that segregation and concentration of an ethnic population maintain distinct ethnic subcultures and transmit them across generations” (p. 621). Living in household clusters and neighborhoods with “like-others” may maintain or increase the “‘cultural glue’ that maintains exchange relations between kin” (Vélez-Ibáñez, 1993, p. 211).

Second, understanding the dynamics of Hispanic neighborhoods, poverty, and resource exchanges within and across generations may provide additional insights into our “barrio advantage” findings. Drawing from sociological essays examining Hispanics neighborhoods and the underclass debate, Moore and Pinderhughs (1993) and their associates (Moore & Vigil, 1993; Rodriguez, 1993; Vélez-Ibáñez, 1993) posit that Hispanic neighborhoods have unique characteristics shaped by cultural, demographic, and historical forces that go against the early images of poverty in urban centers and other geographic settings as marked by isolation, decay, and loss of social control. On the contrary, previous work underscores that Hispanic neighborhoods with high concentrations of Hispanics, and particularly immigrants, contain certain dynamics that may mediate poverty, and actually revitalize neighborhoods, thus leading to better health outcomes: (a) enhancements of ethnic economies and institutions; (b) financial and in-kind exchanges across class levels; (c) provision of trusted cultural ambience buttressed by language and cultural identities; (d) access to trusted and useful formal and informal networks; (e) access to emotional resources and care activities across the lifespan, including care of the aged; and (f) household clusters based on dense exchanges and “‘funds of knowledge’ that form the basis of material survival” (Vélez-Ibáñez, 1993, p. 211).

Less known are the environmental or neighborhood factors that may affect frailty in late life, especially those that present as physical barriers between the person’s functional capacity and the opportunity to carry out desired activities such as walking, obtaining needed resources, socializing with others, and so on. The built environment gives us another perspective to assess the potential influences that external factors may play on disability and frailty (Clark & George, 2005). Defined as the extra-individual forces that exacerbate or narrow the gap between individual functioning and an activity’s
demands (Verbrugge & Jette, 1994), the influences of the built environment on the disablement process may work through such mechanisms such as neighborhood density, pedestrian-oriented designs, land-use diversity, and so on. Empirical work on neighborhood effects on health have more recently included the role of the built environment on health and well-being, including architectural design (Brown et al., 2008). For example, increased availability of safe sidewalks, the accessibility of public transportation stops, and other pedestrian-oriented designs have been shown to encourage nonautomobile travel (Cervero & Kockelman, 1997; Kochera, 2003). The notion is that attributes of the built environment can increase greater “walkability” at the neighborhood level (Frank, Andresen, & Schmid, 2004), and thus, more favorable health outcomes. Prior work has shown that independence in self-care activities varies as a function of built-environment attributes such as housing density, land use diversity, and housing quality (Clark & George, 2005).

According to Brown et al., another possible mechanism by which neighborhoods may affect residents’ behavior and health is the creation or limitation of opportunities for social support, which has been found to be a key determinant of physical and emotional health (Brown et al., 2008; House, Landis, & Umberson, 1988). This can include mixed land use, moderate density, connectivity, as well as architectural and neighborhood design features (e.g., porches, stoops, windows, building along sidewalks just above street level) to promote direct observation and interaction among individuals in a neighborhood (Brown et al., 2008; Jacobs, 1961; Leccese & McCormick, 2000; Leyden, 2003), which in turn promote social capital. The explanation is that direct, face-to-face contact may be enhanced by particular physical/environmental characteristics that augment the availability of support or perceived support among older persons (Thompson & Krause, 1998). For example, older Hispanics in Miami, Florida, were found to have favorable physical functioning when neighborhood architectural features (i.e., front porches, stoops, buildings built above grade) facilitated visual and social contacts (Brown et al., 2008).

Another explanation is the potential health-related effects afforded by providing caregiving services to young family members in a child care role. Research supports the role of older Hispanics in terms of caretaking to young children and youth. Providing care to young children (supervision/escort, meal preparation, personal hygiene, other household tasks, recreation, etc.) necessitates certain physical behaviors (lifting, pushing, walking, etc.) that can be regarded as physical activity to some degree. Inasmuch as the older adult provides such care before and during their late life, the benefits of increased activity may be obtained. The child care/caregiving role would be
highlighted and reinforced in more traditional Hispanic communities where the cultural mores of caretaking to younger family members are reinforced and transmitted across generations (Giarrusso, Feng, & Silverstein, 2001; Schmidt & Padilla, 1983; Williams & Torrez, 1998). These interactions also afford greater social, affirmational, and instrumental interactions across generations not only to the grandchild generation but also to the middle generation as well (Giarrusso et al., 2001; Lawrence, Bennett, & Markides, 1992). Although we did not ascertain the phenomenon of grandparenting-caregiving in this study, future work should highlight this area of investigation as it pertains to health and frailty outcomes.

The medical data are not particularly surprising, given the strong evidence linking medical illnesses and functional disability (ADLs in particular) with frailty (Fried et al., 2001; Ottenbacher et al., 2009). Screening and identification of individuals who may be at risk is an important step toward providing interventions that are geared toward frailty prevention or health maintenance strategies.

