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Physical activity and mortality among middle-aged and older adults in the United States

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Abstract

Background—Physical activity (PA) has been routinely linked to lower all-cause mortality, yet extant research in the United States is primarily based on non-representative samples. Evidence is scant on the relative and independent merits of leisure-time (LTPA) versus non-leisure-time (NLTPA) activities and how the PA-mortality link may vary across racial-ethnic-gender groups.

Methods—Data were from Health and Retirement Study which began in 1992 collecting data on individuals aged 51 to 61 years who were subsequently surveyed once every two years. The present study assessed group-specific effects of LTPA and NLTPA measured in 1992 on mortality that occurred during the 1992–2008 follow-up period. Cox proportional hazard analyses were performed to examine the PA-mortality link.

Results—Net of a wide range of controls, both LTPA and NLTPA showed a gradient negative relation with mortality. No gender-PA interaction effects were evident. Some interaction effects of PA with race-ethnicity were found but they were weak and inconsistent. The mortality reduction effects of PA seemed robust across racial-ethnic-gender groups.

Conclusions—Regardless of personal background, PA is a major health promoting factor and should be encouraged in aging populations. More research is needed to assess relative merits of different types and domains of PA.

Keywords

physical activity; mortality; aging; race; ethnicity

Health benefits of physical activity (PA) have become well-known. Mechanisms underlying the protective effects of PA against mortality for older adults include but are not limited to delayed chronic conditions such as cardiovascular diseases and cancer[1–4], reduced levels of cardiovascular risk factors such as triglyceride, unfavorable lipid and lipoprotein traits, hypertension, and insulin resistance[5], and enhanced fitness and functioning in terms of lung capacity, bone density, muscle structure, function, balance, and cognitive status[6]. For middle-aged to older men and women, prospective cohort studies have reported reduced all-cause mortality associated with regular physical activity (PA)[7–10]. Evidence on the dose-response relation between PA and all-cause mortality is also accumulating[11,12]. That said, current findings on the PA-mortality link in the United States are mostly based on non-representative regional or local studies. The generalizability of these studies is questionable due to their limited geographic coverage[7,9,10,13,14] and sometimes narrow focus on a single racial-ethnic-gender group[7,9]. Large-scale prospective cohort studies based on representative samples are needed to further clarify the effects of PA on mortality in the U.S. population.

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Physical activity can be performed at different domains and for different purposes, which can be generally dichotomized into leisure-time (LTPA) and non-leisure time activity (NLTPA). While both domains of PA have been found to be associated with reductions in mortality[12,15], NLTPA has been less extensively examined and the relative health benefits of LTPA versus NLTPA are less known. Only a small number of studies evaluated relative and independent effects of different domains of PA on mortality, finding mixed patterns[16–18]. The majority of related studies did not simultaneously examine more than one domain of PA.

In addition, few studies have examined whether the merits of PA vary across different racial-ethnic groups. Compared to non-Hispanic whites (‘whites’ thereafter), non-Hispanic blacks (‘blacks’ thereafter) and Hispanics tend to be less socioeconomically advantaged, have less access to health care, and are more likely to be discriminated due to racism[19]. The health benefits of PA may thus be diluted by detrimental impacts of social deprivation disproportionately experienced among ethnic minorities. Apart from social factors, health or behavioral factors may also moderate PA-mortality links across groups. Benefits of PA may be weakened for blacks and Hispanics as they on average have higher prevalence of risk factors(e.g., obesity[20]) and chronic conditions (e.g., diabetes[21]) compared to whites. Impaired exercise capacity has been observed among individuals with diabetes who are overweight or obese[22] which may convert to discounted benefits of PA in groups with high prevalence of both conditions. Moreover, the content of NLTPA and LTPA is culturally sensitive with different tendencies of preferring certain types of PA observed across groups[23]. These nuanced differences in PA preferences may further moderate the PA effects on mortality (although in unknown directions). Research on different racial-ethnic groups is warranted for us to better quantify the PA-mortality link[18].

Gender is another likely moderator in the PA-mortality link, although the reported pattern is mixed. Two reviews documented generally greater PA effects on mortality for women[11,12], whereas one review[24] reported similar magnitude of PA effects on mortality across gender and other studies found stronger PA effects in men[25,26]. Given the observed discrepancies in the role gender plays in the PA-mortality link and considering the complex relationship between gender and health in general, it seems gender-stratified analyses are justifiable in studies of PA benefits.

