EDUCATION IS ASSOCIATED WITH PHYSICAL ACTIVITY AMONG AMERICAN INDIAN ELDERS

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Abstract: Although educational attainment and physical activity levels tend to be positively associated in majority populations, this relationship has not been investigated in American Indian and Alaska Native (AI/AN) elders. This study examined the association between education and physical activity among AI/AN elders (N = 107) using self-report and behavioral outcomes. Regression models showed that higher education was significantly associated with total caloric expenditure for moderate-intensity physical activities and distance traveled during a 6-minute walk test of fitness. Additional research is needed to understand modifiable personal, social, and environmental physical activity barriers in these populations.

Introduction

The proportion of physically inactive adults is steadily increasing in the general U.S. population (National Center for Health Statistics, 2003; U.S. Department of Health and Human Services [DHHS], 1996), and especially among American Indians and Alaska Natives (AI/ANs; Coble & Rhodes, 2006). Relative to majority populations, AI/ANs report lower levels of leisure-time physical activity (Welty et al., 1995; Young, 1991), less frequent exercise (Cheadle et al., 1994; Mendlein et al., 1997), and higher rates of inactive lifestyles (Goldberg et al., 1991; Molina & Campos-Outcalt, 1991). Physical inactivity elevates the risk for obesity, hypertension, type 2 diabetes, and cardiovascular disease (Paffenbarger, Hyde, Hsieh, & Wing, 1986; DHHS, 2000), all of which are becoming more prevalent in many Native communities (Galloway, 2005).

Several factors, such as age, gender, body weight, health status, and environmental features (e.g., availability of sidewalks, green space, neighborhood safety), influence physical activity levels (Martinez-Gonzalez, Martinez, Hu, Gibney, & Kearney, 1999; Trost, Owen, Bauman, Sallis, & Brown, 2002; Umstattd, Saunders, Wilcox, Valois, & Dowda, 2006). Findings from the Behavioral Risk Factor Surveillance System show a clear association between lower educational levels and inactive lifestyles in both the 1990 and 2004 assessment periods (Harper & Lynch, 2007). Although educational attainment tends to be positively associated with engaging in physical activity and exercise in the majority culture (Trost et al., 2002), some studies among AI/ANs have substantiated this association (Coble & Rhodes, 2006; Thompson, Wolfe, Wilson, Pardilla, & Perez, 2003; Doshi & Jiles, 2006) but others have shown only moderate (King et al., 2000; Whitt, DuBose, Ainsworth, & Tudor-Locke, 2004) or non-significant associations (Fischer et al., 1999; Harnack, Sherwood, & Rock, 1999). Evaluating the education-physical activity relationship may be further complicated by considerable disparities in education, as AI/ANs are less likely to have completed high school (Warne, 2007) or to have obtained a college degree (Castor et al., 2006) than members of the general U.S. population.

A limitation of available studies with AI/ANs is the reliance on cross-sectional, self-report measures of physical activity and exercise. The link between education and physical activity in these populations may be clarified by examining performance on an objective, behaviorally-based measure of physical fitness and exercise capacity such as the 6-minute walk test (6MWT). The 6MWT has been used extensively among medically ill (American Thoracic Society, 2002; Carter, Holiday, Stocks, Grothues, & Tiep, 2003; Solway, Brooks, Lacasse, & Thomas, 2001), healthy (Enright & Sherril, 1998; Sanderson & Bittner, 2006; Simonsick, Montgomery, Newman, Bauer, & Harris, 2001), and older (Enright et al., 2003; Peeters & Mets, 1996) adults. Few studies, however, have used this test with non-Caucasian populations (Lee, Chan, Wong, Lau, & Ng, 2007; Poh, Eastwood, Cecins, Ho, & Jenkins, 2006; Sanderson & Bittner, 2006), and none have empirically applied it to AI/ANs.

Because rates of physical inactivity are disproportionately high among older adults in general and AI/ANs as a whole (Centers for Disease Control and Prevention, 2004; Coble & Rhodes, 2006; National Center for Health Statistics, 2003), additional research is warranted to determine those factors that influence physical activity outcomes specific to older

AIs. The purpose of this study, therefore, was to determine whether educational attainment is associated with physical activity among AI elders between 50 and 74 years of age who participated in a randomized physical activity trial. We predicted that higher education would be positively associated both with self-reported physical activity levels and with distance traveled during the 6MWT.

