ASSOCIATION BETWEEN SELF-REPORTED PHYSICAL ACTIVITY AND OBESITY AMONG WHITE, BLACK, HISPANIC, AND ASIAN AMERICANS: 2007 AND 2009 BRFSS

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Objective: To examine the association between self-reported leisure-time moderate- to vigorous-intensity physical activity (MVPA) and obesity among non-Hispanic White, non-Hispanic Black, Hispanic, and Asian Americans.

Methods: We analyzed data from 569,816 Whites, 54,521 Blacks, 44,864 Hispanics, and 11,232 Asians aged 18 to 79 years who participated in the 2007 and 2009 Behavioral Risk Factor Surveillance System. Physical activity, height, weight, and demographic data were self-reported through telephone interviews. MVPA level was categorized into inactive, low, medium, and high, and weight status into normal-weight, overweight, and obese based on body mass index. Race/ethnicity-, sex-, and age group-specific polytomous logistic regression analysis was conducted, adjusted for age, education, and income.

Results: There was an inverse association between self-reported MVPA and obesity among White men and women (*Ps* for trend <.0001). Black and Hispanic women also presented an inverse association (*Ps* for trend <.0001), although the association was weaker compared to White women. In Asians, no association between self-reported MVPA and obesity was observed.

Conclusions: Weak or no association observed between self-reported MVPA and obesity in minority groups may: 1) suggest that other factors than MVPA play more critical roles in determining weight status in minority groups, or 2) reflect large measurement errors of self-report data in minority groups. (*Ethn Dis*. 2013;23[2]:129–135)

Key Words: Weight Status, Body Mass Index, Exercise, Race/ethnicity, Health Disparities, NHANES

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INTRODUCTION

Epidemiologic studies have demonstrated the inverse association between moderate- to vigorous-intensity physical activity (MVPA) and obesity in United States populations.[1] Although substantial racial/ethnic disparities exist in obesity prevalence[2] as well as in physical activity (PA) levels,[3] the majority of those studies have examined non-Hispanic White American (Whites) populations, or reported race/ethnicity-adjusted data. The statistical adjustment approach does not allow for identifying the potential differences in the association according to race/ethnicity. To understand the disparities, studies have examined the effects of socioeconomic status on obesity. The 2005–2008 National Health and Examination Survey (NHANES) showed that the relationships of obesity with income and education levels differ by race/ethnicity as well as sex.[4] Buchowski et al[5] reported that after controlling for age, income, education, current occupational status, smoking status, marital status, and self-reported comorbidities, the inverse association between self-reported PA and body mass index (BMI) was stronger in White women compared to Black women residing in the Southeastern United States. It appears that socioeconomic status only partially explains the differences in MVPA and obesity that have been observed by race/ethnicity.

A better understanding of the difference in the association observed between PA and obesity by race/ethnicity would help in developing effective intervention designs and strategies for PA promotion and obesity prevention for minority populations with the greatest need. However, little research exists to examine the association between PA and obesity by race/ethnicity in a nationally representative sample, especially including Asian Americans. Given that Asian Americans often report low PA,[6] but at the same time, low obesity prevalence,[7] Asian Americans may present unique association patterns. To examine the effect of PA on any health outcomes, valid PA measures should be utilized. However, PA measures, such as self-report PA, have not been validated in racially and ethnically diverse populations. The aim of our study was to examine the association between self-reported MVPA and BMI among White, Black, Hispanic, and Asian Americans, after accounting for socioeconomic status, using the 2007 and 2009 Behavioral Risk Factor Surveillance System (BRFSS) data. We also compared the BRFSS data with NHANES data, which assessed PA using an objective measure.

The aim of our study was to examine the association between self-reported MVPA and BMI among White, Black, Hispanic, and Asian Americans, after accounting for socioeconomic status, using the 2007 and 2009 BRFSS data.

