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Differences in All-cause and Cardiovascular Mortality by Race, Ethnicity and Physical Activity

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Abstract

Aims—This study sought to determine whether the association between varying levels of physical activity (PA) and all-cause and cardiovascular mortality differ by race/ ethnicity in older adults.

Methods—The sample comprised 2,520 women and 2,398 men drawn from National Health and Nutrition Examination Survey III (1988–1994) aged ≥60 years. We used the metabolic equivalent (MET) of self-reported PA levels to define activity groups (inactive: those who did not report any PA; active: those who reported 3–6 METs for ≥5 times/week or >6 METs, ≥3 times/week; insufficiently active: those meeting neither criteria). Racial/Ethnic differences were modeled using proportional hazard regression (HR) adjusting for age, education, smoking, diabetes and hypertension.

Results—Among those classified as inactive, Non-Hispanic Blacks (NHB) (HR: 0.72, 95% CI: 0.58–0.90) and Mexican Americans (HR: 0.59, 95% CI: 0.45–0.78) had a lower risk of all-cause mortality when compared to Non-Hispanic Whites (NHW). Among those classified as insufficiently active, Mexican Americans (HR: 0.63, 95% CI: 0.51–0.77), but not NHB (HR: 0.81, 95% CI: 0.64–1.02) had a lower risk of all-cause mortality when compared to Non-Hispanic Whites. Similar results were observed for cardiovascular mortality.

Conclusion—Overall, PA in the elderly (either insufficient or active) is associated with a lower all-cause mortality across all race/ethnic groups as compared to NHW. Further investigation, including studies with larger sample, are needed to address the health consequences of varying degrees of PA in ethnically diverse populations.

Keywords

Ethnicity; Mortality; Physical activity; Race

Introduction

Participation in regular physical activity (PA) has been associated with lower all-cause and cardiovascular mortality. (Kushi, Fee et al. 1997; Lee and Paffenbarger 2000; Nocon, Hiemann et al. 2008) Accumulating evidence also suggests that there is a dose-response relationship between participation in PA and all-cause mortality risk among adults in the US. (Manini, Everhart et al. 2006) In spite of these very promising results however, there is a lack of generalizable data regarding the association between PA and mortality in diverse populations, particularly for Mexican Americans. (Wen, Li et al. 2014)

In 2007, approximately 25% of non-Hispanic White (NHW) adults report having met the physical activity guidelines, but less than 20% of Hispanic and non-Hispanic Black (NHB) adults report meeting these guidelines (Sundquist, Qvist et al. 2004; 2009; Mathieu, Powell-Wiley et al. 2012); rates are notably lower among older adults.(Manini, Everhart et al. 2009) Given substantial variation in the rates of participation in physical activity by race and ethnicity, it is of public health importance to understand the impact of varying levels of PA on mortality rates among diverse racial and ethnic groups. (Sundquist, Qvist et al. 2004; 2009; Manini, Everhart et al. 2009; Mathieu, Powell-Wiley et al. 2012) The aim of the present study was to determine whether the association between varying levels of physical activity (physical activity outside of work regardless of intensity level) and all-cause and cardiovascular mortality differ by race and ethnicity in older adults.

Material and Methods

The National Health and Nutrition Survey (NHANES) is a population-based survey designed to collect nationally representative data on health and nutrition, using a complex, multistage probability sample design of the United States civilian and non-institutionalized population. The survey includes an in-home interview on general health status, disease history, and diet and lifestyle, as well as a health examination at a mobile examination center.(Centers for Disease Control and Prevention (CDC) and U.S. Department of Health and Human Services 2015) All participants provided written consent, and all interviews and examinations were carried out by trained technicians according to standard operation manuals available at the NHANES website (<http://www.cdc.gov/nchs/nhanes.htm>). Of the 39,695 subjects available, we excluded 31,360 based on our age exclusions criteria. Our final analytic sample included 4,922 individuals 60 years of age, who participated in the MEC component, completed the physical activity section of the NHANES weighted pooled sample (1988–1994). (Batsis, Sahakyan et al. 2013)

