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Is there a relationship between accelerometer-assessed physical activity and sedentary behavior and cognitive function in US Hispanic/Latino adults? The Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

Elizabeth Vásquez *, Garrett Strizich, Carmen R. Isasi, Sandra E. Echeverria, Daniela Sotres-Alvarez, Kelly R. Evenson, Marc D. Gellman, Priya Palta, Qibin Qi, Melissa Lamar, Wassim Tarraf, Hector M. González, Robert Kaplan

University at Albany (SUNY), Epidemiology and Biostatistics, 1 University place, 12144 Rensselaer, United States

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ABSTRACT

Normative changes in cognitive function are expected with increasing age. Research on the relationship between normative cognitive decline and moderate-to-vigorous physical activity (MVPA) and sedentary behavior (SED) needs further investigation in Hispanic/Latinos adults. We assessed the cross-sectional association between accelerometer assessed MVPA and SED with cognitive function in 7,478 adults aged 45–74 years from the Hispanic Community Health Study/Study of Latinos. At baseline, cognitive tests included two executive function tests (Digit Symbol Substitution Test (DSST), a test of language (Word Fluency), and a test of memory (Spanish English Verbal Learning Test). Multiple regression models were used to examine associations of time spent in MVPA and SED with cognitive function by age groups, adjusted for age, education, sex, acculturation, and field center. Mean time spent in sedentary behaviors was 12.3 h/day in females and 11.9 h/day in males (75% and 77% of accelerometer wear time, respectively). Higher SED, but not MVPA, was associated with lower DSST raw scores (β −0.03 with each 10-min increment in SED; $P < 0.05$), indicating lower performance in executive function in all age groups. No associations were observed for MVPA and SED with tests of language or memory tests. Our findings suggest a distinct association of SED but not MVPA on executive functioning in middle-aged and older Latino adults. Longitudinal studies are needed to more conclusively determine causal links.

1. Introduction

With increasing age adults experience normative cognitive decline—cognitive aging, at a rate of 0.04–0.05 SD units/year (Alwin and Hofer, 2011; Castora-Binkley et al., 2015; Hayden et al., 2011; Royall et al., 2005). One possible source of variation in cognitive performance with increasing age is race and ethnicity (Sachs-Ericsson and Blazer, 2005). Although cognition and age-related cognitive decline have been studied extensively, there is currently no consensus regarding their relationship with race/ethnicity (Castora-Binkley et al., 2013; Ho et al., 2011; Masel et al., 2010; Yaffe et al., 2009). In particular, studies evaluating racial/ethnic differences in cognitive function have shown that non-Hispanic Blacks (NHB) decline at faster rates compared with non-Hispanic Whites (NHW) (Castora-Binkley et al., 2013; Masel and Peek, 2009; Park et al., 2003; Yaffe et al., 2009; Zsembik and Peek, 2001). However, while several studies have reported no association between Hispanic ethnicity and the rate of cognitive decline (Castora-Binkley et al., 2013; Karlamangla et al., 2009; Masel and Peek, 2009), others have suggested that Hispanics experience a faster decline in cognitive function in old age (Alley et al., 2007). A better understanding of the patterns of cognitive decline among older Hispanics is important because while the number of older adults in the United States is rapidly growing among all racial/ethnic groups, it is expected to grow faster among Hispanics compared with same-age NHW (Pew Research Center, 2015).

Research has consistently shown that black race is a risk factor for poorer cognitive function when compared to whites, however, it is still unclear as to whether these disparities extend equally to all racial ethnic groups. Perhaps, other factors besides race or ethnicity, such as behavioral factors (i.e. physical activity, sedentary time) could account for the reported racial and ethnic disparities. Physical activity can have a positive effect on a wide range of cognitive functions, although the effect appears to be both general and specific in nature. The general

* Corresponding author.
E-mail address: evasquez2@albany.edu (E. Vásquez).

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effect of increasing physical activity varies across cognitive processes, and the specific effect appears more related to executive control processes (i.e. working memory, multi-tasking) (Hillman et al., 2008). For example, in a study by Vasquez et al. (2015), Hispanics and non-Hispanic blacks who participate in vigorous physical activity (either intermittently or consistently) had better general cognitive function compared with non-active participants after 10 years of follow up (Vasquez et al., 2015). Still, there is insufficient information as to whether a similar consistent pattern of association exists in Hispanics.

Evidence suggests that increasing time spent in sedentary behaviors is distinctly associated with poor health. Sedentary behavior refers to activities that resulting in low levels of energy expenditure (≤1.5 metabolic equivalents) while in a sitting or reclining posture while awake (Tremblay, 2012). Recent population-based estimates of accelerometer-derived sedentary behavior have reported that US adults spend, on average, 55% of their waking hours sedentary (Matthews et al., 2008). Research has also shown racial, ethnic, and age variation with higher sitting time for Mexican American and Hispanics/Latinos females, and non-Hispanic Black males, even after adjusting for education (Sisson et al., 2012).