METHODS

Participants

The BRFSS is an ongoing state-based system of cross-sectional telephone health surveys among noninstitutionalized adults in all 50 states, the District of Columbia, and other US territories. Home telephone numbers were obtained through random-digit dialing and only one adult was interviewed per household. To obtain a sufficient sample size for the Asian group, this report utilized combined datasets of the 2007 and 2009 BRFSS. We noted that the associations between MVPA and obesity, as well as obesity prevalence and inactivity prevalence were fairly consistent in 2007 and 2009; the differences of the prevalence were within 2%. Data from US territories such as Puerto Rico, the US Virgin Islands, and Guam were excluded from our analysis. We identified 738,431 participants who were Whites, Blacks, Hispanics, or Asians aged 18 to 79 years, of which, 680,433 (91.4%) had data on PA and BMI (including the BMI missing category for women; see the Statistical Analysis section). Because the BRFSS is a publicly available anonymous data source, Human Subject Committee did not review this study.

To compare the strength of the association between MVPA and BMI when using self-report versus objective data, we additionally examined the association between accelerometer-measured MVPA and BMI calculated from measured height and weight (measured BMI) among 4,408 participants who were Whites, Blacks, or Mexican Americans (Hispanics) aged 18 to 79 years, using the 2003–2004 NHANES data. We were not able to examine Asians, because the NHANES did not include the discrete racial category for Asian.

Data Collection

BRFSS

The 2007 and 2009 BRFSS data were collected through computer-assisted telephone interviews in English (97%) or Spanish (3%). The BRFSS protocol guidelines and questionnaires are available at the BRFSS website: cdc.gov/brfss. The demographics questionnaire included questions regarding age, sex, race/ethnicity, education, annual household income, height, and body weight. For ethnicity information, participants were inquired of their Hispanic or Latino origin and race with the following questions: "Are you Hispanic or Latino?" and "Which one or more of following would you say is your race? 1) White, 2) Black or African American, 3) Asian, 4) Native Hawaiian or other Pacific Islander, 5) American Indian or Alaska Native, or 6) other." Self-reported BMI, calculated as self-reported weight divided by self-reported height squared, was used to classify weight status as normal-weight (BMI <25 kg/m^2), overweight (25 kg/m$^2 \leq$ BMI <30 kg/m^2), or obese (BMI ≥ 30 kg/m^2). We applied these BMI cut-points to Asians for uniform definitions across race/ethnicity.[8]

The PA module collected data on the frequency and duration of non-occupational moderate-intensity PA (MPA) and vigorous-intensity PA (VPA). Moderate-intensity PA information was obtained with the question, "(when you are not working) in a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes some increase in breathing or heart rate?" followed by its frequency and duration questions. For VPA, the question was "(when you are not working) in a usual week, do you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that cause large increase in breathing or heart rate?" followed by its frequency and duration questions. MVPA was defined as: (MPA frequency $\times$ MPA duration + 2 $\times$ VPA frequency $\times$ VPA duration) and categorized into high (301+ min/wk MVPA), medium (150–300 min/wk MVPA), low (10–149 min/wk MVPA), and inactive ($<$ 10 min/wk MPA or VPA), in accordance with classifications of the 2008 PA guidelines.[9]

NHANES

Detailed methods for the 2003–2004 NHANES data analysis are described elsewhere.[10] Briefly, height and weight were measured during NHANES physical examinations. A subsample of participants was asked to wear the Actigraph AM-7164 accelerometer monitor for seven consecutive days, removing it only for sleeping, bathing, or water activities. Accelerometers were considered as not worn if a period of 60 consecutive minutes of zero accelerometer counts was encountered in the accelerometer data array. To be included in this analysis, participants needed $\geq$four days of accelerometer data and $\geq$10 hours per day. MVPA was defined as $\geq$1,952 counts/min.[11]

Statistical Analysis

BRFSS

All statistical analyses were conducted using the Statistical Analysis System (SAS) version 9.2 (Cary, NC) taking into account the BRFSS sampling weights. All analyses were stratified by race/ethnicity, sex, and age group (18–39 years [younger], 40–59 years [middle-aged], and 60–79 years [older]).