Therefore, we conducted a prospective cohort study to simultaneously examine the relative and independent effects of LTPA and NLTPA on mortality and their interaction effects with race-ethnicity. We also separated our analyses by gender and reported group-specific and whole-sample patterns of prospective PA effects on mortality after adjusting for a wide range of potential confounders. This study is among the first to analyze a nationally representative sample presenting evidence of the graded effects of different levels of LTPA and NLTPA at middle age on subsequent mortality risks across racial-ethnic-gender groups in the United States.

MATERIALS AND METHODS

Study population: The Health and Retirement Study

The Health and Retirement Study (HRS) is an ongoing longitudinal study funded by the National Institute on Aging that collects information on a wide array of topics including demographics, economic and financial conditions, health status, health behaviors, as well as their changes over time. To ensure its representativeness, the HRS utilizes a national area probability sample of households in the contiguous United States, with oversamples of blacks and Hispanics. Institutionalized individuals are excluded from the survey population[27].

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The first wave of data collection started in 1992, soliciting information from 9,771 respondents who were born between 1931 and 1941 based on in-home interviews. The response rate was 81.6 percent[28]. These respondents were then re-interviewed every other year by telephone for updated information. By the year of 2008, 2,021 or 20.7 percent of the baseline sample died (passive attrition) and 893 or 9.1 percent were lost for follow up (active attrition). The active attrition rates among whites, blacks, and Hispanics were 9.5 percent, 7.4 percent, and 9.1 percent, respectively. Cao and Hill[29] examined sample attrition in the HRS from 1992 to 2002 and compared between those remaining in the sample and those lost due to active attrition. They found that these two groups were very similar to each other in terms of health status, household income, assets, and labor market status at the 1992 baseline. They concluded that active attrition does not appear to be selective in the HRS and therefore sample attrition bias induced by active attrition—if any—is probably statistically ignorable.

The longitudinal design of the HRS allows for the merge of the 1992 baseline data with the 2008 tracker and exit file for information on vital status and its timing. While the HRS tracker file was created to facilitate the use of HRS data within and across waves, the HRS exit file was based on information collected from interviews with a "proxy informant" for panel members who have died. Excluding other racial-ethnic groups, the working HRS sample in this study contains 6,248 white, 1,524 black, and 806 Hispanic respondents who were between ages of 51 and 61 in 1992 and who were followed through 2008 with complete information on vital status and its timing, constituting 98% of the entire HRS sample in 1992.

Measures

Mortality in the 1992–2008 period—The HRS updates information on vital status and its timing at each wave. In the event where death was reported, an exit interview was attempted, which was most often accomplished with the widow(er) or with another close relative of the deceased respondent[30]. Records on mortality and its timing were verified by linking the HRS data to the National Death Index. In our study, we related physical activities at the 1992 baseline to mortality in the subsequent 16 years.

Physical activities at the 1992 baseline—We followed He and Baker's approach[31] to measuring PA, taking both intensity and frequency of activities into account. We assessed LTPA with two questions regarding activities performed: "How often do you participate in *light* physical activity, such as walking, dancing, gardening, golfing, or bowling, etc.," and "How often do you participate in *vigorous* exercise or sports, such as aerobics, running, swimming, or bicycling?"

The responses for light and vigorous LTPA were used to create an LTPA scale. Based on the average times/month that a person performed vigorous exercise, the activity points were assigned as, 0:"never or less than once/month," 2:"1–3 times/month," 6:"1–2 times/week," and 12:"≥ 3 times/week." For light activities, we assigned values one half those for vigorous exercise (i.e., 0, 1, 3, and 6, respectively). The LTPA scale was calculated as the sum of the points for light and vigorous activities.

Heavy housework was determined by asking: "How often do you do heavy housework like scrubbing floors or washing windows?" The response categories included "never," "less than once per month," "1–3 times per month," "1–2 times per week," or "≥3 times per week." Self-reported job-related activity was determined based on participants' response to the question: "My job requires lots of physical effort, such as lifting heavy loads, stooping, kneeling, or couching." The response options were "all or almost all of the time."

Participants who responded “non-employed” were assigned to the “none or almost none of the time” category.

For heavy housework, the same point system as that of vigorous LTPA was used (0, 2, 6, 12, respectively). For job-related activities, the points were assigned as, 0:“none of almost none of the time,” and 2:“some of the time,” 6:“most of the time,” and 12:“all or almost all of the time.” This point scale equates performing strenuous job-related activities “all or almost all of the time” with performing vigorous LTPA “≥3 times/week.” The NLTPA scale was calculated as the sum of the points for housework and job-related activities.

