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The Impact of 10-year Physical Activity Changes on 7-year Mortality in Older Mexican Americans

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Abstract

Background—We investigated the association between 10-years of change in physical activity levels and 7-year all-cause mortality.

Methods—Mexican-American adults aged 67 and older (N=803) participating in the Hispanic Established Population for the Epidemiologic Study of the Elderly (1995/1996 to 2012/2013) were included. All-cause mortality was our outcome. Participants were divided into four groups based on their difference in overall physical activity between 1995/1996 and 2005/2006 measured by the Physical Activity Scale for the Elderly. Participants were classified as having unchanged low physical activity (n=339), decreased activity (n=233), unchanged high activity (n=166), and increased activity (n=65). Change in the frequency of physical activity domains were also investigated. Physical-activity domains included leisure, household, sedentary, and walking activities.

Results—After controlling for all covariates, results from the Cox proportional hazards regression found a 43% lower mortality risk in the increased physical activity group [Hazards Ratio (HR) =0.57, 95% Confidence Interval (CI) = 0.34–0.97] compared to the unchanged low physical activity group. In the entire sample, a significantly lower mortality risk was also present among walking (HR=0.88) and household (HR=0.88) activities.

Conclusion—Our results suggest that, independent of other factors, increasing physical activity is most protective of mortality among older Mexican-Americans.

Keywords

aging; epidemiology; mortality; older adults; physical activity

INTRODUCTION

A minimum of 150 minutes of moderate aerobic activity a week and muscle-strengthening exercises twice a week is the current public health guideline to maintain and improve health.^{1,2} Strong evidence exists that shows a dose-response relationship to the volume of physical activity (PA) and mortality, with PA levels up to 3 times higher than the recommended value yielding the most favorable all-cause mortality rates.^{3–6} However, the rate of individuals meeting the minimal recommended level decreases with age. Based on subjective measures, approximately 27% of adults over 75 years of age meet this guideline while approximately 11% participate in leisure-time and muscle-strengthening activities.⁷ Using an objective measure, the percentage of older adults meeting the recommended level is as low as 3%, with varying rates across different ethnic and race groups.⁸ There are some reports that older Mexican-American men and women are more active than their non-Hispanic White and Black counterparts, but with daily averages of moderate or vigorous activity ranging from 8 to 18 minutes they still fall below the recommended level.⁸ To reach the recommended levels, PA can fall into different domains: leisure-time (sports, recreational activities, walking for exercise) and non-leisure time (occupation, transportation, household activities).⁹ Older Mexican-Americans largely report non-leisure time PA.¹⁰ In terms of leisure-time PA, Mexican-Americans have lower rates than other race and ethnic groups.^{10,11} Despite the low levels of leisure-time PA and the strong evidence that suggests this form of PA results in lower mortality rates, Mexican Americans have a lower all-cause mortality rate than non-Hispanic Whites.¹¹

Change in PA levels overtime also impacts mortality rates. Investigators have found that an increase in PA or maintenance of a high PA level results in a more favorable mortality outcome compared to unchanged low levels of PA.^{12–17} Furthermore, maintaining a low level of PA or decreasing PA over time increases the risk for premature death.^{12–14,18} However, few studies that evaluate the effect of changing PA level differentiate between PA domains or investigate this relationship among Mexican-Americans who have a lower mortality rate and a higher rate of non-leisure time PA.^{10,11} There is some evidence that suggests sustained PA and consistent non-sedentariness improve mortality rates among Hispanics,^{16,19} but these studies are not specific to Mexican-Americans¹⁹ and were exclusively among myocardial infarction patients.¹⁶ PA domains, such as leisure-time, walking and household activities, have been shown to reduce mortality risk among older Mexican Americans.^{20,21} Of those, walking is the preferred activity for older adults.^{22–25} All of the aforementioned domains of PA are associated with vitality, but limited evidence exists in which domain drives the changes in PA among Mexican-Americans.

