Walking Activity and Physical Function Among Mexican American Older Adults Over 9 Years of Follow Up

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Background: Walking activity has been associated with reduction in the development of chronic disease, cognitive and physical function impairment, disability, and mortality. The objective of this study was to examine the relationship between walking activity and physical function over 9 years of follow-up among Mexican Americans aged 78 years and older. Methods: Participants (N = 998) were from the Hispanic Established Population for the Epidemiologic Study of the Elderly (2007–2016). Measures included walking activity duration and frequency, socio-demographics, body mass index, medical conditions, pain, depressive symptoms, limitation in activities of daily living, and the Mini-Mental State Examination. Low physical function was defined as scoring <7 on the Short Physical Performance Battery. At baseline, participants were grouped into nonwalkers (n = 653), walked <150 minutes/week (n = 144), and walked 150 minutes/week or more (n = 201). A Generalized Estimating Equation model was used to estimate the odds ratio and 95% CI of low physical performance as a function of walking activity status. Results: Compared with nonwalkers, participants walking <150 minutes/week had lower odds (odds ratio = 0.66, 95% CI, 0.51–0.86) of low physical function over time, after controlling for all covariates, as did those walking ≥150 minutes/week (odds ratio = 0.54, 95% CI, 0.41–0.71). Conclusions: Mexican American older adults who engage in any walking activity are at reduced risk of low physical function, even those with disability. Interventions at the individual and community level are recommended to reduce physical function impairment, even in those with preexisting medical conditions or disability.

Keywords: exercise, mobility, aging, Hispanic, Short Physical Performance Battery

The Centers for Disease Control and Prevention (CDC) recommend that adults aged 65 years or older walk briskly at least 150 minutes each week, along with performing at least 2 muscle-strengthening exercises each week.¹,² Although walking activity has not been proven to outright increase the life expectancy of older adults, it has been shown to reduce the development of chronic disease, cognitive and physical function impairment, disability, and risk of mortality.³–⁷ Findings from national population-based studies show that the proportion of older adults meeting the walking activity guideline (WAG) ranges from 27.3% to 44.3%,⁸ with men reporting higher levels of walking activity than women, and non-Hispanic Whites reporting higher levels of walking activity than non-Hispanic Blacks and Hispanics.²,⁸ Studies have also demonstrated that prevalence of walking activity in older adults decreases with age.⁵,⁹

Both subjective and objective measures of walking activity in the older adult population shows clinically significant improvement in studies measuring physical function, such as balance performance and gait speed.³,⁶,⁷,¹¹ While limitations in mobility and self-reported poor physical health are among the most reported barriers to walking activity,¹²,¹³ walking activities help improve both of these conditions.¹⁶,¹⁴ Even older adults with mobility limitations may see improvement in their physical function with some walking activity, even at a level below national recommendations.²,³

The number of people aged 65 and older in the United States is projected to increase from 49 million in 2016 to 94.7 million by 2060, and to become more racially and ethnically diverse,¹⁵ with the Hispanic population increasing from 11% to 22%.¹⁶ Limited evidence exists on whether Mexican American older adults walk at the WAG recommended level. Data from the Behavioral Risk Factor Surveillance System showed that Hispanic adults had the highest prevalence of physical inactivity (32.1%), followed by non-Hispanic Black (30.0%), non-Hispanic American Indian/Alaska Native (29.1%), non-Hispanic White (23.0%), and non-Hispanic Asian adults (20.1%).¹⁷ Previous findings in Mexican American older adults showed that higher levels of walking activity were associated with lower cognitive decline and mortality rates.¹⁸ Another study that examined the effect of 10-year physical activity changes on 7-year mortality found that walking activity increased in the group with high unchanged physical activity and among those in the increased all physical activities group.¹⁹ However, no studies have examined the effect of exercise on physical function among Mexican American older adults. Therefore, this study aims to examine the relationship between level of walking activity and physical function impairment among older Mexican Americans aged 78 years and older over 9 years of follow up. We hypothesize that those who walk at or above WAG will have lower odds of physical function impairment over time.