Frequency analyses were performed. The responses of 'refused' and 'don't know' were treated as missing. If missing data represented more than 5% in a particular variable, an additional category was created for missing data; this was the case in household income (both for men and women) and BMI (only for women) variables. Otherwise, missing data were excluded from the frequency analysis and modeling.

Age (continuous)-adjusted multivariable polytomous logistic regression models were fit to predict the probability of being overweight or being obese against being normal-weight according to MVPA levels (reference group: inactive). The models were then further adjusted for household income (<$25,000; $25,000–<$50,000; ≥$50,000; missing) and education (≤high school; >high school).

NHANES

Taking the complex sampling design into account, means and 95% CIs of daily sum of accelerometer counts during minutes of MVPA (MVPA counts) were calculated according to race/ethnicity, sex, age group, and BMI categories.

RESULTS

BRFSS

Data analysis included 569,816 Whites, 54,521 Blacks, 44,864 Hispanics, and 11,232 Asians aged 18 to 79 years. As shown in Table 1, higher proportion of White obese men and women reported inactivity, compared to White normal-weight counterparts. This trend was also found in Black women, Hispanic women, and Asian men, but not among Black men, Hispanic men, or Asian women.

Among Whites, the odds of obesity decreased with increasing MVPA (*P*s for trend <.0001; Figure 1). Among Black men, there was no significant association between MVPA and obesity regardless of age groups. Among Black women, MVPA was inversely associated with obesity in the older age group only (*P* for trend <.0001). With Hispanic men, no consistent patterns in an association between MVPA and obesity were found across age groups. Among Hispanic women, particularly the older age group, results revealed an inverse association between MVPA and obesity. There was no association between MVPA and obesity among Asians, except for older Asian women. Overall, adjusting for education and income did not change the association trends.

NHANES

Of 4,408 Whites, Blacks, and Hispanics aged 18 to 79 years who agreed to wear an accelerometer, 3,548 participants (2,003 Whites, 724 Blacks, and 821 Hispanics) had valid accelerometry data (80% valid data). Overall, an inverse association between MVPA and obesity was observed, particularly in younger and middle-age groups across

Table 1. Moderate- to vigorous-intensity physical activity levels of participants, 2007 and 2009 BRFSS