The purpose of this study was to expand upon previous research using data from the Hispanic Established Population for the Epidemiologic Study of the Elderly (H-EPESE).²⁰ Our study aimed to determine the association between 10-years of change in PA level, measured by the *Physical Activity Scale for the Elderly (PASE)* and 7-year all-cause mortality. In addition, we aimed to investigate the extent of participation in different PA domains within our sample. Based on previous population-based research,^{20,25–27} we hypothesized that maintaining a high level of PA or increasing the overall PA level will be associated with a lower mortality rate than maintaining a low level.

METHODS

Data were from the H-EPESE, an ongoing longitudinal study of Mexican Americans aged 65 years and older residing in the Southwestern United States. Participants were selected using area probability sampling procedures within selected census tracts. Sampling involved selecting specific counties, census tracts, and households. The original H-EPESE sample consisted of 3,050 participants interviewed in 1993/94 at baseline and followed up every two or three years. In 2005/06 a subsample aged 75 and older ($n = 1,013$) was randomly selected to study frailty, and three follow-ups were conducted.²⁵ The inclusion criteria were the ability to respond to questions without a proxy and to complete performance tasks for the frailty index. Participants not included in the frailty study were older, had a lower PASE score, a lower Mini-Mental State Examination (MMSE) score, and were more likely to report diabetes, hip fracture, and limitations in Activities of Daily Living (ADL). Further details on sampling procedures, assessment strategies, and participant characteristics are available and archived at the National Archive of Computerized Data on Aging.²⁸

The present study included participants with complete information in the PASE scale who were interviewed in the second wave of the original sample (1995/96) and who participated in the frailty subsample study (2005/06) ($N=803$). These participants were followed in 2007/08, 2010/11, and 2012/13. Data were not from the inception of the H-EPESE in 1993/94 because PASE was only measured in the second (1995/96) and fifth (2005/06) waves. Participants were examined in their homes by trained personnel. Figure 1 displays the timeline of study measurements. Out of the 803 participants, 339 were re-interviewed, 367 were confirmed deceased through the National Death Index and reports from relatives, and 67 were lost to follow-up. Participants with missing data on the covariates at baseline ($N=364$) were significantly more likely to have lower PASE scores (67.2 ± 59.2 , $p < 0.05$), a lower Mini-Mental State Examination (MMSE) score (19.6 ± 5.5 , $p < 0.05$), and to report emphysema (13.4%, $p < 0.01$), a heart attack (4.7%, $p = 0.04$), high depressive symptoms (27.5%, $p < 0.01$), and more ADL limitations (47.0%, $p < 0.01$) compared with those without missing information. The mean and frequency values for those without missing data are listed in Table 1.

The University's Institutional Review Board approved the study protocol, and informed consent was obtained from each participant at the time of the interview.

Measures

Independent Variable—The PASE scale was used to measure PA in 1995/1996 and 2005/2006. The PASE is a well-established instrument that has been validated to measure PA in older adults.^{29,30} The instrument relies on the participant to recall their frequency and duration of activities completed in the last week. PA is measured across three subscales: household, leisure activity, and occupational activity. Household activities included caring for others, gardening, housework, and lawn work. Leisure activities included endurance, muscle strength, sporting, and walking activities. Occupational activity reflects the number of hours of sedentary or active work. Each activity is given a weight which estimates the intensity of that activity. The total PA score is derived from the summation, after multiplying the specified weight by the amount of time spent in each activity. In the validation of the

PASE measurement, scores ranged from 5 to 365 points among adults 65–100 years of age, with a gender-age specific mean scores ranging from 62.3–144.3 points.^{29,30} The PASE scale also measures sitting activities but this is not accounted for in the total PASE score.^{29,30}