Mortality data

NHANES III participant records were linked to mortality data from the National Death Index using a unique identifier based on death certificate data and updated through December 31, 2006. Mortality ascertainment was based upon results from a probabilistic match between NHANES III and death certificate records. All-cause and cardiovascular mortality data were classified using the ninth revision of the International Statistical Classification of Disease, Injuries and Causes of Death guidelines (deaths before 1999), and the 10th revision for deaths after 1999.(Batsis, Sahakyan et al. 2013; Centers for Disease Control and Prevention (CDC) and U.S. Department of Health and Human Services 2015) Cardiovascular death was classified using codes I00 to I78. Person-months were calculated in months from date of interview to date of death or most recent vital status record. Mortality status (dead/alive) was ascertained in over 99% of our sample.

Baseline physical activity

All study participants completed a global physical activity questionnaire (1988–1994) including questions on the frequency of leisure time physical activity in the past month. (Bull, Maslin et al. 2009) Participants were asked about the frequency of walking a mile without stopping, running or jogging, riding a bicycle, swimming, aerobics, dancing, calisthenics, garden or yard work, lifting weights, or other activities. Based on the Compendium of Physical Activities Report, the level of physical activity was assessed using metabolic equivalent (MET) intensity levels. (Ainsworth, Haskell et al. 2000; Ainsworth, Haskell et al. 2011) We defined the inactive group of participants as those who did not report any PA, active those who reported 3–6 METs for 5 times/week or >6 METs, 3 times/week, or insufficiently active (meeting neither criteria).

Demographics and covariates

Race and ethnicity was assessed by self-report and subjects were categorized into mutually exclusive categories as non-Hispanic White, non-Hispanic Black and Mexican Americans. Age was used as a continuous variable collected by self-report at the date of the interview. Self-reported years of education were assessed. Smokers were classified as never smoker, ex-smoker, and current smoker. Current smokers were defined as those who ever smoked at least 100 cigarettes per lifetime and are currently smoking.

Weight was measured in kilograms on a calibrated digital scale, and standing height was measured in centimeters with the participant's back to a stadiometer's backboard. Body mass index (BMI) was calculated as weight (kilograms (kg)) divided by height (meter (m)) squared. We classified participants as having hypertension (yes/no) if they reported being told by a health care professional to have hypertension. Participants were further classified as having diabetes if they self-reported current usage of antidiabetic medications (insulin and oral medications) and/or self-reported diabetes diagnosis.(Batsis, Sahakyan et al. 2013)

This study was considered exempt from Institutional Review Board as our analysis was based on secondary non-identified data (demographic questionnaire and de-identified mortality files).

Analysis

Descriptive statistics were calculated as weighted means (standard errors) and counts (weighted percentages) to describe the demographic characteristics of the sample. Bivariate analysis was used to evaluate the relationship between race and ethnicity and a selected set of covariates, with differences tested using chi-square test for proportions as appropriate.

Differences by race and ethnicity and gender in the association between PA, all-cause and cardiovascular mortality were tested using Cox-Proportional hazard models. For the primary analysis evaluating the association between levels of physical activity and mortality, we used data from all participants who completed the physical activity questionnaire. We calculated all-cause and cardiovascular hazard ratios (HR) between individuals in different racial and ethnic groups (NHW as the referent group), stratified by PA category.

We computed estimates for all cause and cardiovascular mortality using the full sample adjusted for age, gender years of education, smoking status (never smoker, ex-smoker, and smoker), and history of comorbidities (diabetes, hypertension). The proportional hazard assumption was examined and met. We subsequently determined the association between race/ethnic differences in mortality, stratified by PA.

All estimates were weighted and calculated using SAS (Version 9.2, SAS Institute, Cary, North Carolina) procedure SURVEYPHREG that accounts for a complex survey design, using pseudo-strata, pseudo-primary sampling units, and sampling weights provided. To account for the complex study design, procedure SURVEYMEANS or SURVEYFREQ were used. Taylor series linearization approach was used for variance estimation. Statistical significance was defined as $p < 0.05$.

