Differences in Vigorous and Moderate Physical Activity by Gender, Race/Ethnicity, Age, Education, and Income among U.S. Adults

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ABSTRACT

Background: Inconsistent findings exist regarding correlates of physical activity (PA) in the literature. Leisure-time physical activity among U.S. adults has declined for the last decade. Purpose: This article examines differences in vigorous-intensity and moderate-intensity physical activity by gender, race/ethnicity, age, education, and income among a representative sample of U.S. adults. Methods: A total of 1,000 adults participated in a random-digit telephone survey in 2005 (62% response rate and 82% cooperation rate). Non-Hispanic Blacks and Hispanics were oversampled to produce reliable estimates for these groups. Standard errors and odds ratios were calculated utilizing SUDAAN, reflecting differential probabilities of selection. Results: After adjusting for differences in existence of a serious health problem, body mass index, marital status, employment status, and smoking status in the multivariable logistic models, none of the five demographic variables except race/ethnicity were predictive of meeting the moderate PA guideline, whereas each of the five variables was predictive of meeting the vigorous PA guideline. Discussion: Because most U.S. adults fail to meet physical activity guidelines, health practitioners must be vigilant in helping people adopt and adhere to active lifestyles. Translation to Health Education Practice: The results of this study support different approaches for different intensity levels of PA. Given the lack of evidence about the efficacy of moderate-intensity PA on reducing body weight, health educators must be cautious against providing expectation that people could lose substantial weight by engaging in moderate PA.

BACKGROUND

Identifying significant correlates of physical activity (PA) is important because subgroups of physically inactive adults can be targeted for tailored intervention programs. Whereas correlates of leisure-time PA have been commonly assessed,[1,2] few studies have been conducted to identify correlates of PA with different intensity, i.e., moderate and vigorous intensity, using a nationally representative sample of U.S. adults. In general, PA is less common among women than men[2,3] and among those with lower income than higher income.[4] This is particularly true for vigorous sports and exercise. However, this statement may be incorrect or even reversed if household, childcare, and work-related physical activities are considered.[5,6] Given that overweight and obesity result from energy imbalance involving lack of energy expenditure compared with caloric intake, it is imperative to examine correlates of both vigorous-intensity and moderate-intensity physical activities that account for a substantial proportion of daily energy expenditure.

Literature suggests that gender,[2,3] race/ethnicity,[1,6-8] age,[2,3,6,9] education,[1,2,6,7] income,[10] health status,[1,3,9] employment status,[9,10] marital status,[2,6,9] body mass index (BMI),[11] and smoking status[2,6] are significant predictors for PA among U.S. adults. However, inconsistent findings are noted for many of the correlates. Whereas many

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studies showed a significant relationship between race/ethnicity and PA,[1,3,6-8] some other studies[9,12] reported no significant relationship between them. He and Baker[1] added an insight into this discrepancy, reporting that differences in health status and education accounted for virtually all racial and ethnic differences in leisure-time PA among U.S. adults age 51-61 years. Age was a significant predictor for PA in many studies,[3,6,9,13] but its significance was not established in other studies.[2,14] Inconsistent findings are also observed regarding the association between PA and health status,[1,3,9,14] BMI,[6,9,11,14] marital status,[6,14,15] and employment status.[9,15] These inconsistent findings appear to have occurred due, in part, to (1) failure to account for vigorous-intensity and moderate-intensity activities separately, (2) lack of an appropriate statistical adjustment of the effect of other confounders, (3) temporal changes in the dynamics of PA correlates (i.e., some studies were conducted in the early 1990s and others in 2005; due to changes in PA levels and other contributing factors to PA, early findings may not reflect current correlates of PA), or (4) lack of representativeness of a selected sample.

The prevalence of no leisure-time PA among U.S. adults age ≥ 18 years declined from 29.8% in 1994 to 23.7% in 2004 ($p<$ .001), with more U.S. adults becoming overweight or obese.[16] This finding is affirmed by another government report.[17] According to the CDC's National Center for Health Statistics, the proportion of physically inactive adults age ≥ 18 years dropped from 40.5% in 1998 to 37.6% in 2003, whereas those who engaged in regular leisure-time PA increased from 29.5% in 1998 to 32.8% in 2003.[17] This significant change in the prevalence of adults' physical activity may have caused changes in the PA correlates or in the relationships among different correlates.