For data analysis, we calculated the overall PA score and the total frequency of specific PA domains at each time point. The domains included household, leisure, sedentary, and walking. Walking was extracted separately from leisure activities to examine its independent association to mortality.^{25,26} The other domains reflect the subscales of the PASE instrument and domains known to be associated with mortality.^{19,29–31} Participants reported the frequency of each activity as “never”, “seldom”, “sometimes”, and “often”. These values were quantified to determine total frequency by assigning incremental values, starting at 1, for each response, with “often” given the maximum score of 4. With the exception of household activities which were coded as 1 for a “yes” response and 0 for a “no” response. A sum frequency score was calculated from each question related to the specific domain. The range of possible frequency scores for each domain are as follows: household activities 0–6, walking activities 0–4, leisure activities 0–16, and sedentary activities 0–4. Occupational activity was not analyzed separately due to the low number of the sample currently working. Total frequencies were used because a weight was not provided for sedentary activities, and a score could not be calculated based on the PASE scoring system. This method has been used in previous research to report sub-scales of the PASE instrument.³² See the Appendix for the specific PASE question related to each PA domain.

Participants were divided into four PA groups according to the difference between PASE scores at the two time points. Participants below or above the median PASE score (105.8 points) in 1995/96 were categorized as low or high PA, respectively. For example, a person that walked outside for 2–4 hours every other day, performed light housework for up to 2 hours a day once a week, and cared for another person for less than 1 hour every day would have a PASE score of 63.8 and be categorized as low PA. A person that walked outside for up to 2 hours every day, participated in light sporting activities for 2–4 hours every other day, completed light housework for up to 2 hours a day once a week, and completed yard work for more than 4 hours once a week would have a PASE score of 166.05 and be categorized as high PA. Participants that changed from low to high PA in 2005/06 based on the 105.8 median PASE score were categorized into the increased group; participants that changed from high to low were categorized into the decreased group; and participants that remained in the same activity group from 1995/96 to 2005/06 were classified in the unchanged low or unchanged high group. This method for assigning PA change groups accounts for baseline PA levels and has been used in previous studies.^{14,15}

In an effort to estimate the influence of change in PASE score on mortality, we also used the continuous PASE score change from 1995/96 to 2005/06. This was not the primary analysis of PA because it does not account for baseline PA levels and does not account for PA maintenance.

Dependent Variable—Death was determined through the National Death Index or reports by relatives at each follow-up (2007/08, 2010/11, 2012/13). Although death was assessed at

the three follow up periods, mortality was analyzed continuously using the date of death from the National Death Index or report from relatives.

Covariates—Variables known to be associated with risk of mortality in older adults were included as covariates.^{20,33} Sociodemographic variables included age (continuous), gender, marital status (married vs unmarried), and years of formal education (continuous). Body mass index (BMI) was calculated based on objective measurements of height and weight. Depressive symptoms was assessed with the Center for Epidemiologic Studies Depression Scale (CES-D).³⁴ Cognitive function was assessed with the Mini-Mental State Examination (MMSE).³⁵ Functional disability was assessed from a modified Katz ADL scale.³⁶ Smoking status was determined based on self-report as a current smoker, former smoker, or never smoker. Comorbidities were assessed by a sum total of present medical conditions. The following conditions were considered present if a doctor had ever told the participant that he or she had a stroke, heart attack, cancer, hypertension, diabetes, fracture, emphysema, or anemia. Covariates were assessed from the interview in 2005/2006 (here-after referred as baseline).

Statistical Analysis—Descriptive statistics across PA groups were calculated based on means and frequencies. Chi-square, analysis of variance, and post hoc Tukey's test were used to examine the distribution of covariates for participants. Cox proportional hazards regression analysis was used to estimate the hazard of death at each follow-up as a function of PA change. The Cox proportional hazard regression assumption was confirmed. Two hierarchical models assessed mortality across PA groups. Model 1 included age, gender, marital status, years of formal education, smoking status (current, former), and PA change group assignment. Model 2 included all variables in Model 1 along with BMI, MMSE, CES-D, ADL, and comorbidities. Survival curves were estimated according to the Kaplan Meier method, and PA change groups were compared using the log-rank test. Additional survival analyses were conducted in the entire study sample using the PA domain variables (household, leisure, sedentary, walking) in 1995/96 and 2005/06. Continuous PASE score change was analyzed using the methods described in Model 2. All analyses were performed using SAS for Windows, version 9.3 (SAS Institute, Inc., Cary, NC) in 2016 and significance was determined with $\alpha < 0.05$.