Control variables—Five demographic variables were included in the analyses: race-ethnicity (whites, blacks, Hispanics), age (continuous), gender (male versus female), nativity (US-born versus foreign-born), and marital status (married versus unmarried). Socioeconomic status was characterized by three variables including years of education (continuous), annual household income (ordinal; 4 levels), and health insurance status (insured versus non-insured). Household income was calculated by adding income from all sources and was categorized into four levels: less than \$20,000, \$20,000 to \$40,000, \$40,000 to \$65,000, and more than \$65,000.

The baseline health status was captured by a range of health and behavioral variables. Current smoking status was tapped by the question “Do you smoke cigarettes now?” (yes/no) History of alcohol addiction was assessed by the question “Have you ever taken a drink first thing in the morning to steady your nerves or get rid of a hangover?” (yes/no) Body mass index (BMI) was calculated using self-reported height and weight (kg/m^2). Self-rated health was measured by the question “Would you say your health is excellent, every good, good, fair, or poor?” Functional difficulty was indicated by self-reported presence of any difficulty dealing with a variety of activities such as running, jogging, walking, sitting, climbing stairs, and carrying things. The presence of chronic condition was denoted if a respondent reported s/he was ever told by doctors that s/he had hypertension, diabetes, cancer, chronic lung diseases, arthritis or rheumatism, and other chronic conditions. Lastly, self-rated emotional health was measured by respondents’ rating their own emotional health on a scale ranging from excellent, very good, good, fair, to poor.

These socio-demographic and health-related variables are well-known factors of mortality and correlates of PA. We control for them as potential confounders of the PA-mortality link. Meanwhile, they may also help explain interaction effects of PA with race-ethnicity if observed.

Statistical analysis

Correlation analyses were run to explore correlations among baseline variables. Chi-square tests and ANOVA analyses were performed to test group differences in the variables examined in the study. A series of group-specific Cox proportional hazards (CPH) models were run, where the relative risk of mortality in the 1992–2008 period was modeled as a function of LTPA and NLTPA and selected controls measured at the baseline in 1992. For each subgroup and for the total sample, three CPH models were run all including LTPA and NLTPA. In samples combining groups together, Model 1 controlled for age and race-ethnicity and included interaction effects between race-ethnicity and the two PA measures. In group-specific subsamples, Model 1 only controlled for age in addition to LTPA and NLTPA; Model 2 added additional demographic and socioeconomic controls; and Model 3 added baseline health status and behavior variables. This modeling strategy would allow us to assess main effects of LTPA and NLTPA and their interaction effects with race-ethnicity and explore possible confounding or mediating effects of socio-demographic and health.

RESULTS

LTPA and NLTPA are positively and significantly correlated although the magnitude of correlation is small (r=0.08). Both LTPA and NLTPA are negatively correlated with BMI, functional difficulty, chronic conditions while positively with self-rated general health and emotional status (data not shown).

Table 1 presents sample statistics by race-ethnicity and gender. Most group differences are significant. For both men and women, whites have the highest level of LTPA but lowest level of NLTPA, are most advantaged in socioeconomic status, and have the highest marriage rate. They also are better off in terms of the baseline health status and behavior except for smoking and chronic conditions. Blacks and Hispanics have similar PA prevalence rates; and Hispanics are notably more socioeconomically disadvantaged than blacks.

Table 2 shows results of the CPH analyses for women. When the three racial-ethnic groups are combined (all women), LTPA exhibits significant and negative effects on mortality whereas NLTPA shows a strong effect in the baseline model but the effect size decreases as more controls are included. No interaction between LTPA and race-ethnicity is observed. Compared to whites, NLTPA seems more beneficial for blacks and Hispanics but these advantages become less obvious when socio-demographic and health variables are controlled and the interaction effects are rendered non-significant in Model 3. Group-specific results show for whites the LTPA benefits are greater than those of NLTPA; for blacks LTPA and NLTPA are equally beneficial; and for Hispanics the NLTPA benefits are observed in reduced models while LTPA is not significant in any model. Adjusting for the socio-demographic and baseline health controls renders the effect sizes of LTPA and NLTPA smaller but no substantial effect reductions are evident for any group.