Methods

Participants and Procedures

The present study represents an analysis of data collected as part of the larger randomized physical activity trial (Sawchuk et al., in press). Participants were 125 AI/AN elders who enrolled in a 6-week randomized trial that compared physical activity monitoring only to physical activity monitoring with the use of a pedometer. Study recruitment efforts and procedures were conducted at the Seattle Indian Health Board, a large, urban primary care medical facility for AIs and Alaska Natives. Inclusion criteria included sedentary lifestyle (responding “no” to the question “Have you been physically active for the past 6 months?”), ability to walk without assistance, no medical contraindications to walking, living within a 2-hour radius of the study site, and age between 50 and 74 years. (In contrast to the majority culture, the term elder in AI/AN communities is not entirely defined by chronological age. Rather, elder represents a level of status and respect within the family and community.) Approval for this study was obtained from the Human Subjects Division at the University of Washington and the Privacy Board at the Seattle Indian Health Board. The study was conducted between April and November, 2005.

During the first study visit, participants completed a structured interview that gathered self-report data and measured body mass index (BMI). Participants were then randomly assigned to a group that either monitored their daily physical activities or monitored their daily physical activities and total step counts with the use of a pedometer. Participants were given a series of weekly activity-monitoring sheets, and the research assistant demonstrated how to complete each daily activity entry. The research assistant reviewed different types of physical activities and exercises the participant might try over the six-week study period. An educational handout on the health benefits of increased physical activity was also reviewed with each participant. At the second visit 6 weeks later, participants completed the self-report measures again, and the BMI was reassessed, followed by the 6MWT. Following completion of the walk, participants were compensated for their time and debriefed about the goals of the activity trial.

Demographic and Health Information

Demographic information collected included age and sex. BMI was calculated using the following formula: weight in kg/height in meters^2. We created 3 education variables: less than a high school education; completed high school, GED, or some vocational/technical training; and completed some college education. Participants were classified as either current smokers or nonsmokers based on endorsing the question: "Do you smoke cigarettes now?" Lastly, the Mental Component and Physical Component Summary scores derived from Medical Outcomes Survey Short Form-36 (SF-36; Ware & Sherbourne, 1992) were used as an index of health status over the last 4 weeks. The SF-36 has well-established reliability and validity (Ware & Sherbourne, 1992) and has been used with diverse patient populations (Schlenk et al., 1998; Yost, Haan, Levine, & Gold, 2005), including older adults (Chapman, Duberstein, & Lyness, 2007; Hu, 2007; Wolinsky et al., 1998), and AIs (Beals et al., 2006; Johnson, Nowatzki, & Coons, 1996).

Self-report Physical Activity Measure

The Community Healthy Activities Model Program for Seniors (CHAMPS) Questionnaire is a 41-item self-report measure assessing a range of light, moderate, and vigorous physical activities in leisure, work, exercise, and chore-related domains (Stewart et al., 1997). Respondents report their weekly frequency and duration of participation in activities over the previous 4 weeks. For this study, we examined responses on the following subscales: (1) total weekly caloric expenditure for all exercise activities, and (2) total weekly caloric expenditure for moderate or greater intensity exercise-related activities. The CHAMPS has excellent psychometric characteristics and has been used extensively with older adults (Harada, Chiu, King, & Stewart, 2001; Stewart et al., 2001) and non-Caucasian populations (Resnicow et al., 2003; Stewart et al., 2006) as an outcome measure for physical activity interventions.

Performance-based Physical Activity Measure

The 6MWT has been widely used as a reliable and valid measure of fitness in healthy (Harada, Chiu, & Stewart, 1999; Harada et al., 2001; Simonsick et al., 2001) and medically ill (Bittner et al., 1994; Peeters & Mets, 1996; Montgomery & Gardner, 1998) older adults. Participants are instructed to walk unassisted around 2 traffic cones on opposite ends of a 50-foot corridor and cover as much distance as possible within a 6-minute time frame. Following a standardized administration protocol (Peeters & Mets, 1996), a research assistant provided verbal encouragement at fixed intervals during the walk, and recorded the total number of laps completed. At the end of 6 minutes, a marker was placed on the ground next to the participant and the total distance in feet was calculated with a rolling tape measure. Previous studies have found that performance on the 6MWT is influenced by age, gender, body mass, and health status (Sanderson & Bittner, 2006).