RESULTS

The mean age of participants at baseline was 82.3 ± 4.6 years; 63.0% were female; 42.0 % were married; and the mean years of formal education was 5.0 ± 3.9 . The mean BMI was 27.4 ± 5.0 kg/m² and the mean MMSE score was 20.9 ± 4.7 . Approximately, 18.6% of participants reported high depressive symptoms, 38.6% were functionally disabled, 6.8% were current smokers, and 37.0% were former smokers. On average, participants had 1.5 ± 1.0 comorbidities. The most prevalent comorbidities were hypertension (66.7%) and diabetes (35.6%). Most participants remained at a low level of the PA over 10-years ($n=339$). Participants in the unchanged high level of PA were significantly younger than those in the unchanged low group. Participants in the unchanged high group also had a significantly higher cognition score, household frequency scores and lower comorbidity score than

participants in the decreased and unchanged low groups. Table 1 displays complete characteristic information of participants at baseline by change in overall PA group.

Figures 2 and 3 illustrate the 10-year change in overall PASE score and PA domain frequency scores. The unchanged high and unchanged low groups had a -0.9 and -13.9 point change in PASE score, respectively. The increased group gained 82.5 points while the decreased group lost 102.7 points. The unchanged high and increased groups were 54.1 and 42.5 points above the median value, respectively. The unchanged low and decreased groups were 63.8 and 58.3 points below the median, respectively. All participants increased their frequency of leisure and marginally increased sedentary activities (from $+0.5$ to $+0.8$ points for leisure activities, from $+0.1$ to $+0.2$ points for sedentary activities). The unchanged low and decreased groups decreased their frequency of household activities (-0.6 points and -2.7 points, respectively) and walking activities (-0.4 points and -0.6 points, respectively) after 10 years. The unchanged high group decreased their frequency of household activities (-0.5 points) and increased their rate of walking activities ($+0.2$ points). The increased group increased in all PA domains (household: $+1.8$ points, leisure: $+0.9$ points, walking: $+0.6$ points, sitting: $+0.1$ points). The most drastic changes were observed in household activities. The decreased group dropped 2.3 points and the increased group gained 1.8 points in household frequency score.

Table 2 presents the hazards ratios (HR) and 95% Confidence Interval (CI) for 7-year mortality as a function of change in overall PA. **Model 1** included age, gender, marital status, education, smoking status (current, former), and group assignment. **Model 2** included all of the aforementioned variables as well as BMI, depressive symptoms, cognitive function, functional disability, and comorbidities. Unchanged low PA was used as the reference group. In both models, increased PA was protective of mortality (Model 1: HR=0.42, 95% CI= 0.25–0.71; Model 2: HR=0.57, 95% CI=0.34–0.97) when compared with the unchanged low PA group. The protective trend of unchanged high PA was significant in Model 1 (HR=0.52, 95% CI=0.37–0.73) when compared with the unchanged low PA group. This association became non-significant when all covariates were added in the equation. A decrease in PA level was not significantly associated with mortality in either model. Figure 4 displays the Kaplan-Meier survival curve over 7 years as a function of change in PA. The decreased group follows a similar trajectory as the unchanged low group. After 3 years, the increased group had a more favorable survival rate than the unchanged high group. Secondary analysis of the overall change in PASE score found that a 1 point increase in PASE score over 10 years is associated with a 0.12 decrease hazard of mortality, independent of all covariates (HR=0.88 95% CI =0.80–0.98) (complete analysis not shown).