Methods

Sample

Data were from the Hispanic Established Populations for the Epidemiologic Study of the Elderly, a longitudinal study of Mexican Americans aged 65 and older residing in Arizona, California,
Participants were grouped into those with no walking activity per week of walking activity by dividing the sum of the totals by the Death Index or reports from relatives. The university Institutional interview, and 559 were con
At the end of the follow up, 330 participants were interviewed in Performance Battery (SPPB) scores, and lower handgrip strength. The Mini-Mental State Examination (MMSE), lower Short Physical daily living; and to have a low body mass index, lower scores on fracture, high depressive symptoms, and limitations in activities of likely to be older; to report diabetes, stroke, heart failure, hip fracture, cancer, or stroke. Pain on weight-bearing was assessed with the following question: “In the past month, did you notice any pain or discomfort when you stood or walked?” to which participants responded either “Yes” or “No.” Body mass index was calculated by dividing the participant’s measured weight in kilograms by measured height in meters squared (in kilograms per meter squared). Depressive symptoms were measured with the Center for Epidemiologic Study Depression Scale; scores ranged from 0 to 60, with a score of 16 or more indicating a participant with high depressive symptoms. We assessed cognitive function using the 30-item MMSE. We defined disability as no help required versus requiring help or unable to perform one or more of the 7 activities of daily living (grooming, bathing, eating, transferring, walking, toileting, and dressing).

Socio-demographic variables included age, sex, years of formal education, marital status (married vs unmarried), and nativity (United States born vs Foreign-born). The presence of comorbidities was assessed by asking if a medical doctor previously told participants that they had hypertension, arthritis, diabetes mellitus, heart failure, heart attack, hip fracture, cancer, or stroke. Pain on weight-bearing was assessed with the following question: “In the past month, did you notice any pain or discomfort when you stood or walked?” to which participants responded either “Yes” or “No.” Body mass index was calculated by dividing the participant’s measured weight in kilograms by measured height in meters squared (in kilograms per meter squared). Depressive symptoms were measured with the Center for Epidemiologic Study Depression Scale; scores ranged from 0 to 60, with a score of 16 or more indicating a participant with high depressive symptoms. We assessed cognitive function using the 30-item MMSE. We defined disability as no help required versus requiring help or unable to perform one or more of the 7 activities of daily living (grooming, bathing, eating, transferring, walking, toileting, and dressing).

Chi-square and analysis of variance tests were used to examine the baseline distribution of variables by level of walking activity. Generalized Estimation Equation (GEE) models using the GENMOD procedure in SAS were used to estimate the odds ratio (OR) and 95% CI of low physical function over time as a function of level of walking activity after controlling for all covariates. The models used a logit link binomial distribution and unstructured correlation structure to account for repeated measures of participants. The covariation matrices for GEE were chosen based on the Akaike information criterion and Bayesian information criterion values. We used GEE models because of their several strengths: (1) the number of repeated measurements per study participant is not required to be constant, (b) the assessment times do not have to be the same across study participants, (3) the GEE approach can be applicable to a binary response variable, (4) continuous and categorical variables can be used as time-dependent and time-independent variables, and (5) the GEE handles missing data using an all available pairs method. All variables were analyzed as time-varying, except for sex, education, and nativity. Two sensitivity analyses were performed: (1) we repeated the analyses, excluding those with SPPB <7 (n = 431) and (2) we analyzed separately the 3 tests of the SPPB (standing balance, a timed 8-feet walk, and repeated timed chair stands). Each test was categorized as unable to do or poor performance versus moderate, good, or best; the analyses for the 3 tests were performed with and without those with SPPB <7 at baseline. Participants who died, refused to participate, or were lost to follow up were included until their last interview over the 9 years of follow up. All analyses were performed using the SAS System for Windows (version 9.4, SAS Institute, Inc).

Table 1 presents the baseline descriptive characteristics of the overall sample and by level of walking activity. At baseline,

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653 of the 998 participants (65.4%) were nonwalkers, 144 (14.4%) walked <150 minutes per week, and 201 (20.1%) walked ≥150 minutes per week. The overall mean age was 82.8 (4.2) years, 61.9% of participants were female, 39.6% were married, 57.3% were born in the United States, and the mean years of education was 5.7 ± 3.9 years. The most frequently reported medical conditions were hypertension (66.8%), arthritis (62.2%), and diabetes (32.3%). Fifty-five percent reported pain on weight-bearing, and the mean MMSE and SPPB scores were 23.1 ± 5.9 and 5.5 ± 3.7, respectively. Compared with nonwalkers, those who walked ≥150 minutes per week were significantly more likely to be younger, male, and have a higher level of education; less likely to have arthritis, depressive symptoms, or pain; and had higher scores on the MMSE and the SPPB.