Statistical Analyses

We calculated means and 95% confidence intervals for age, sex, BMI, and the Mental Component and Physical Component Summary scores at enrollment for the 3 educational categories. For sex and current smoking status, we calculated proportions and their associated 95% binomial confidence intervals by education category.

We used data from weeks 1 and 6 to determine each participant's weekly caloric expenditures due to any exercise-related activity, and those due to moderate or greater intensity exercise. As the continuous CHAMPS measure of weekly caloric expenditure was heavily right-skewed, we calculated the unadjusted median weekly expenditure for each education category and constructed 95% confidence intervals using established techniques (Conover, 1980). We assessed trends on CHAMPS subscales across education category by regressing each log-transformed CHAMPS measure on a linear education category term.

For adjusted analysis of the CHAMPS measures, we conducted regressions of the log-transformed caloric expenditure measures on education category. Our regression models controlled for age, male sex, BMI, current smoking status, and the Mental Component and Physical Component Summary scores. This procedure capitalized on longitudinal measures of CHAMPS and Short Form-36 data taken at weeks 1 and 6 of the study. Our procedures assumed an independent working correlation matrix and an identity link function to accommodate the correlation between repeated observations of the same individual (Diggle, Heagerty, Liang, & Zeger, 2002).

To generate an adjusted summary measure for caloric expenditure, we transformed the adjusted predicted values from the generalized estimating equation models back to the CHAMPS data's original scale (kcal/week), and calculated adjusted medians and their 95% confidence intervals for each education category. We evaluated trends in the predicted values using a generalized estimating equation regression that modeled education category with a single linear term.

We calculated the unadjusted mean 6MWT distance for each education category separately and constructed a 95% confidence interval for each estimate. We investigated the significance of trends across education groups using the same procedure we used with the CHAMPS data. Adjusted analysis of the 6MWT was calculated by conducting multiple linear regressions of 6MWT on education category, controlling for the same covariates mentioned above. We then calculated adjusted means and their 95% confidence intervals for each education category based on the linear regression parameter estimates. We then assessed a trend in adjusted mean 6MWT across education categories, as described above.

Results

Participant Characteristics

Of the 125 participants in the original randomized trial, 107 provided complete information on age, sex, BMI, smoking status, physical and mental health, and self-reported exercise-related activity. Table 1 summarizes participant characteristics for the whole group and by education category. Members of the three education categories were similar with respect to age, sex, BMI, and baseline Mental and Physical Component scores.

Education and Self-reported Physical Activity

The unadjusted median weekly caloric expenditure from exercise-related activities is shown in Table 1. Groups did not differ significantly in unadjusted expenditure from overall exercise, nor was there evidence of any trend across education groups. The groups did differ, however, in unadjusted expenditure from moderate to vigorous exercise ($p < 0.01$), and a significant increasing trend in expenditure was evident as education increased ($p < 0.01$).

Table 2 presents adjusted estimates of median CHAMPS caloric expenditure measures and adjusted mean 6MWT distances by education category. The groups did not differ significantly in the adjusted caloric expenditure due to all exercise activity, and we did not detect a trend across the educational groups ($p = 0.13$). As with the unadjusted results, groups differed significantly in caloric expenditure due to moderate to vigorous exercise ($p < 0.01$), and an increasing trend was significant as educational attainment increased ($p < 0.01$).

Table 1
Characteristics and Unadjusted Outcome Measures by Education Category among American Indian Elder Study Participants