Table 3 shows the results for men. When the three racial-ethnic groups are combined (all men), both LTPA and NLTPA exhibit significant and negative effects on mortality although the magnitude of NLTPA effects seem a bit weaker than that of LTPA. Contrary to what found for women, no interaction between NLTPA and race-ethnicity is observed but weak interaction of LTPA with Hispanics is observed. Compared to whites, LTPA seems slightly less beneficial for Hispanics but the difference is marginally significant only in the baseline model and disappears when controls are added. Group-specific results show for whites LTPA and NLTPA are both beneficial with stronger effect found for LTPA; for blacks LTPA and NLTPA are equally beneficial; and for Hispanics NLTPA benefits are observed but LTPA is not significant. These group-specific patterns are similar to those for women.

Based on previous findings and qualitative interests in gender differences in PA effects on mortality, we conducted gender-stratified analyses presented in Tables 2 and 3. However, preliminary analyses showed that gender by PA interactions were not evident. Therefore, we combined men and women and repeated the analyses in the full sample. The results are shown in Table 4. Both LTPA and NLTPA are significantly beneficial with weaker effect of NLTPA found in Model 1 but the effect gap closes as controls are added to the baseline model. There is a marginally significant interaction effect between Hispanics and LTPA with LTPA benefits somewhat weaker in Hispanics compared to whites. This interaction effect is rendered non-significant as socio-demographic controls are added and then further attenuated when baseline health variables are added. There is also a significant interaction between black and NLTPA in the baseline model where the benefits of NLTPA are stronger for blacks compared to whites. Again, this interaction effect is rendered non-significant as the controls are added to the baseline model.

The LTPA and NLTPA benefits protective against mortality are illustrated in Figure 1 plotting smoothed hazard function of mortality against different PA levels in the full model adjusting for all the socio-demographic and health controls. Four PA groups are graphed, corresponding to the PA levels of zero, median, 75^{th} percentile, and 90^{th} percentile. There is a clear dose-response pattern for both domains of PA. Figures for each subgroup by gender and race-ethnicity have similar shape and gradient as those shown in Figure 1.

To test sensitivity of these results to health conditions, we excluded respondents with heart problems or difficulty of walking at the baseline. The adjusted effects of LTPA and NLTPA remained strong.

DISCUSSION

Our findings reveal significant, prospective, and graded benefits of both LTPA and NLTPA in the full sample, suggesting the benefits of LTPA and NLTPA are independent and possibly additive. The dose-response relationship between PA measures and mortality is consistent with previous findings[11,12] and studies reporting greater benefits of vigorous PA versus light-moderate PA[7,9,32]. PA is linked to many health benefits, directly enhancing physical fitness and exercise capacity. Higher PA levels reflect greater total energy expenditure and sometimes also signal greater intensity in cardio exercise. It is unclear though whether the dose-response risk reduction associated with PA is due to differences in intensity of the activity or those in total energy expenditure[12]. We need more studies to explore this distinction to better inform health policy and intervention.

These patterns generally hold across racial-ethnic groups, with a few exceptions. Benefits of LTPA seem to be slightly weaker for Hispanics compared to whites and benefits of NLTPA seem to be stronger for blacks. We expected weaker benefits of PA in blacks and Hispanics because of their higher prevalence of risk factors and greater social disadvantages compared to whites. Presumably, health benefits of a specific behavior would be compromised by the presence of other forceful risk factors. Our empirical findings provide mixed evidence on this hypothesis. For Hispanics, the weaker LTPA benefits seemed attributable to socio-demographic and health differences compared to whites at the baseline, lending some support for this hypothesis. That said, the finding that NLTPA is more beneficial for blacks than for whites was not in accordance with our expectation. In any event, despite some interaction effects observed in the reduced model, none remained significant in the full model. The socio-demographic and health variables included in the analyses are either confounding or mediating factors underlying the race-ethnicity by PA interactions which were neither strong in magnitude nor robust to the controls. Further quantifying the mediating or confounding effects of these controls variables would entail sophisticated path analyses or variable decomposition analyses that are beyond the scope of this study.

As to the role of gender in contributing to the PA-mortality link, no significant gender-PA interactions were detected. This is inconsistent with recent studies that reported stronger[11,12] or weaker[25,26] risk reduction in women than in men but consistent with some studies finding no effect moderation by gender[24]. One commonly hypothesized mechanism explaining observed gender differences is that women are protected against cardiovascular diseases up to menopausal period and PA somehow mitigates the threat from menopause by adjusting reproductive hormones which may lead to greater risk reduction in women[11,12]. This hypothesis has not been well tested and gender-PA interaction needs to be further evaluated.