Figure 1 shows the percent of those with low physical function (SPPB <7) over time as a function of level of walking activity. The percent of those with low physical function ranged from 63.1% to 83.9% in the nonwalking group, 55.6% to 66.0% in the group that walked <150 minutes/week, and 37.3% to 63.6% in the group that walked ≥150 minutes/week. The percent of those with low physical function was significantly lower in those who walked ≥150 minutes per week compared to those who walked <150 minutes per week (p < .0001).

### Table 1 Overall Baseline Descriptive Characteristics of the Sample and by Walking Activity (N = 998)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total, N (%)</th>
<th>Nonwalking activity, N (%)</th>
<th>Walking &lt;150 min per week, N (%)</th>
<th>Walking ≥150 min per week, N (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>998 (100)</td>
<td>653 (65.4)</td>
<td>144 (14.4)</td>
<td>201 (20.1)</td>
<td>.6556</td>
</tr>
<tr>
<td>Age, y, mean (SD)</td>
<td>82.8 (4.2)</td>
<td>82.9 (4.3)</td>
<td>83.0 (4.4)</td>
<td>82.1 (3.7)</td>
<td>.0449</td>
</tr>
<tr>
<td>Sex (female)</td>
<td>618 (61.9)</td>
<td>416 (63.7)</td>
<td>93 (64.6)</td>
<td>109 (54.2)</td>
<td>.0416</td>
</tr>
<tr>
<td>Education, y</td>
<td>5.7 (3.9)</td>
<td>5.3 (3.8)</td>
<td>5.9 (4.1)</td>
<td>6.3 (4.2)</td>
<td>.0021</td>
</tr>
<tr>
<td>Marital status (married)</td>
<td>395 (39.6)</td>
<td>260 (39.8)</td>
<td>55 (38.2)</td>
<td>80 (39.8)</td>
<td>.9348</td>
</tr>
<tr>
<td>Nativity (US born)</td>
<td>572 (57.3)</td>
<td>385 (59.0)</td>
<td>77 (53.5)</td>
<td>110 (54.7)</td>
<td>.3429</td>
</tr>
<tr>
<td>BMI, kg/m², mean (SD)</td>
<td>26.9 (5.1)</td>
<td>27.1 (5.2)</td>
<td>27.1 (5.3)</td>
<td>26.4 (4.4)</td>
<td>.1900</td>
</tr>
</tbody>
</table>

**Medical conditions**

- Hypertension: 667 (66.8%), 441 (67.5%), 96 (66.7%), 130 (64.7%), p = .7526
- Arthritis: 621 (62.2%), 432 (66.2%), 87 (60.4%), 102 (50.8%), p = .0004
- Diabetes: 322 (32.3%), 218 (33.4%), 42 (29.2%), 62 (30.9%), p = .5510
- Heart failure: 257 (25.8%), 180 (27.6%), 36 (25.0%), 41 (20.4%), p = .1238
- Heart attack: 37 (3.7%), 24 (3.7%), 6 (4.2%), 7 (3.5%), p = .9439
- Stroke: 29 (2.9%), 21 (3.2%), 6 (4.2%), 2 (1.0%), p = .1624
- Cancer: 77 (7.7%), 51 (7.8%), 14 (9.7%), 12 (6.0%), p = .4312
- Hip fracture: 13 (1.3%), 10 (1.5%), 2 (1.4%), 1 (0.5%), p = .5253
- Depressive symptoms (CES-D ≥16): 217 (21.7%), 158 (24.2%), 27 (18.8%), 32 (15.9%), p = .0291
- MMSE, mean (SD): 23.1 (5.9), 22.9 (6.2), 22.7 (5.3), 24.0 (5.3), p = .0506
- ADL disability: 396 (39.7), 310 (47.5), 50 (34.7), 36 (17.9), <.0001
- Pain on weight-bearing: 552 (55.3), 379 (58.0), 89 (61.8), 84 (41.8), <.0001
- SPPB, mean (SD): 5.5 (3.7), 4.9 (3.9), 5.8 (3.2), 7.4 (3.0), <.0001

**Abbreviations:** ADL, activities of daily living; BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression Scale; MMSE, Mini-Mental State Examination; SPPB, Short Physical Performance Battery.
physical function was consistently lower in the group that walked ≥150 minutes/week compared with the other 2 groups.