Finally, there are documented sex differences in specific cognitive abilities reported from childhood through adulthood (McCarrey et al., 2016). On average, men outperform women on spatial tasks, while women outperform men on some tests of verbal ability differences (Hebert et al., 2000; Mortensen et al., 2014). However, the effect of sex, age, and race/ethnicity continue to be less well studied in the relationship between physical activity behaviors and cognition across the life span. Specifically, identifying these relationships among Hispanics/Latinos is of public health importance given documented racial/ethnic disparities in cognition and this fast-growing segment of the US population. Moreover, few studies have used accelerometry-based data to study the association of physical activity and sedentary behavior on cognition in minority populations such as Hispanics/Latinos. The purpose of this study is to describe the cross-sectional association between physical activity and sedentary behavior and specific domains of cognitive function (executive function and memory), and how this varies by sex and age in a sample of US Hispanic/Latino middle aged and older adults in the US.

2. Methods

2.1. Study design and population

The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a cohort study of 16,415 community-dwelling Hispanic/Latino adults of diverse backgrounds (Central American, Cuban, Dominican, Mexican, Puerto Rican, and South American) living in four US cities (Miami, FL, Bronx, NY, Chicago, IL, and San Diego, CA). Participants were recruited using a 2-stage area probability sampling design, as described previously (Lavange et al., 2010; Sorlie et al., 2010). Participants were ages 18–74 years at screening, able to travel to the local study field center, and had no plans to move out of the study area; 41.7% of screened individuals were enrolled.

The HCHS/SOL baseline examination was conducted in 2008–2011 by bilingual interviewers in either English or Spanish and included a comprehensive clinical evaluation, accelerometry, and questionnaires covering a variety of sociodemographic, medical, environmental and lifestyle topics. A neurocognitive battery was administered by study staff to those age 45 years and older (n = 9714). The current analysis excluded participants with incomplete neurocognitive data (n = 373), those who did not wear the accelerometer (n = 847), those and those who attempted accelerometry but who were not adherent to the accelerometer protocol (n = 1006; at least 3 days with 10 h of wear time each). These exclusions yielded an analytic sample of n = 7478 (77% of participants age 45 years and older). Institutional review boards at each participating institution approved the study and all participants gave written informed consent.

2.2. Assessment of sedentary behavior and physical activity

All participants were asked to wear an accelerometer (Actical model 198-0200-03; Respironics Co. Inc., Bend, Oregon) for seven days with removal only for swimming, showering, and sleeping (Evenson et al., 2015). The Actical was positioned above the right iliac crest and programmed to measure accelerations in "counts" in 1-minute epochs (cpm). The Actical has been previously shown to be reliable (r = 1.0) (Choi et al., 2011; Esliger et al., 2007; Esliger and Tremblay, 2006; Welk et al., 2004). Non-wear time was determined using the Choi algorithm (Choi et al., 2011; Vasquez et al., 2016). Accelerometer data were summarized as the number of minutes per day spent sedentary (<100 cpm) and in moderate-vigorous physical activity (MVPA; ≥1535 cpm), according to established cut-points (Colley et al., 2011; Wong et al., 2011).

2.3. Assessment of cognitive function

The HCHS/SOL neurocognitive battery included 1) Brief Spanish English Verbal Learning Test (B-SEVLT); 2) Word Fluency (WF) test; and 3) Digit Symbol Substitution Test (DSST), as described previously (Gonzalez et al., 2015). The B-SEVLT is a measure of episodic verbal learning and memory that is psychometrically equivalent in English and Spanish versions and consists of three 15-word learning trials, a fourth interference trial, and a fifth recall trial of the initial word set (Gonzalez et al., 2001). Two aspects of the B-SEVLT were analyzed here: "learning" defined as the sum of the first three trials, and "delayed recall" representing the retention of previously learned material and defined as the number of words correctly recited in the fifth trial. The Brief Spanish English Verbal Learning Test— is reported to have a test-retest reliability coefficient of 0.65 and 0.72 for the internal consistency intraclass correlation (Campo and Morales, 2004). In the fluency test, participants were asked to produce as many words as possible beginning with the letters F, then A, in consecutive 1-minute trials (Spreen and Strauss, 1998). This test has a test-retest reliability correlation of 0.79 and a construct validity of 0.66 (Cohen and Stanczak, 2000). In the DSST of the Wechsler Adult Intelligence Scale (Lezak, 1993), scores represent the number of digit-symbol pairs transcribed in 90 seconds using a key that pairs each of the digits 1–9 with unique symbols. The DSST has high test-retest reliability with correlation coefficients ranging from 0.82 and 0.88 (Matarazzo and Herman, 1984). All tests were administered by trained personnel who were certified for proficiency by licensed neuropsychologists with regular, periodic recertification. From the raw cognitive test scores, we created a global cognitive function index using an average of the four indices ([individual value − mean value] / SD).

2.4. Other covariates

Hispanic/Latino background was assessed by asking, "Which of the following best describes your Hispanic/Latino heritage?" Other self-reported sociodemographic characteristics considered were age, years of education, sex, annual household income, highest level of education, employment status, and place of birth. The Physical Component Score (PCS) of the SF-12 Health Survey Version 2.0 (QualityMetric Inc., Lincoln, RI) was included as an aggregate measure of self-reported physical health status to account for prevalent diagnosed and undiagnosed conditions that may limit physical activity and also be related to cognitive functioning. The test-retest reliability of the self-reported physical health survey was reported to be 0.89 (Ware et al., 1996). Body mass index (BMI) was calculated as weight in kilograms divided by height squared (normal 18.5 < BMI < 25; overweight, 25–<30; obese, ≥30).