			Normal-weight				Overweight				Obese			
		Sample	Inactive	Low	Medium	High	Inactive	Low	Medium	High	Inactive	Low	Medium	High
	Age Group	*n*	%	%	%	%	%	%	%	%	%	%	%	%
Non-Hispanic White														
Men	18–39 years	42,176	5.6	14.1	17.6	62.8	5.2	13.1	19.7	62.0	8.7	19.4	20.7	51.2
	40–59 years	97,486	8.9	16.0	20.2	54.9	7.9	17.9	21.5	52.7	13.3	23.2	22.3	41.2
	60–79 years	81,994	12.8	17.8	19.9	49.5	12.1	21.1	21.4	45.4	21.0	24.6	19.9	34.5
Women	18–39 years	66,880	5.6	19.4	22.1	52.9	6.9	24.6	25.2	43.3	9.8	30.9	23.7	35.7
	40–59 years	149,360	6.1	19.8	22.9	51.2	8.6	26.3	25.1	40.0	15.1	34.7	23.3	26.9
	60–79 years	131,920	13.3	22.4	22.4	41.8	15.4	28.1	23.5	33.0	26.5	33.1	18.8	21.6
Non-Hispanic Black														
Men	18–39 years	4,056	11.4	13.2	16.9	58.5	9.1	15.3	16.0	59.6	12.1	16.5	17.8	53.6
	40–59 years	7,733	19.2	18.8	18.1	43.7	13.3	19.6	21.4	45.7	17.1	21.6	19.3	42.1
	60–79 years	4,941	28.1	23.9	16.5	26.4	19.7	22.6	17.5	40.2	23.6	26.3	18.2	31.9
Women	18–39 years	10,369	15.7	26.1	20.1	38.2	16.4	24.7	20.0	38.9	17.5	33.3	21.1	28.7
	40–59 years	16,505	19.0	24.1	21.5	35.5	16.8	26.2	20.7	36.3	21.4	31.0	19.4	28.2
	60–79 years	10,917	24.4	33.2	17.5	24.9	24.1	30.7	21.8	23.4	31.9	32.4	18.6	17.1
Hispanic														
Men	18–39 years	6,155	14.5	16.3	16.0	53.2	10.4	16.5	20.0	53.0	14.0	21.4	17.3	47.3
	40–59 years	6,304	20.0	17.7	16.3	46.0	16.8	19.0	20.2	44.1	18.4	24.1	18.7	38.8
	60–79 years	3,125	25.5	21.5	20.1	32.9	19.5	18.9	21.8	39.8	22.2	20.2	20.9	36.7
Women	18–39 years	12,124	13.4	19.9	21.7	45.0	14.6	22.2	23.4	39.8	17.1	27.1	19.4	36.4
	40–59 years	11,376	15.0	20.4	20.6	44.0	15.6	23.1	23.3	38.0	21.7	29.9	18.4	29.9
	60–79 years	5,780	21.3	26.7	20.2	31.9	22.2	27.5	20.1	30.2	31.0	29.8	16.4	22.8
Asian														
Men	18–39 years	1,536	8.8	27.6	17.9	45.7	9.6	26.2	22.8	41.4	12.2	14.3	14.8	58.7
	40–59 years	2,052	13.1	22.2	31.9	32.8	8.4	26.4	25.4	39.8	20.7	23.3	23.7	32.4
	60–79 years	1,128	18.0	20.4	25.2	36.4	22.9	24.0	22.5	30.6	29.0	17.6	35.5	17.9
Women	18–39 years	2,211	15.0	28.5	22.6	33.9	11.7	33.6	26.2	28.4	12.4	31.7	11.9	44.0
	40–59 years	2,761	18.3	29.4	23.4	28.9	20.3	28.8	25.1	25.8	9.6	36.5	21.4	32.5
	60–79 years	1,544	25.7	27.5	15.4	31.3	18.6	33.4	21.4	26.5	30.5	41.1	14.2	14.3

All sample sizes are presented as un-weighted. All percentages are presented as weighted.