Regarding the two domains of PA examined in this study, LTPA has received more research attention but NLTPA is a more prominent source of PA among older adults[33]. Representative data from the USA showed that housework PA contributed 35.2% of total energy expenditure compared to 5.2% of LTPA among individuals aged 65–74[33]. More research needs to be done to better understand patterns, causes, and consequences of NLTPA which is by definition less structured and less purposeful than LTPA but may not be less beneficial given the evidence reported here. Our study thus joins a growing number of studies supporting the importance of simultaneously studying different domains of PA[16,18].

Although the PA measures used in this study have not been assessed in comparison to objective PA measures, their construct and predictive validity appears good given the prospective PA-mortality link observed in this study and the baseline PA-health correlations observed in this study. The validity of LTPA is also supported by previous findings that LTPA was negatively associated with decline in health and functioning[34]. That said, the reliance on self-reports in measurement is a key limitation of this study as self-reports are subject to response bias. For example, survey-based evidence shows Mexican Americans were less active than non-Hispanic whites but data collected by accelerometry revealed an opposite pattern[35]. This documented discrepancy may suggest Mexican Americans tend to underestimate their PA levels in health surveys, which would reduce the measured PA-mortality association in this particular group. In general, random misclassification of an exposure reduces the measured association between the exposure and the outcome[36]. Since we found strong PA-mortality associations across racial-ethnic-gender subgroups, these potential response biases seem unlikely to invalidate our key conclusion.

The study is also limited in other aspects. Although the study benefited from prospective cohort design and used nationally representative data, annual sample attrition due to lost-to-follow-up is an unavoidable problem in cohort studies. The PA measures used in this study were intuitive instead of being quantitatively precise and did not distinguish different types of LTPA and NLPTA. The race-ethnicity measure did not include Asians and sample sizes of Hispanic men and women were small which may have led to an underestimation of effect significance for Hispanic groups. However, the PA-Hispanic interactions in the full sample were not strong making it less important to show Hispanic-specific patterns. Lastly, despite a rich set of confounders examined in this study, other important controls such as diet and parental longevity were not accounted for.

Despite these limitations, the current study is among the first to provide gender-specific evidence on long-term prospective effects of LTPA and NLTPA on mortality in three major racial-ethnic groups in the United States, using a nationally representative longitudinal sample of middle-aged and older Americans. A key public health message from the present study is that LTPA and NLTPA are independently protective against mortality during a 16-year follow-up period, net of a host of confounders, mediators, and moderators at the baseline. This finding is encouraging as it shows that a lifestyle behavior can have such a salient role in contributing to survival in later life irrespective to differential social circumstances and behavioral exposures experienced in different racial-ethnic groups. Future studies should strive for more comprehensively measuring PA to better evaluate relative salutary effects of different types and domains of the activities across social groups and life stages.

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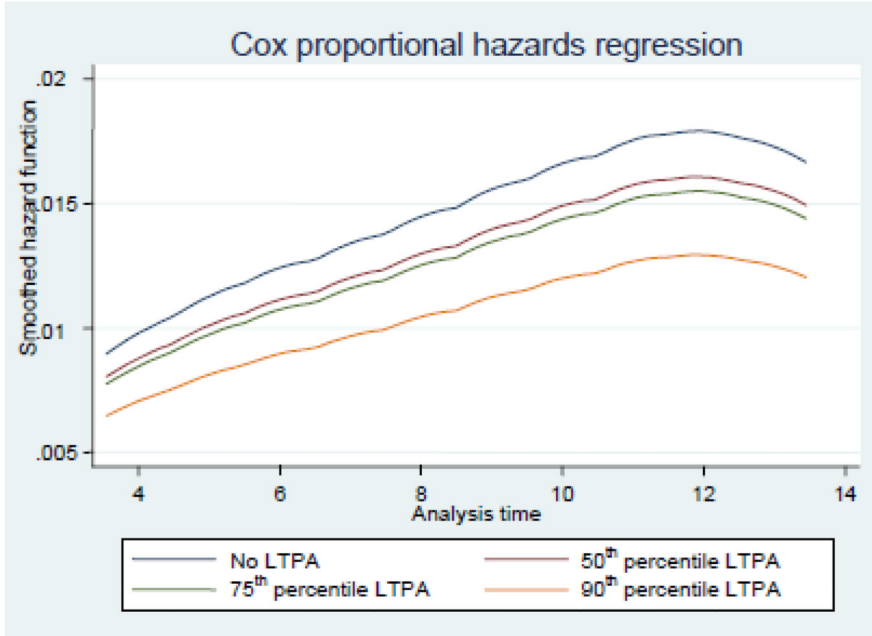