Two additional fully-adjusted hazard regression models were conducted using the entire sample (Table 3). One model included PA domain frequency scores from 1995/96 while the other model included 2005/06 PA domain frequency scores, controlling for all covariates. Of the PA domains, walking frequency at both time points were significantly associated with reduced mortality rates (1995/96: HR=0.90, 95% CI=0.81–0.99; 2005/06: HR=0.88, 95% CI=0.77–1.00). Household activities were also significant in 2005/06 (HR=0.88, 95% CI=0.78–1.00). The association between mortality and walking or household activities became non-significant after controlling for other pertinent covariates.

DISCUSSION

The purpose of this study was to examine changes in overall PA and determine the association of these patterns with 7-year all-cause mortality in older Mexican-Americans. In addition, this study aimed to investigate PA domain patterns over 10-years. Most participants in our sample remained at a low level of activity over 10-years, with a small number increasing their activity level. The most drastic changes were observed in household activities among the increased and decreased groups. As we hypothesized, increasing the overall PA level or maintenance of a high level, was significantly associated with a lower mortality rates than maintenance of a low level. However, only an increase of PA significantly reduced risk, independent of all other pertinent factors with a 1 point increase in PASE score over 10 years resulting in a 0.12 reduction in hazard of mortality.

In the general population, increasing one's PA level or remaining physically active significantly reduces one's mortality risk.^{12,13,15} One author suggested that it may take 5–10 years before an effect of increased PA reaches the rate of an unchanged high level.¹⁴ Although we found a protective trend in the unchanged high and increased groups, our results are more comparable to the evaluation of PA change among participants (48.3% Mexican Americans) with a history of myocardial infarction enrolled in the Corpus Christi Heart Project.¹⁶ The authors found that, compared to the unchanged sedentary group, the increased activity group yielded the most favorable 12-year all-cause mortality rates after adjusting for other factors. They also found a significantly reduced risk among their no change active and decreased activity groups. Furthermore, the divergence between the increased and remained active groups occurred around 1050 survival days (approximately 3 years).¹⁶ Our results, along with the results reported from the Corpus Christi Heart Project,¹⁶ suggest that Mexican Americans benefit most from an increase in PA and the resulting lower mortality rates may appear in as early as 3 years.

A minimum increase of 60 to 75 minutes of moderate or vigorous activity a week is necessary to improve mortality rates,³ but more activity will result in further protection against premature mortality.^{3–6} Results from a meta-analysis show that the incremental relative risk reduction of mortality from expending 1000 kcals/week to 2000 kcal/week and 3000 kcals/week is 11%, 22% and 31%, respectively.³ Although the change in PA level from the PASE score is not expressed in energy expenditure, the 57% hazard ratio observed in the increase group within our study represents a greater decrease in risk of mortality than the 31% relative risk reduction in expending 3000 kcals/week.

The changes in PA domains observed in our study do not generally follow previous evaluations.^{19,24} A study conducted by Päävi et. al. found that after 8 years, older adults aged 64–74 increase their frequency of chores (household activities) while women also increase their frequency of walking several times a week.²⁴ The same study found that individuals decrease their participation in walking 1–2 times a week as well as their participation in moderate/vigorous activity.²⁴ In our sample, only participants that increased their overall level of PA increased their frequency of household activities after 10 years. Moreover, all of our participants increased their frequency of leisure activity and participants with a high PA level in 2005/06 increased their frequency of walking. Other evaluations also highlight the

impact of change in sedentary behavior on mortality,^{19,27} however our sample had negligible changes in sedentary activities. Previous investigations suggest that leisure-time PA, walking, moderate/heavy gardening, light household activities and activities of daily living are inversely associated with all-cause mortality and significantly reduce premature death.^{3,25,37,38} However, the significance may be lost among Mexican-Americans.³⁷ Our analysis of PA domains in 1995/96 and 2005/06 found walking and household activities to be protective against mortality. This may be driven by the higher walking frequencies in 1995/96 and the large difference in the frequency of walking and household activities between participants with high and low PA in 2005/06 (Figure 3, **Panel A and C**). The 10–12% reduced risk of walking and household activities is comparable to previous investigations of moderate household activities (HR=0.90)³⁸, light gardening (adjusted relative risk=0.89)²⁵, and accumulating 300 minutes of walking a week (relative risk=0.86).³