Results

Table 1 summarizes the sample demographic and health characteristics by race and ethnicity. The sample was 59.5% NHW, 21.4% NHB, and 19% Mexican Americans. NHBs and Mexican-Americans were slightly younger and less educated than NHWs. NHBs and Mexican Americans were also more likely to be classified as inactive as their NHW counterparts. NHWs and NHBs reported higher rates of hypertension than Mexican Americans, but NHBs and Mexican Americans had higher rates of diabetes than NHWs. Mexican Americans had the lowest prevalence of all-cause and cardiovascular mortality when compared to the total sample (41.0% and 19.2% respectively). Participants were followed for an average of 12 years and there were 902 deaths (18%).

Table 2 demonstrates the association between levels of PA and all-cause mortality by race/ethnicity and sex. Among those classified as inactive, NHB (HR: 0.72, 95% CI: 0.58–0.90) and Mexican Americans (HR: 0.59, 95% CI 0.45–0.78) had a lower risk of all-cause mortality when compared to NHW. Among those classified as insufficiently active only Mexican Americans had lower risk of all-cause mortality (HR: 0.63, 95% CI: 0.51–0.77). After stratifying the sample by sex both Mexican American males (HR: 0.58, 95% CI: 0.40–0.84) and females (HR: 0.65, 95% CI: 0.45–0.95) in the in the insufficiently active group had a lower prevalence of all-cause mortality. In the active group, only Mexican American

females (HR: 0.47, 95% CI: 0.28–0.79) had lower odds of all-cause mortality when compared to NHW.

Table 3 demonstrates the association between PA and risk of cardiovascular mortality by race/ethnicity and sex. Among those classified as inactive, NHB and Mexican Americans had lower cardiovascular mortality risk when compared to NHW (HR: 0.72, 95% CI: 0.58–0.88) and HR: 0.59, 95% CI: 0.45–0.77) respectively). Among those who were insufficiently active Mexican Americans, (HR: 0.62, 95% CI: 0.51–0.76), but not NHB (HR: 0.81, 95% CI: 0.64–1.01) appeared to benefit from PA. When the sample was stratified by sex, inactivity was associated with lower all-cause in NHB males and for both males and females in the Mexican American sample. For the active group only female Mexican Americans in the active PA group demonstrated lower risk of all-cause and cardiovascular mortality when compared to NHW (HR: 0.47, 95% CI: 0.28–0.80)

Discussion

In this study, we estimated the cross-sectional relationship between race and ethnicity, all-cause and cardiovascular mortality and self-reported physical activity in a nationally representative sample of community dwelling older adults. Overall, the association between various levels of PA and mortality was mixed in this diverse sample. For both all-cause mortality and cardiovascular mortality, we find that NHB males, Mexican American males, and Mexican American females classified as inactive had significantly lower mortality rates than NHW. For those classified as insufficiently active, Mexican American men and women had significantly lower all-cause mortality rates than NHW. There were no ethnic/racial differences among men classified as *active*, but there were differences among women classified as *active*.

These results suggest that there are other key factors among Mexican Americans and NHB that may moderate the association between PA and mortality risk. Two key factors that merit further consideration as moderators of the relationship between PA and mortality are the roles of socioeconomic status (Oguma, Sesso et al.) and occupation. It is well known that education is strongly associated with SES and occupational status, which are in turn associated with health (Marmot, Ryff et al. 1997; Mulatu and Schooler 2002). Individuals with low education /occupational status are also more likely to be engaged in physically demanding work than their more educated counterparts (Warren, Hoonakker et al. 2004) which plays a role in frequency of engagement in PA. Evidence to this effect has been recently presented by Gay and Buchner (2014) who found that low to moderate income Mexican American adults are in fact engaged in more physical activity than NHB and White adults when work-related activity are considered. (Gay and Buchner 2014) Given that there were significant ethnic differences in educational attainment in our sample, it is plausible that both SES and occupational status may have played a role in our results, and merit further investigation. Future analyses should explore the role of demographic, socioeconomic determinants and occupation as moderating factors between PA and mortality risk in minority populations.