	Less than High School Diploma	**High School Graduate, GED, or Vocational**	**At Least Some College**	**Total**
	(95% CI)	*(95% CI)*	*(95% CI)*	*(95% CI)*
Characteristic	*n = 17*	*n = 35*	*n = 55*	*n = 107*
Demographic Measures				
Age at interview, *mean*	59 (57, 60)	59 (57, 60)	58 (56, 59)	58 (57, 59)
Male sex, *%*	18 (4, 43)	31 (17, 49)	22 (12, 35)	24 (17, 34)
Body mass index, *mean*	30 (28, 33)	31 (29, 33)	30 (29, 32)	31 (29, 32)
Current smoker, *%*	41 (18, 67)	37 (21, 55)	29 (17, 43)	34 (25, 43)
Short Form-36				
Physical component summary, *mean*	46 (41, 51)	42 (39, 45)	42 (39, 45)	43 (41, 45)
Mental component summary, *mean*	49 (42, 55)	45 (41, 48)	48 (45, 51)	47 (45, 49)
Unadjusted Outcome Measures				
CHAMPS Exercise-Related Activity Level				
All activity, *median*	3,133 (1,743, 3,708)	2,967 (1,532, 4,905)	3,493 (2,723, 4,325)	3,422 (2,723, 4,101)
Moderate or higher intensity†, *median*	838 (629, 1,376)	1,432 (507, 2,548)	1,449 (926, 2,255)	1,369 (926, 1,652)
6-minute walk distance†, *mean*	1,198 (1,101, 1,294)	1,251 (1,145, 1,356)	1,416 (1,358, 1,482)	1,329 (1,279, 1,379)

CI = confidence interval
CHAMPS = Community Healthy Activities Model Program for Seniors Questionnaire
† $p < 0.01$

Table 2
Adjusted Outcome Measures by Education Category among American Indian Elder Study Participants

	Less than High School Diploma	High School Graduate, GED, or Vocational	At Least Some College	$p_{(trend)}$
	Estimate (95% CI)	*Estimate (95% CI)*	*Estimate (95% CI)*	
Outcome Measure	*n = 17*	*n = 35*	*n = 55*	
CHAMPS Exercise-Related Activity Level				
All activity, *median*	2,658 (2,067, 2,793)	2,333 (2,103, 3,034)	2,990 (2,748, 3,430)	0.13
Moderate or higher intensity, *median*	888 (740, 941)	1,299 (1,008, 1,579)	1,638 (1,332, 1,988)	≤ 0.01
6-minute walk distance, *mean*	1,192 (1,093, 1,290)	1,250 (1,183, 1,318)	1,412 (1659, 1466)	≤ 0.01

CI = confidence interval
CHAMPS = Community Healthy Activities Model Program for Seniors Questionnaire

Education and Objective Physical Activity Performance

The bottom of Table 1 presents the objective physical activity outcome for each education category. The unadjusted mean 6MWT, measured only at week 6, differed significantly by education category ($p < 0.01$), and demonstrated an increasing trend over increasing educational attainment ($p < 0.01$).

As shown in Table 2, after adjustment for demographic and health-related covariates, education categories still differed significantly in adjusted mean 6MWT measures at week 6 ($p < 0.01$). The upward trend observable in this measure as education category increased was also significant ($p < 0.01$).

Discussion

Our study confirmed the previously reported positive relationship between educational attainment and physical activity levels in a sample of AI/AN elders. As in other studies with both majority (Harper & Lynch, 2007; Trost et al., 2002) and AI (Doshi & Jiles, 2006; Thompson et al., 2003) participants, higher levels of education were positively related to self-reported measures of physical activity. This association was specific to median caloric expenditure for moderately intense physical activities in both unadjusted models and after controlling for relevant demographic and health variables. A similar pattern of findings emerged on our behavioral outcome of physical activity performance. A significant positive trend was found between higher levels of education and increased distance covered during the 6MWT, for both unadjusted and fully adjusted models. Our results are strengthened by the congruence between self-reported and performance-based outcomes. Furthermore, the utility of the 6MWT as a behavioral outcome is underscored, given its sensitivity in assessing physical fitness, and its brevity and ease of administration in the primary care setting (Enright et al., 2003; Solway et al., 2001).

Failure to engage in leisure-time physical activity is a commonly used self-reported index to classify individuals as physically inactive. Findings from the Behavioral Risk Factor Surveillance System found clear, stepwise trends in educational inequities and rates of physical inactivity (Harper & Lynch, 2007). Specifically, the 1990 survey noted that 51% of respondents with less than a high school education were classified as physically inactive compared to 34% of those who had completed high school, 25% with some college education, and 17% with at least a bachelor's degree. In the 2004 survey period, rates of physical inactivity slightly declined across all educational groups, but striking disparities in physical inactivity by educational attainment remained (Harper & Lynch, 2007). One explanation for the high levels of inactivity among AI/ANs is their generally low levels of education due to their lack of educational opportunities. In this regard, educational disparities are the greatest among AI/ANs compared to the general U.S. population, with lower educational attainment typically embedded within a broader system of other socioeconomic inequities, including poverty, unemployment, and poor health care (Castor et al., 2006; Warne, 2007).