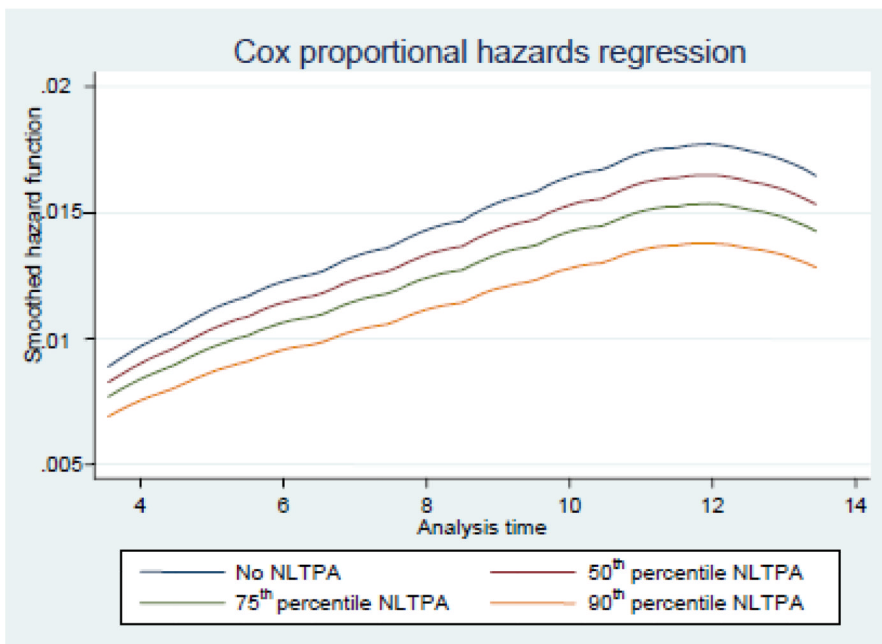

Figure 1.

Mortality Hazard Curves for LTPA and NLTPA in the Full Sample of 1992–2008 HRS (The four PA levels correspond to zero PA and values of median, 75th percentile, and 90th percentile of PA)

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Table 1

Sample Statistics of the 1992 HRS Baseline by Gender and Race/Ethnicity (Mean or %)

	Male[a]			Female[b]		
	Whites	**Blacks**	**Hispanics**	**Whites**	**Blacks**	**Hispanics**
Leisure-time physical activity (LTPA)	6.9	5.8	6.0	6.1	4.5	4.4
Non-leisure-time physical activity (NLTPA)	4.8	6.2	6.6	5.6	6.7	6.8
Age, years	55.8	55.7	55.4	55.7	55.7	55.5
Nativity						
Not born in the U.S.	3.8	4.1	50.9	4.8	4.8	55.2
Born in the U.S.	96.2	95.9	49.1	95.2	95.2	44.8
Marital status						
Unmarried	15.1	35.9	21.0	25.8	57.8	37.5
Married	84.9	64.1	79.0	74.2	42.2	62.5
Years of Education	12.8	10.9	8.7	12.5	11.4	8.2
Total family annual income						
Less than $20,000	14.7	34.0	36.4	23.6	45.6	44.8
$20,000 to $40,000	23.4	26.5	37.2	26.5	27.1	32.2
$40,000 to $65,000	29.5	21.5	17.5	25.3	17.3	13.3
More than $65,000	32.4	17.9	8.9	24.7	10.0	9.7
Health insurance status						
Insured	90.0	80.2	64.2	89.5	81.5	64.6
Uninsured	9.9	19.5	35.3	9.9	17.2	33.8
Current smoking status						
Yes	27.6	40.3	28.6	26.9	24.2	20.2
No	72.4	59.7	71.4	73.1	75.8	79.8
Ever addicted to alcohol						