Future Research

Our results prompt future investigation on predictors of PA change. We observed highly active individuals at the beginning (1995/96) become very inactive at the end of the 10-year period. The reverse was true for participants in the increased PA group (Figure 2). In our sample, participants that increased their level of PA were not significantly different from those that decreased their activity or remained at a low level. More research is needed to investigate and identify factors that may drive PA change. Future research should also identify the impact of PA change in other populations.

There is growing support that exercise is medicine, since it is a crucial modifiable factor for preventing early mortality.³⁹ Our results further support this concept. Our results suggest that there is a mediating relationship between pertinent covariates (i.e. functional ability, body mass index, cognition, depression, comorbidities) and a maintenance of a high PA level. However, the reduced mortality rate from an increase in PA level is independent of these factors. Clinicians should continue to prescribe exercise but there should be an emphasis on PA increase among Mexican Americans. For healthy individuals, high levels of moderate PA are usually safe³⁹ and clinicians and researchers should evaluate methods to also make PA increase safe for older adults.

Limitations

This study is not without its limitations. The PASE instrument is a subjective measure that relies on self-report and participant recall. Individuals often incorrectly report their PA on subjective instruments.^{8,40} Despite this limitation, PASE is a reliable and valid instrument for estimating PA.^{29,30} Our study was limited to PA information at two time-points and patterns across the 10 years could not be evaluated. It is possible that some participants were misclassified if participants slightly moved across the median. Furthermore, change in the frequency of PA domain could not be calculated due to the low median score. Lastly, participants in this sample who were born outside of the US have been shown to live longer than expected⁴¹; therefore, the results may not be generalizable to all Mexican-Americans.

The major strength of this investigation is its study design. The longevity of the H-EPESE allowed us to assess PA at two time-points over 10 years and associate PA change with 7-

year mortality. We were able to identify different PA domains that may contribute to changes in overall PA within this population. Finally, this study focused on an underrepresented population with special socioeconomic and health characteristics.

Conclusion

High levels of PA reduce the risk of mortality among older adults.^{1,15–18,20,21,25,26,31,39,42–44} The results of this current study of older Mexican Americans show that increased PA with age results in a 43% reduction of mortality risk compared to unchanged low activity, after controlling for all covariates. The mortality risk from increasing PA was more favorable than an unchanging high level of PA after 3 years. Furthermore, an increase of 1 point in PASE score over 10 years was associated with a 0.12 reduction in hazards of mortality. Our results also suggest that walking and household activities may be the PA domains driving the change in overall PA. Clinicians should continue to prescribe exercise as medicine, and future research should investigate how to make increased exercise safe for older adults and should help to identify the drivers of PA change.

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Figure 1.
 Timeline of Study Measurements
 PASE: Physical Activity Scale for the Elderly

Figure 2.
Change in Physical-Activity Score by Physical Activity Change Group over the 10-year Period.
PASE: Physical Activity Scale for the Elderly

Figure 3.

Change in Frequency of Physical Activity Domains by Physical Activity Change Group over the 10-year Period.

Panels A, B, C, and D display the frequencies of household, leisure, walking, and sedentary activities, respectively, in 1995/96 and 2005/96 by physical activity change group. Values in Y-axis represent the minimum and maximum frequency score for each domain.

Figure 4.
Kaplan-Meier Survival Curve for Overall Physical-Activity Change and 7-year Mortality.