Our study has a number of strengths. First, our data are based on a national survey that is representative of the United States population. Using a national survey-based dataset, we were able to evaluate an array of covariates measured at the time of the survey from which the racial and ethnic patterns of mortality can be understood more thoroughly. This gives us an important advantage over the more limited vital statistics-based data currently used in the literature. Second, NHANES oversamples racial and ethnic minorities and older adults, allowing us to make conclusions about the strengths of associations. Third, although PA was measured using self-reported questionnaires, the detail to which they were asked allowed calculation of METs. Our study adds to previous reports of PA effects on reduced mortality, and by demonstrating that even very low levels of PA are associated with lower mortality risk in racially and ethnically diverse older adults.

These study findings offer support for including maintenance of at least a modest amount of PA in strategic planning for all-cause and cardiovascular mortality prevention and intervention across all racial and ethnic groups. We also acknowledge that self-reported PA data may include reporting errors. In addition, our METS calculations did not include work related physical activity which may have resulted in underestimation of physical activity in this sample of older adults.

Limitations

We recognize that our study has limitations. Changes in functional status may be partially responsible for some of the racial and ethnic differences in mortality in the different levels of PA, which were not measured in this study. For some racial and ethnic groups composed of a large percentage of immigrants (e.g., Mexican Americans), return migration to the country of origin, after their original inclusion in the survey, may have biased survey-based follow-up estimates of mortality downward (Abraido-Lanza, Dohrenwend et al. 1999). However, return migration effects cannot account for the relatively low older adult mortality rates that have been demonstrated for the U.S. Hispanic population (salmon bias) (Abraido-Lanza, Dohrenwend et al. 1999; Markides and Eschbach 2005). In addition, self-reported PA data may include reporting errors because some respondents may not accurately recall their past month's level of PA or answer the question correctly.

In this study, we had fewer subjects in the active PA category than in the inactive or insufficiently active category which raises some issues. However, our category classifications were based on standard cutpoints provided by the measuring tool we used (Physical Activity Guidelines Advisory Committee 2008; Bull, Maslin et al. 2009). Moreover, the analyzed Hispanic sample was predominantly Mexican American, which likely limited generalizability across Hispanic subgroups, particularly given evidence of significant heterogeneity in Hispanic subgroup mortality outcomes.

In summary, our study findings offer support for including maintenance of at least a modest amount of PA in strategic planning for all-cause and cardiovascular mortality prevention and intervention across all racial and ethnic groups. While our results demonstrate favorable results in Mexican Americans, we continue to advocate the need for physical activity programs that engage all participants. Longitudinal research studies with larger numbers of racial and ethnic groups and with objective measures of PA are needed to improve our

understanding of more subtle differences in PA levels and to assess potential causal roles. Studies need to further explore the impact of demographic and socioeconomic determinants in the development of intervention programs for minority elders.

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Table 1

Baseline Characteristics for the Entire Analytical Sample (N=4922)

	Total sample n=4922	Non- Hispanic Whites N=2932	Non- Hispanic Blacks N=1051	Mexican Americans N=939	P-Value
Age, years	70.5± 0.26	70.6±0.30	69.9±0.32	68.1±0.44	<0.001
Sex					0.017
Males	2378 (42.0)	1378 (41.7)	525 (43.4)	495 (47.2)	
Females	2524 (58.0)	1554(58.3)	526 (56.7)	444 (52.9)	
Education, years	11.3±0.12	11.6±0.12	9.6±0.18	7.0±0.28	<0.001
Physical activity					<0.001
Inactive	1342 (20.9)	666 (19.2)	357 (34.8)	319 (31.7)	
Insufficiently active	1453 (28.4)	833 (28.2)	326 (30.6)	294 (29.9)	
Active	2127 (50.7)	1433 (52.7)	368 (35.0)	326 (38.5)	
Body mass index, kg/m ²	26.9±0.12	26.8±0.14	27.9±0.30	28.3±0.31	<0.002
Comorbidities					
Hypertension	3079 (59.2)	1843 (58.6)	691 (65.9)	545 (54.8)	<0.001
Diabetes	1007 (16.5)	476 (15.4)	260 (24.7)	271 (26.4)	<0.001
All-cause mortality	2892 (52.3)	1543 (52.6)	541 (51.5)	385 (41.0)	0.002
Cardiovascular mortality	1380 (24.1)	710 (24.2)	250 (23.8)	180 (19.2)	0.007

NOTE: Continuous variables are represented as means ± SE, and categorical variables as counts (%).