	Male[a]			Female[b]		
	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics
Yes	7.2	15.5	13.2	1.7	3.9	1.6
No	92.8	84.5	86.8	98.3	96.1	98.4
Body mass index						
Underweight (BMI<18.5)	0.4	1.7	0.3	2.4	1.1	1.8
Normal weight (25>BMI>=18.5)	30.0	31.3	25.6	44.5	19.8	29.0
Overweight (30>BMI>=25)	49.0	42.8	50.4	32.3	37.4	37.9
Obese (BMI>=30)	20.6	24.2	23.7	20.8	41.6	31.3
Self-rated health status						
Excellent	24.4	13.3	20.5	24.6	8.6	9.7
Very good	30.2	19.6	17.5	32.2	20.8	11.7
Good	27.9	32.1	29.6	25.4	33.0	33.3
Fair	10.2	21.3	23.2	11.9	23.9	28.0
Poor	7.3	13.7	9.2	5.9	13.8	17.2
Functional difficulty						
Yes	34.3	37.1	32.3	46.1	49.0	46.7
No	65.7	62.9	67.7	53.9	51.0	53.3
Personal history of chronic conditions						
Yes	66.0	73.2	59.6	68.2	81.8	70.6
No	34.0	26.8	40.4	31.8	18.2	29.4
Self-rated emotional health						
Excellent	23.4	16.4	19.1	18.8	12.8	10.6
Very good	30.0	28.7	19.9	32.2	22.1	19.3
Good	31.9	31.9	40.2	31.9	37.3	38.9
Fair	11.2	17.5	16.2	12.7	20.5	26.7
Poor	3.7	5.5	4.6	4.5	7.2	4.6
Sample size	3,064	652	371	3,184	872	435

Source: The Health and Retirement Study (n=8,578).

[a]Among men, group differences are significant at 5% level for all the variables except functional difficulty and BMI.

[b]Among women, group differences are significant at 5% level for all the variables except functional difficulty and age.

Table 2

Women: LTPA and NLTPA in 1992 and Hazard Ratios of Mortality in the 1992–2008 Period

	All Women			White Women		
	Model 1[a]	**Model 2[b]**	**Model 3[c]**	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**
LTPA	0.74**	0.79**	0.89*	0.74**	0.79**	0.90*
	(0.67 – 0.81)	(0.72 – 0.88)	(0.81 – 0.99)	(0.66 – 0.81)	(0.72 – 0.88)	(0.81 – 0.99)
NLTPA	0.97	0.92+	0.95	0.97	0.91*	0.94
	(0.88 – 1.06)	(0.84 – 1.01)	(0.87 – 1.04)	(0.88 – 1.06)	(0.83 – 1.00)	(0.86 – 1.03)
Blacks* LTPA	0.99	0.97	0.92			
	(0.81 – 1.22)	(0.78 – 1.19)	(0.75 – 1.13)			
Hispanics* LTPA	1.17	1.15	1.03			
	(0.84 – 1.61)	(0.83 – 1.58)	(0.75 – 1.41)			
Blacks* NLTPA	0.83*	0.85*	0.89			
	(0.71 – 0.97)	(0.72 – 0.99)	(0.76 – 1.04)			
Hispanics* NLTPA	0.77+	0.81	0.85			
	(0.59 – 1.00)	(0.62 – 1.05)	(0.66 – 1.09)			
Blacks	1.63**	1.26*	1.15			
	(1.36 – 1.94)	(1.04 – 1.51)	(0.95 – 1.38)			
Hispanics	1.06	0.89	0.88			
	(0.81 – 1.39)	(0.65 – 1.23)	(0.64 – 1.20)			
Observations	4,455	4,417	4,417	3,161	3,140	3,140
	Black Women			**Hispanic Women**		
	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]
LTPA	**0.73****	**0.76****	**0.82***	**0.85**	**0.86**	**0.89**
	(0.61 – 0.88)	(0.63 – 0.91)	(0.68 – 0.99)	(0.62 – 1.15)	(0.63 – 1.17)	(0.66 – 1.21)
NLTPA	**0.81****	**0.79****	**0.86***	**0.75***	**0.77***	**0.82**
	(0.71 – 0.92)	(0.69 – 0.90)	(0.75 – 0.99)	(0.59 – 0.96)	(0.60 – 0.99)	(0.64 – 1.05)
Observations	865	855	855	429	422	422

** $p<0.01$,

* $p<0.05$,

+ $p<0.1$

a. Model 1 controls for age;

b. Model 2 controls for age, nativity, marriage, education, family income, and insurance status;

c. Model 3 controls for current smoking status, alcohol addiction history, body mass index, chronic conditions, self-rated health, functional difficulty, emotional impairment.