Similar to the results found by others (Ostir et al., 2004; Ottenbacher et al., 2009) we found partial support for the association between psychosocial variables and increased frailty. With the exception of social support and living alone, both positive affect symptoms and cognitive functioning measures were significant predictors. Thus, similar to the findings by Ottenbacher and his associates, our study lends support to the recommendation that operational definitions of frailty include cognitive measures (Ferrucci et al., 2004; Kuh & New Dynamics of Ageing (NDA) Preparatory Network, 2007; Samper-Ternent et al., 2008).

Positive affect was found to be a significant correlate of frailty as previously found by Ostir et al. (2004). Although criteria for frailty and depression overlap, there is a lack of research on their reciprocal relationship (Bergman et al., 2007), which is problematic given the higher rates of severe depression in a large representative sample of older U.S. Hispanics (Jimenez et al., 2010). Future research will need to address the behavioral health implications of frailty on the individual and family caregivers, particularly in light of the fact that depression is poorly detected and managed in older adults in general, and in older Hispanics, in particular (Aranda, 2006).

Our study has several limitations worth noting. The follow-up period was relatively short, though we were able to find significantly associated determinants during this period. The rates of frailty may have been underestimated, given that our modified Frailty Index did not include the full components such as data on activity level. We identified only one dimension of neighborhood
context—ethnic density composition of the target population under study. Prior work has shown the importance of including multiple neighborhood context dimensions such as neighborhood economic level, density of foreign-born residents, indicators of social capital, characteristics of the built environment, and proximity to U.S.-Mexico border (Patel et al. 2003). Lastly, the medical comorbidity and functional disability data relied on responded self-reports versus clinically rendered diagnoses as an objective measurement of clinical and functional status. Nevertheless, assessments of ADL functioning and comorbidity have demonstrated a high concordance between self-reported data and direct observations and physician-rendered diagnoses, respectively (Haapanen, Miilunpalo, Pasanen, Oja, & Vuori, 1997; Reuben, Siu, & Kimpau, 1992).

Selection bias may have played a role in two ways. First, in our bivariate analyses we found statistical differences between the two samples of respondents living in more dense versus less dense Mexican-American neighborhoods. Perhaps some older Hispanics may choose to live in more (or less) dense neighborhoods as a result of personal, economic, familial, or community influences compared to their counterparts—preferences that we cannot ascertain in the current article.

For example, we found that respondents living in higher Mexican American-density areas were more likely to have private insurance and to be foreign born—two factors known to be associated with better physical health among older Hispanics. Second, because our intent was to ascertain determinants of increasing frailty in nonfrail respondents over the 2-year period, we omitted respondents who were already frail at baseline. As expected, we found that these already frail respondents differed in terms of indicators used in our frailty measure and other indicators associated with frailty (e.g., hip fracture, lower education). Yet it is unlikely that these older respondents would have become nonfrail after 2 years; thus, our proportion of frail respondents at the 2-year observation point is likely underestimated.

Two points are worth mentioning. First, though older Mexican Americans are not a segment of the population that moves frequently, it would be important to account for respondents who may have relocated to other neighborhoods between the two observation points, especially if the ethnic-compositions of those two neighborhoods were quite different. This is unlikely given that income levels among this old-old population are not likely to vary significantly, and changes in living arrangements (e.g., moving in with family or related adults) among this noninstitutionalized sample are more likely due to health-related events such as increased frailty. Second, though poverty level
is not a primary focus of this work, it would have been helpful to know whether, in fact, there is a significant correlation between Mexican American neighborhood concentration and poverty as reported in previous research (Angel & Angel, 2009). This would allow for more nuanced comparisons as a function of poverty level and ethnic composition.

Our study includes several strengths. To our knowledge, we are the first to draw our data from the largest community-based study of older Mexican Americans in the United States, and the first to include the sixth and latest wave of data in the H-EPESE of old-old respondents aged more than 75 years for which the Frailty Index is particularly salient. Thus, a major strength of the study is the use of longitudinal data to observe determinants of increasing frailty, strengthening the argument that neighborhoods may have some causal effect on health independent of system-level. Our frailty measure was operationally defined based partly on several field-based objective measures (upper-extremity strength, height, and weight). We are the first to use a dimension of neighborhood context as a determinant of frailty with a focus on Mexican Americans, a rapidly growing segment of the U.S. older population. Furthermore, we provide several multilevel explanations to help disentangle the barrio advantage with respect to a minimally studied health phenomenon in older Hispanics: frailty.

In conclusion, research into the paradox of the barrio advantage in late life can open new perspectives on aging successfully. Future work will be needed to disentangle the potential socioenvironmental influences that bestow protective effects on health in late life among minorities who will comprise a sizeable segment of our aging population. The mechanisms by which facets of ethnic culture, demographics, and historical forces interact with the built environment and traditional assessments of frailty may provide a key to healthy aging. We signal a call for translational research that leads to the adoption of biopsychosocial-environmental interventions that reduce the burden of frailty among older persons, families, and the larger community.

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Declaration of Conflicting Interests

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