Table 2 presents the GEE results for low physical function (SPPB <7) as a function of walking activity over 9 years of follow up. Those who walked <150 minutes per week and those who walked ≥150 minutes per week had lower odds of low physical function (OR = 0.66, 95% CI, 0.51–0.86 and OR = 0.54, 95% CI, 0.41–0.71, respectively) than nonwalkers, after controlling for all covariates. Factors associated with greater odds of low physical function over time included age (OR = 1.12, 95% CI, 1.08–1.15), female sex (OR = 1.86, 95% CI, 1.44–2.40), body mass index (OR = 1.06, 95% CI, 1.04–1.07), arthritis (OR = 1.43, 95% CI, 1.15–1.77), cancer (OR = 1.72, 95% CI, 1.16–2.56), depressive symptoms (OR = 1.70, 95% CI, 1.33–2.18), and pain (OR = 1.66, 95% CI, 1.33–2.05). Time (in years) (OR = 0.82, 95% CI, 0.77–0.86) and high MMSE scores (OR = 0.93, 95% CI, 0.91–0.95) were associated with lower odds of low physical function over time.

Supplementary Table S1 (available online) presents the GEE models for lower performance on the balance, repeated timed chair stands, and timed 8-feet walk tests as a function of walking activity over 9 years of follow up among those with SPPB ≥7 at baseline. We found that those who walked ≥150 minutes per week had lower odds of low physical function (OR = 0.53, 95% CI, 0.31–0.92) than nonwalkers, after controlling for all covariates. The association between those who walked <150 minutes per week and low physical function was not statistically significant. Those who walked ≥150 minutes per week had lower odds of lower performance on the balance and timed 8-feet walk tests (OR = 0.67, 95% CI, 0.46–0.98 and OR = 0.65, 95% CI, 0.46–0.90, respectively) than nonwalkers, after controlling for all covariates. The association between walking activity and repeated timed chair stand test was not statistically significant.

### Table 2 Generalized Estimating Equation Models for Low Physical Function (SPPB <7) as a Function of Walking Activity Over 9 Years of Follow Up (N = 998)

<table>
<thead>
<tr>
<th>Variables</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time, y</td>
<td>0.82 (0.77–0.86)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Walking activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonwalking activity</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>&lt;150 min per week</td>
<td>0.66 (0.51–0.86)</td>
<td>.0023</td>
</tr>
<tr>
<td>≥150 min per week</td>
<td>0.54 (0.41–0.71)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Age, y</td>
<td>1.12 (1.08–1.15)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Sex (female)</td>
<td>1.86 (1.44–2.40)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Education, y</td>
<td>0.98 (0.95–1.01)</td>
<td>.2581</td>
</tr>
<tr>
<td>Nativity (US-born)</td>
<td>0.99 (0.78–1.27)</td>
<td>.9875</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>1.06 (1.04–1.07)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.84 (0.67–1.08)</td>
<td>.1735</td>
</tr>
<tr>
<td>Arthritis</td>
<td>1.43 (1.15–1.77)</td>
<td>.0014</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.97 (0.76–1.22)</td>
<td>.7662</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1.27 (0.99–1.61)</td>
<td>.0558</td>
</tr>
<tr>
<td>Heart attack</td>
<td>1.14 (0.74–1.76)</td>
<td>.5610</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.46 (0.88–2.41)</td>
<td>.1445</td>
</tr>
<tr>
<td>Cancer</td>
<td>1.72 (1.16–2.56)</td>
<td>.0067</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>1.53 (0.87–2.66)</td>
<td>.1372</td>
</tr>
<tr>
<td>Depressive symptoms (CES-D ≥16)</td>
<td>1.70 (1.33–2.18)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>MMSE</td>
<td>0.93 (0.91–0.95)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Pain on weight-bearing</td>
<td>1.66 (1.33–2.05)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression Scale; MMSE, Mini-Mental State Examination; OR, odds ratio; SPPB, Short Physical Performance Battery.