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Table 3

Men: LTPA and NLTPA in 1992 and Hazard Ratios of Mortality in the 1992–2008 Period

	All Men			White Men		
	Model 1[a]	**Model 2 [b]**	**Model 3 [c]**	**Model 1 [a]**	**Model 2 [b]**	**Model 3 [c]**
LTPA	0.75**	0.80**	0.92*	0.75**	0.81**	0.93+
	(0.69 – 0.81)	(0.74 – 0.86)	(0.85 – 0.99)	(0.69 – 0.81)	(0.75 – 0.88)	(0.86 – 1.01)
NLTPA	0.85**	0.81**	0.87**	0.85**	0.80**	0.87**
	(0.79 – 0.93)	(0.75 – 0.88)	(0.80 – 0.95)	(0.79 – 0.93)	(0.74 – 0.87)	(0.80 – 0.94)
Blacks* LTPA	1.08	1.04	0.98			
	(0.92 – 1.26)	(0.89 – 1.22)	(0.83 – 1.15)			
Hispanics* LTPA	1.20+	1.16	1.07			
	(0.97 – 1.49)	(0.93 – 1.44)	(0.86 – 1.33)			
Blacks* NLTPA	0.95	1.02	1.09			
	(0.82 – 1.11)	(0.88 – 1.19)	(0.94 – 1.26)			
Hispanics* NLTPA	0.99	1.05	1.09			
	(0.80 – 1.23)	(0.84 – 1.30)	(0.88 – 1.35)			
Blacks	1.64**	1.26**	1.10			
	(1.42 – 1.90)	(1.08 – 1.48)	(0.94 – 1.29)			
Hispanics	1.06	0.87	0.87			
	(0.86 – 1.31)	(0.68 – 1.13)	(0.67 – 1.12)			
Observations	4,056	4,047	4,047	3,042	3,037	3,037
	Black Men			**Hispanic Men**		
	Model 1[a]	Model 2 [b]	Model 3 [c]	Model 1 [a]	Model 2 [b]	Model 3 [c]
LTPA	0.81**	0.83*	0.89	0.90	0.92	1.00
	(0.71 – 0.93)	(0.72 – 0.96)	(0.77 – 1.04)	(0.74 – 1.10)	(0.75 – 1.14)	(0.81 – 1.24)
NLTPA	0.81**	0.84**	0.96	0.83+	0.84+	0.94
	(0.71 – 0.92)	(0.74 – 0.95)	(0.84 – 1.09)	(0.68 – 1.02)	(0.68 – 1.03)	(0.76 – 1.16)

	All Men			White Men		
	Model 1 [a]	**Model 2** [b]	**Model 3** [c]	**Model 1** [a]	**Model 2** [b]	**Model 3** [c]
Observations	645	643	643	369	367	367

** p<0.01,

* p<0.05,

+ p<0.1

a. Model 1 controls for age;

b. Model 2 controls for age, nativity, marriage, education, family income, and insurance status;

c. Model 3 controls for current smoking status, alcohol addiction history, body mass index, chronic conditions, self-rated health, functional difficulty, emotional impairment.

Table 4

All: LTPA and NLTPA in 1992 and Hazard Ratios of Mortality in the 1992–2008 Period

	Model 1[a]	Model 2 [b]	Model 3 [c]
LTPA	**0.75****	**0.80****	**0.91****
	(0.70 – 0.79)	(0.75 – 0.85)	(0.86 – 0.97)
Black * LTPA	1.04	1.00	0.95
	(0.92 – 1.18)	(0.89 – 1.14)	(0.84 – 1.08)
Hispanic * LTPA	1.19+	1.16	1.07
	(1.00 – 1.42)	(0.97 – 1.38)	(0.89 – 1.27)
NLTPA	**0.90****	**0.85****	**0.90****
	(0.85 – 0.96)	(0.80 – 0.91)	(0.85 – 0.96)
Black * NLTPA	0.90*	0.94	1.00
	(0.80 – 1.00)	(0.85 – 1.05)	(0.90 – 1.11)
Hispanic * NLTPA	0.89	0.95	0.98
	(0.76 – 1.05)	(0.80 – 1.12)	(0.83 – 1.15)
Observations	8,511	8,464	8,464

** p<0.01,

* p<0.05,

+ p<0.1

a. Model 1 controls for age;

b. Model 2 controls for age, nativity, marriage, education, family income, and insurance status;

c. Model 3 controls for current smoking status, alcohol addiction history, body mass index, chronic conditions, self-rated health, functional difficulty, emotional impairment.