Physical activity classification: *inactive* those who did not report any LTPA, *active* those who reported 3–6 METs for 5 times/week or >6 METs, 3 times/week, or *insufficiently active* (meeting neither criteria).kg/m²: kilograms/ meter²

Table 2

All-Cause Mortality by Self-Reported Physical Activity Race/Ethnicity, Race and Gender

	All-Cause Mortality			
	Total sample Model 1 ^a HR (95% CI)	Total sample Model 2 ^b HR (95% CI)	Male Model 2 ^b HR (95% CI)	Females Model 2 ^b HR (95% CI)
Inactive				
Non-Hispanic Whites	Ref	Ref	Ref	Ref
Non-Hispanic Blacks	0.84 (0.69–1.02)	0.72 (0.58–0.90)	0.66 (0.46–0.94)	0.77 (0.60–1.03)
Mexican Americans	0.66 (0.50–0.89)	0.59 (0.45–0.78)	0.55 (0.39–0.78)	0.65 (0.46–0.92)
Insufficiently active				
Non-Hispanic Whites	Ref	Ref	Ref	Ref
Non-Hispanic Blacks	0.90 (0.72–1.11)	0.81 (0.64–1.02)	0.80 (0.57–1.12)	0.80 (0.60–1.21)
Mexican Americans	0.71 (0.58–0.88)	0.63 (0.51–0.77)	0.58 (0.40–0.84)	0.65 (0.45–0.95)
Active				
Non-Hispanic Whites	Ref	Ref	Ref	Ref
Non-Hispanic Blacks	0.90 (0.71–1.13)	0.81 (0.64–1.01)	0.78 (0.60–1.02)	0.81 (0.58–1.13)
Mexican Americans	0.87 (0.68–1.11)	0.80 (0.62–1.02)	1.00 (0.80–1.26)	0.47 (0.28–0.79)

^aModel 1: Adjusted for sex and age^bModel 2: Adjusted for age, smoking status, education, HTN, DM

Table 3

Cardiovascular mortality by self-reported activity Race/Ethnicity and gender.

	Cardiovascular Mortality			
	Total sample Model 1 ^a HR (95% CI)	Total sample Model 2 ^b HR (95% CI)	Male Model 2 ^b HR (95% CI)	Females Model 2 ^b HR (95% CI)
Inactive				
Non-Hispanic Whites	Ref	Ref	Ref	Ref
Non-Hispanic Blacks	1.03 (0.81–1.31)	0.72 (0.58–0.88)	0.65 (0.46–0.92)	0.76 (0.56–1.03)
Mexican Americans	0.79 (0.59–1.06)	0.59 (0.45–0.77)	0.53 (0.37–0.74)	0.65 (0.46–0.92)
Insufficiently active				
Non-Hispanic Whites	Ref	Ref	Ref	Ref
Non-Hispanic Blacks	0.77 (0.57–1.05)	0.81 (0.64–1.02)	0.80 (0.57–1.11)	0.80(0.57–1.13)
Mexican Americans	0.86 (0.60–1.23)	0.62 (0.51–0.76)	0.57 (0.39–0.83)	0.60 (0.45–0.96)
Active				
Non-Hispanic Whites	Ref	Ref	Ref	Ref
Non-Hispanic Blacks	0.81 (0.59–1.11)	0.79 (0.63–1.01)	0.78 (0.60–1.03)	0.78 (0.55–1.09)
Mexican Americans	0.73 (0.48–1.10)	0.79 (0.61–0.87)	1.00 (0.79–1.26)	0.47 (0.28–0.80)

^aModel 1: Adjusted for sex and age^bModel 2: Adjusted for age, smoking status, education, HTN, DM

Note: showing final model which also includes additional covariates for the HR (age, smoking, education, diabetes and hypertension). To maintain our focus on race/ethnicity and PA these variables are not included in the table but are available upon request).