### Discussion

Our study investigated the relationship between walking activity and low physical function among Mexican American older adults over a 9-year period of follow up. Those who walked below and above the recommended CDC and Prevention guidelines for older adults of 150 minutes per week had significantly lower odds of physical function impairment over time compared to those who did not walk. On average, those who walked the recommended ≥150 minutes per week were 46% less likely to experience low physical function, while those who walked less than the recommended 150 minutes per week were 34% less likely to experience low physical function, compared with those who did not walk. Those who walked the recommended ≥150 minutes per week were less likely to experience lower performance on balance (44%), repeated timed chair stand (27%), and timed 8-feet walk (26%) tests, compared with those who did not walk. Participants with high MMSE scores had lower odds of experiencing low physical function over time.

Some mechanisms may explain the protective effect of walking on physical function in older adults. Walking involves repetitive compression and decompression of the joints in the lower extremities, which improves the blood flow to the cartilage and may be protective against osteoarthritis.31 Walking causes stress at several skeletal locations, reducing the rate of bone reabsorption32 and potentially reducing the risk of fractures that can compromise physical function.33 Walking also activates various muscle groups and joint kinetics, which may improve lower-extremity strength and range of motion, improving gait.34

Prior studies have similarly indicated that regular walking activity in older adults improves physical function or reduces its decline.14,35–38 For example, Chalé-Rush et al35 demonstrated that participants who engaged in 150 minutes/week or more of more vigorous physical activity (MVPA), which included walking activity, performed better in the SPPB and 400-m walk test than those who engaged in <150 minutes/week of MVPA. Another study, conducted by Nicklas et al.39 that examined the feasibility and acceptability of a community-based walking program (Walk On!)}

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among older adults with functional limitations found an improvement of 15.4% in the SPPB test. Marsh et al examined whether a walking program accompanied by tasks designed to challenge balance and mobility (WALK+) improves physical function more than a traditional walking program (WALK). They found that those with low physical function at baseline who were assigned to the WALK+ group experienced an improvement of 2.2 units in the SPPB test, while those assigned to the WALK group improved only 0.3 units in the SPPB test. A meta-analysis by Yokote et al showed that various types of walking (brisk, outdoor, treadmill, and Nordic) were associated with improved physical function, as measured by the continuous Scale Physical Functional Performance Test and the SPPB. A meta-analysis by Chase et al showed that community-dwelling older adults engaging in walking activity, measured by accelerometer, had significant improvements in physical function performance-based outcomes, such as grip strength, chair stand time, and gait speed.

This study has some limitations. First, walking activity was assessed through self-report and not objectively measured via pedometer. However, self-reported walking is significantly correlated with objective walking activity. Second, information on walking intensity and speed, as well as the performance of other physical activities such as jogging, yard work, dancing, calisthenics or general exercise, bicycle riding, swimming or water exercises, bowling, or golfing, was not asked in the survey. Third, excluding subjects from the study because of missing variables may have resulted in underestimation of the relationship between walking activity and physical function. Fourth, information on neighborhood and environmental characteristics was not collected in the survey. Fifth, the findings are generalizable only to Mexican American older adults resided in the southwest of the United States. The Hispanic population is comprised of those of different nationalities, namely those from Mexico, Central and South America, and the Caribbean, all with different health profiles. For example, rates of obesity vary from 26.8% among South American males to 51.4% among Puerto Rican females. Despite these limitations, the study strengths include its longitudinal design that examined the independent effect of walking activity on physical function over 9 years of follow up; the objective assessment of physical function; the focus on participants with a mean age of 80 years and older; and a study population with high rates of disability.

**Conclusions**

Mexican American older adults who engaged in walking activity were at lower risk of low physical function over time. Interventions at the individual and community level are recommended to reduce the likelihood of experiencing low physical function, even in those with preexisting medical conditions or disability.

**Acknowledgments**

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**References**