Table 1
Baseline Participant Characteristics by Overall Physical Activity Change Group in 2005–2006 (N=803)

Baseline Characteristic	Un- changed High PA	Decreased PA	Increased PA	Un- changed Low PA	Total (%) or Mean (SD)
Total (%)	166 (20.7)	233 (29.0)	65 (8.1)	339 (42.2)	803
Death (%)	57 (34.3)	118 (50.6)	17 (26.2)	175 (51.6)	367 (45.7) **
Age, years, mean (SD)	81.5 (4.0)	82.5 (4.4)	81.7 (3.9)	83.0 (4.8)	82.3 (4.6) ^{a,*}
Female (%)	61 (36.8)	135 (57.9)	41 (63.1)	269 (79.4)	506 (63.0) **
Married (%)	94 (57.3)	93 (40.6)	34 (52.3)	110 (33.3)	331 (42.0) **
Years of education, mean (SD)	5.4 (3.9)	5.0 (3.9)	5.0 (3.7)	4.8 (3.6)	5.0 (3.9)
PASE score, mean (SD)	159.9 (45.0)	74.5 (30.8)	148.3 (33.9)	42.0 (30.8)	76.6 (61.6) *
Leisure PASE frequency, mean (SD)	1.4 (1.7)	0.8 (1.3)	1.1 (1.5)	0.7 (1.1)	0.9 (1.4)
Household PASE frequency, mean (SD)	3.9 (1.0)	1.8 (0.8)	3.7 (1.0)	1.7 (0.7)	2.5 (1.3) ^{a,b,*}
Sedentary PASE frequency, mean (SD)	2.9 (0.4)	2.9 (0.4)	2.9 (0.5)	2.8 (0.5)	2.9 (0.5)
Walking PASE frequency, mean (SD)	2.7 (0.7)	1.7 (1.2)	2.7 (0.7)	1.6 (1.2)	1.9 (1.2)
Body Mass Index, kg/m ² , Mean (SD)	27.0 (4.1)	28.0 (5.0)	27.3 (5.4)	27.5 (5.4)	27.4 (5.0)
Depression (%)	8 (4.8)	55 (23.6)	5 (7.7)	81 (23.9)	149 (18.6) **
MMSE score, mean (SD)	22.5 (4.0)	20.6 (4.9)	22.0 (3.1)	20.5 (4.9)	20.9 (4.7) ^{a,b,*}
ADL limitations (%)	21 (12.7)	104 (44.6)	8 (12.3)	177 (52.2)	310 (38.6) **
Smoking Status					
Current (%)	8 (5.2)	21 (9.6)	3 (4.8)	19 (6.0)	51 (6.8)
Former (%)	70 (45.8)	76 (34.9)	21 (33.9)	111 (34.8)	278 (37.0)

Baseline Characteristic	Un- changed High PA	Decreased PA	Increased PA	Un- changed Low PA	Total (%) or Mean (SD)
Never (%)	75 (49.0)	121 (28.6)	38 (61.3)	189 (59.3)	423 (56.3)
Number of Comorbidities, Mean (SD)	1.1 (0.9)	1.6 (1.1)	1.3 (0.9)	1.6 (1.1)	1.5 (1.0) ^{a,b**}
Stroke (%)	8 (4.8)	16 (6.9)	3 (4.6)	22 (6.5)	49 (6.1)
Heart Attack (%)	2 (1.2)	6 (2.6)	1 (1.5)	13 (3.8)	22 (2.7)
Cancer (%)	10 (6.0)	20 (8.6)	3 (4.6)	26 (7.7)	59 (7.4)
Hypertension (%)	98 (59.0)	156 (67.0)	49 (75.4)	232 (68.6)	535 (66.7)
Diabetes (%)	40 (24.1)	101 (43.4)	15 (23.1)	130 (38.4)	286 (35.6) **
Fracture (%)	0 (0)	5 (2.2)	0 (0)	10 (3.0)	15 (1.9)
Emphysema (%)	9 (5.4)	16 (6.9)	7 (10.8)	35 (10.4)	67 (8.4)
Anemia (%)	12 (7.2)	43 (18.5)	7 (10.8)	66 (19.7)	128 (16.0) **