Likewise, AI/AN women with some college education were 3 times more likely to be physically active than their counterparts who did not complete high school (Thompson et al., 2003). AI/AN women with less than a high school degree were also twice as likely to be classified as having no leisure-time physical activity in comparison to those with a college education (Doshi & Jiles, 2006). Other investigations from diverse tribal regions have shown either moderate (King et al., 2000; Whitt et al., 2004) or non-significant associations (Fisher et al., 1999; Harnack et al., 1999) between education and physical activity. Of note, half the AI/AN elders in our study had some level of college education, a rate similar to other samples examining physical activity levels in AI/ANs (Thompson et al., 2003). Even so, others have demonstrated that educational attainment does not reliably differentiate AIs who meet physical activity benchmarks established by the Centers for Disease Control and Prevention and the American College of Sports Medicine

(King et al., 2000; Thompson et al., 2003). Among AI women, other factors, such as exercise self-efficacy, perception of being in good health, and knowing other people who exercise have been found to predict meeting physical activity benchmarks (Thompson et al., 2003).

Promotion of physical activity among at-risk populations must take into consideration both the content of the material and the methods by which this information is delivered. Previous studies have found that educational resources distributed in the medical setting are written well above the average reading level of the U.S. population (Johnson & Stern, 2004; Wallace & Lennon, 2004). Materials for health and exercise promotion should therefore be adapted to an appropriate reading level for those populations with lower education levels. Acceptance of and adherence to physical activity guidelines can be enhanced by marketing campaigns that contain motivational, informative, thought-provoking, and persuasive messages (Brawley & Latimer, 2007). Linking physical activity messages to core cultural values (e.g., physical and spiritual healing) and practices (e.g., potlatches) may be particularly important in these populations (Kirby, Levesque, Wabano, & Robertson-Wilson, 2007). Delivery of physical activity interventions and health-related information may also vary between urban and rural environments. Studies suggest that urban-dwelling adults are twice as likely to meet physical activity benchmarks than rural residents (Parks, Houseman, & Brownson, 2003) Although differential facilitators and barriers to exercise exist between urban and rural environments, rural areas may need to emphasize the use of telephone-based motivational interventions to reach target populations (Kolt et al., 2006; Pinto et al., 2002).

Our study has several limitations and notable strengths. First, we did not assess other factors that influence physical activity levels, such as social support, neighborhood walkability, and the availability of places to exercise. These factors may mediate the education-physical activity relationship. Second, our findings may not be generalizable to younger AI/ANs or those residing in rural areas. Third, though not a goal of the study, we did not assess whether our participants met physical activity benchmarks established by the Centers for Disease Control and the American College of Sports Medicine, as did other studies of AIs (King et al., 2000; Thompson et al., 2003).

Despite these limitations, our study is unique in assessing the relationship between education and physical activity in a rarely studied group, AI/AN elders. Furthermore, unlike previous studies that have relied exclusively on self-reported physical activity (Doshi & Jiles, 2006; Fisher et al., 1999; Harnack et al., 1999; King et al., 2000; Thompson et al., 2003;

Whitt et al., 2004), we incorporated a behavioral outcome measure, the 6MWT. In addition, we did not rely on a single assessment of self-reported physical activity. Rather, we used changes in our physical activity measure across a 6-week trial as the outcome. Finally, our sample included both men and women, which extends previous research on the education-physical activity relationship that was limited to AI/AN women (Doshi & Jiles, 2006; Thompson et al., 2003).

Although disparities in physical activity and exercise engagement are evident among older, ethnically diverse populations, few attempts have been made to better understand demographic, personal, and environmental factors that affect this important health-related behavior. Routine physical activity can reduce the risk for many health problems disproportionately experienced by AI/ANs (Galloway, 2005). Future research should investigate novel, low-cost methods for promoting exercise in older AI/ANs, especially at the frequency and intensity levels recommended by public health agencies. Furthermore, several variables likely mediate and moderate the education-physical activity relationship; thus, future research with a larger sample will be necessary to explore these complex associations.

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