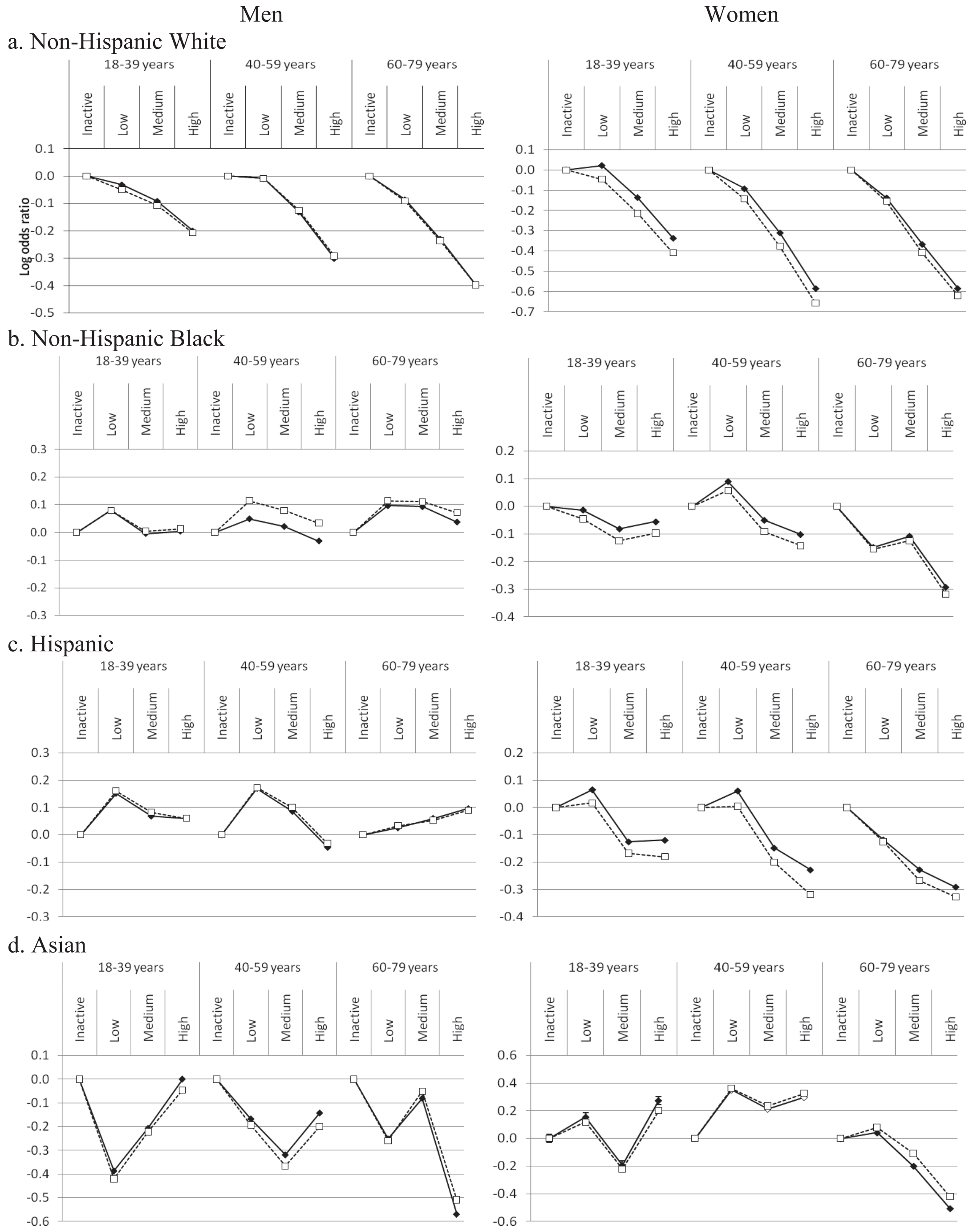

Fig 1. Log-transformed odds ratios of obesity for various moderate- to vigorous-intensity physical activity levels versus inactivity: 2007 and 2009 BRFSS. □ age-adjusted, ♦ age-, education-, and income-adjusted

three racial/ethnic groups (*Ps* for trend <.05; Figure 2). However, there was no significant inverse association in Hispanic women. Older age groups in Black men and women did not show a significant inverse association.

DISCUSSION

Our study confirmed the strong inverse association between self-reported MVPA and obesity among Whites. However, the inverse association was less clear among Blacks and Hispanics, particularly in men. No association was observed among Asians. These findings are consistent with studies by Buchowski et al[5] and Gordon-Larsen et al.[12] Our study also showed that adjustment for