* p 0.05,

** p<0.01,

^a Unchanged high group is different from the unchanged low group,

^b Unchanged high group is different from the decreased group

PA=Physical Activity; ADL - Activities of Daily Living; MMSE- Mini-Mental State Examination; PASE- Physical Activity Scale for the Elderly

Table 2

Survival Analysis over 7-year Follow-up as a Function of Change in Physical Activity

Variable	Model 1	Model 2
Hazards Ratio (95% Confidence Interval)		
Physical Activity Group		
Unchanged High	0.52 (0.37–0.73) **	0.77 (0.53–1.10)
Decreased	0.94 (0.73–1.21)	1.01 (0.76–1.34)
Increased	0.42 (0.25–0.71) **	0.57 (0.34–0.97) *
Unchanged Low	1.00	1.00
Covariates		
Age	1.09 (1.07–1.12) **	1.10 (1.07–1.13) **
Female	0.74 (0.56–0.96) *	0.81 (0.60–1.09)
Married	1.08 (0.85–1.38)	1.07 (0.81–1.40)
Education	1.02 (1.00–1.05)	1.06 (1.03–1.09) **
Current smoker	1.01 (0.61–1.66)	1.34 (0.81–2.23)
Ever smoked	1.23 (0.97–1.56)	1.26 (0.96–1.64)
Body mass index		0.97 (0.95–1.00) *
Cognition		0.95 (0.93–0.98) **
Depression		1.39 (1.02–1.90) *
Functional disability		1.39 (1.08–1.80) **
Comorbidities		1.26 (1.11–1.41) **

* p 0.05,

** p<0.01

Decreased physical activity was used as the reference group in each category

Model 1 included age, gender, marital status, education, smoking status and physical activity groups.

Model 2 included body mass index, depressive symptoms, cognition, functional disability and comorbidities along with variables in Model 1.

Table 3

Survival Analysis over 7-year Controlling for Physical Activity Domain within the Entire Sample

Variable	PA domain 1995/96		PA domain 2005/06	
Hazards Ratio (95% Confidence Interval)				
Physical Activity Domain				
Leisure	0.98 (0.88–1.08)	0.98 (0.87–1.09)	1.00 (0.91–1.11)	0.97 (0.87–1.08)
Walking	0.90 (0.81–0.99) *	0.91 (0.81–1.02)	0.88 (0.77–1.00) *	0.91 (0.80–1.05)
Household	0.98 (0.91–1.05)	1.04 (0.95–1.12)	0.88 (0.78–1.00) *	0.95 (0.84–1.08)
Sedentary	0.96 (0.79–1.18)	0.92 (0.75–1.13)	1.13 (0.80–1.60)	1.06 (0.74–1.53)
Covariates				
Age	1.10 (1.08–1.13) **	1.10 (1.08–1.13) **	1.11 (1.08–1.14) **	1.12 (1.08–1.15) **
Female	0.73 (0.57–0.94) *	0.74 (0.56–0.99) *	0.75 (0.55–1.02)	0.73 (0.53–1.01)
Married	1.02 (0.80–1.30)	1.01 (0.77–1.33)	1.08 (0.80–1.45)	1.00 (0.78–1.45)
Education	1.03 (1.00–1.06)	1.06 (1.03–1.10) **	1.02 (0.98–1.05)	1.05 (1.01–1.09) *
Current smoker	1.00 (0.63–1.62)	1.23 (0.76–2.00)	1.06 (0.64–2.09)	1.48 (0.82–2.69)
Comorbidities		1.29 (1.15–1.46) **		1.25 (1.08–1.45) **
Body mass index		0.98 (0.95–1.00)		0.99 (0.95–1.02)
Cognition		0.95 (0.93–0.98) **		0.96 (0.92–1.00) *
Depression		1.47 (1.07–2.00) *		1.13 (0.74–1.73)
Functional disability		1.40 (1.08–1.80) *		1.30 (0.94–1.78)

*
p 0.05,**
p<0.01

PA: physical activity

All variables, other than the frequency of physical activity domain, was measured in 2005/06