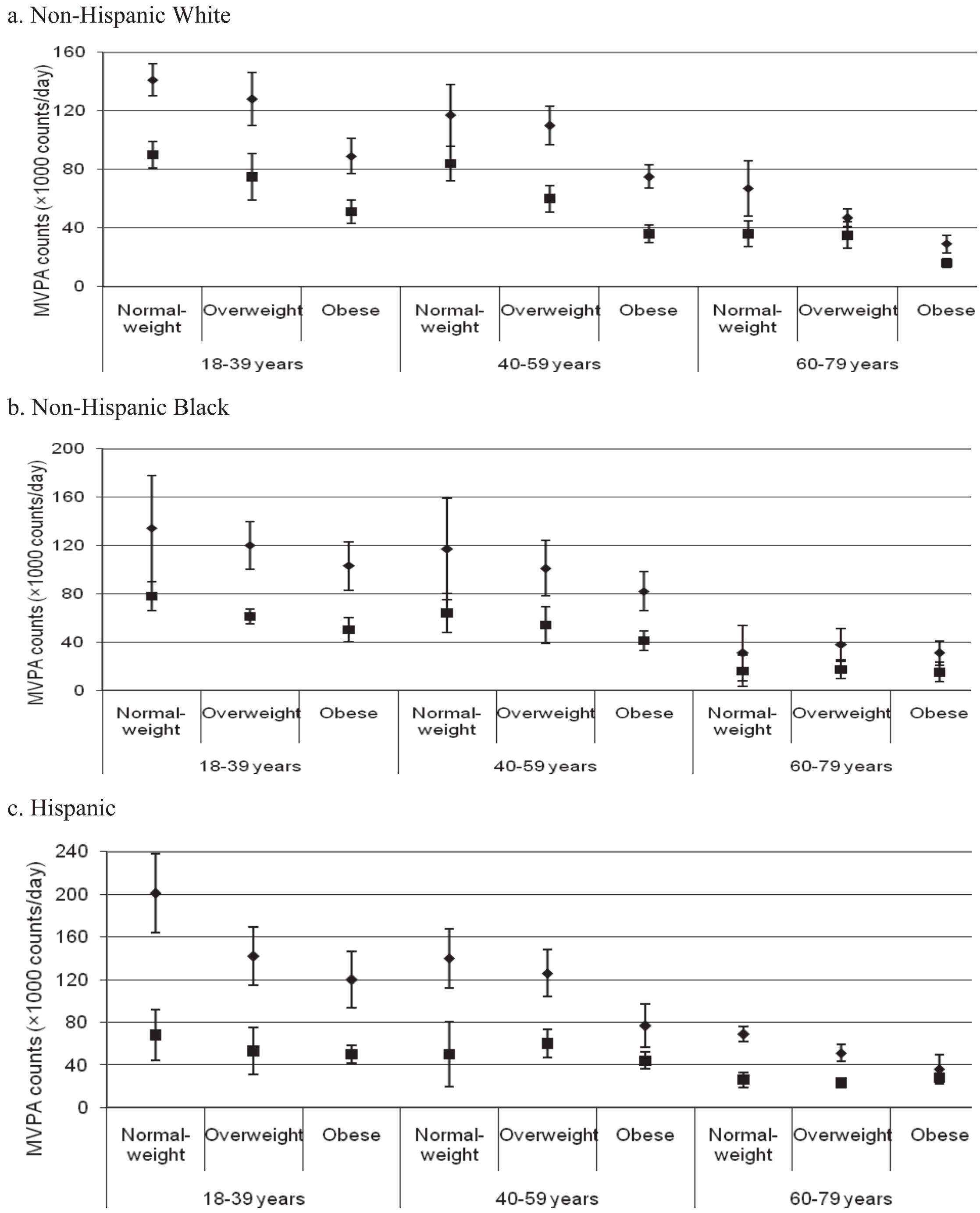

Fig 2. Means and 95% confidence intervals of moderate- to vigorous-intensity physical activity accelerometer counts according to weight status: 2003–2004 NHANES. ♦ Men, ■ Women

education and income levels little changed the strength of the association between PA and obesity.

The first plausible explanation for the racial/ethnic differences in the association between MVPA and BMI is that other confounding factors, for example, other domains of PA and calorie intake, may play a more important role in determining weight status among minority groups than among Whites. Evenson et al[13] reported that occupational activity was highest among Blacks, and leisure-time PA highest among Whites. However, in an additional exploration of an association between occupational activity levels (sitting, walking, and heavy labor) and BMI in the 2007 and 2009 BRFSS, *Our study confirmed the strong inverse association between self-reported MVPA and obesity among Whites.*

we did not find a clear pattern in the association among any of the race/ethnicities (data not shown). In the current study, Asians presented distinct outcomes. Asians' dietary patterns, which result in low added sugar,[14] fat, and calorie intake,[15] may help maintain normal weight although they were found to be least engaged in MVPA. We were not able to account for calorie intake due to no available data in the BRFSS.

The racial/ethnic differences in the association between MVPA and obesity may also be caused by measurement error of self-reported BMI. Self-reported height and weight have questionable accuracy especially among racial/ethnic minority groups. Using the 1988–1994 NHANES data, Gillum and Sempos[16] reported that the sensitivity of obesity defined by self-reported BMI against measured BMI was lower among Hispanics (69% to 83%), compared to Whites (80% to 93%) or Blacks (83% to 92%). Regardless of race/ethnicity, the sensitivity was lower among women than men. The study also showed that the obesity prevalence rates estimated by self-reported BMI were 4% to 12% lower than those by measured BMI.[16] Consistent with the study by Gillum and Sempos,[16] we also observed that the difference in obesity prevalence estimates based on the 2007 and 2009 BRFSS self-reported BMI and 2007–2008 NHANES measured BMI[17] was the largest among Hispanics, particularly among women.

Self-report PA data are often a concern due to the threat to measurement error. A validity study of the 2001 version of the BRFSS PA questionnaire (85% White and 15% Black)[18] showed that kappa coefficients for test-retest reliability were .35 to .53 for MPA and .80 to .86 for VPA. The kappa validity of the questionnaire data against accelerometer data was .31 for MPA to .17 for VPA; Pearson correlation coefficients were .16 to .27 for MPA and .52 to .63 for VPA. In addition to the general inaccuracy (eg, recall bias) of self-reported PA data, these data from minority groups may be more inaccurate because self-reported PA instruments have often been designed for Whites and English speakers. Minority groups may interpret types, intensities, and durations of PA differently from White respondents.[19,20]

For Asian, we found no association between MVPA and obesity. We were not able to verify the association using objectively-measured PA data from a representative sample of Asians in the NHANES dataset because of the lack of available data. More data needs to be collected among Asians; oversampling Asians in the NHANES, for example, will allow for obtaining objective health data in Asians.[21] Given the low obesity prevalence in Asians, investigations on the determinants of maintaining normal weight among Asians may help to develop obesity prevention strategies for other racial/ethnic groups.

The strengths of this study include the use of BRFSS, a nationally representative sample of diverse racial/ethnic groups, and particularly the Asian group. Race/ethnicity-, sex-, and age group-specific analyses are believed to provide better insights to understand the differences by race/ethnicity in the association observed between PA and obesity. However, self-reported data are prone to measurement error. The exclusion of households without landline telephones may have caused selection bias. We did not consider the significant potential confounding factor, calorie intake. We performed a secondary analysis to verify the association between MVPA and obesity using objectively-measured PA data from a nationally representative sampling (NHANES) which had sufficient data for several racial/ethnic subgroups. In addition, this observational study cannot eliminate error introduced by residual and unmeasured confounding factors.

In conclusion, our study shows substantial variability in the strength of the association between self-reported PA and obesity across racial/ethnic groups. Our study suggests that even though the inverse association of PA and BMI is widely accepted, this relationship may present a different picture across racial/ethnic minority populations. Culturally appropriate PA instruments are recommended to be developed and validated in racially/ethnically diverse samples.

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AUTHOR CONTRIBUTIONS

Design and concept of study: Kwon
Acquisition of data: Kwon, Hawkins
Data analysis and interpretation: Kwon, Hawkins
Manuscript draft: Kwon, Wang, Hawkins
Statistical expertise: Kwon, Hawkins
Administrative: Kwon