The current study examined differences in the correlates of vigorous-intensity and moderate-intensity physical activities by gender, race/ethnicity, four distinct age groups (18-33; 34-49; 50-65; and 66+), educational attainment, and income groups among a recent representative sample of U.S. adults after adjusting for differences in five confounders. The adjusted confounders included (1) existence of a serious health problem such as heart disease, stroke, cancer, diabetes, arthritis, hypertension, thyroid disorders, lung disease, asthma, or kidney disease, (2) BMI calculated from self-reported weight and height (kg/m^2), (3) marital status, (4) employment status, and (5) smoking status. Based on the literature, it was hypothesized that each of the five demographic variables—gender, race/ethnicity, age, education, and income—is an independent predictor of both vigorous-intensity and moderate-intensity activities among U.S. adults.

METHODS

A nationally representative sample of noninstitutionalized civilian U.S. residents age 18 years or older was interviewed by professional interviewers in an independent survey institute in Florida that was contracted to perform a random-digit dialing telephone survey. This study was conducted in conjunction with another that examined racial/ethnic differences in BMI, morbidity, and attitudes toward obesity using the same sample; the results of this study have not been included in other manuscripts. The telephone interview was administered both in English and in Spanish in March and April 2005. Non-Hispanic Blacks and Hispanics were oversampled to produce reliable estimates for these groups. The individuals within a household were randomly selected to complete the interview using a randomization procedure built into the computer-assisted telephone interviewing (CATI) software—"Interviewer" by Voxco of Montreal, Canada—that is well suited for bilingual interviewing. The design and all procedures for this study were approved by the Institutional Review Board of the investigators' university.

The survey resulted in 1,000 complete interviews, 24 break-offs, 189 refusals, 86 non-interview due to language barrier, 1,211 answering messages, 361 fax/data lines, 1,264 nonworking/disconnected numbers, and 296 government/business numbers. The response rate (RR 3) and cooperation rate (COOP 3), calculated by standards established by the American Association for Public Opinion Research,[18] were 62% and 82%, respectively. The formulas used were RR 3 = Complete interviews / [(complete interviews + partial interviews) + (refusal and break-offs + noncontacts + other) + *e* (unknown household + unknown other)], and COOP 3 = Complete interviews / [(complete interviews + partial interviews) + refusal and break-offs]. The *e*, an estimated proportion of cases of unknown eligibility that are eligible, was estimated to be .10.

Physical activity measures were adapted from CDC's Youth Risk Behavior Survey[19] and He and Baker.[1] Vigorous PA was measured by asking "On how many of the past 7 days did you exercise or participate in physical activity for at least 20 minutes that made you sweat or breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities?" For moderate PA, the participants were asked "On how many of the past 7 days did you exercise or participate in physical activity for at least 30 minutes that did not make you sweat or breathe hard, such as walking, gardening, golfing, slow bicycling, pushing a lawn mower, or mopping floors?" Current smokers were defined as those who had smoked at least 100 cigarettes in their lifetime and were currently smoking every day or some days.[20] Demographics were assessed by questions regarding eight variables derived from the Behavioral Risk Factor Surveillance System questionnaire: self-reported age, gender, race, ethnicity, marital status, educational attainment, employment status, and income group.[20]

Statistical Analysis

Data were analyzed using the SAS (release 9.1; SAS Institute, Cary, NC) and SUDAAN (release 9.0; Research Triangle Institute, Research Triangle Park, NC) software programs. Sampling weights were calculated that took into account unequal probabilities of selection resulting from the sample design, from unequal number of adults and landlines in a household, and

from planned oversampling of non-Hispanic Black and Hispanic populations. All analyses reflected differential probabilities of selection. Standard errors and odds ratios were calculated utilizing SUDAAN software. Out of 1,000 complete surveys, 12 pregnant women and 7 other respondents who lacked race/ethnicity information were dropped from the analyses, reducing the sample size to 981 (553 non-Hispanic Whites, 205 non-Hispanic Blacks, 193 Hispanics, and 30 others). Logistic regressions were conducted for two dichotomized categorical variables to examine both unadjusted and adjusted odds ratios (ORs) of PA correlates. The two categorical outcome variables included dichotomized vigorous PA (coded 1 for those who met the vigorous guideline on 3 or more days, corresponding to *Healthy People 2010* objective 22-3) and dichotomized the moderate PA (coded 1 for those who met moderate guideline on 5 or more days, corresponding to *Healthy People 2010* objective 22-2).[21]

RESULTS

Bivariate Relationships

As can be seen in Table 1, 41% of the total respondents (n=407) participated in at least 20 minutes of vigorous PA on 3 or more of the previous 7 days, and 48% (n=467) participated in at least 30 minutes of moderate PA on 5 or more of the previous 7 days.

Chi square analyses were used to examine bivariate associations between PA levels and correlates of interest. Three variables—age group, BMI group, and marital status—showed significant associations with both levels of PA. Gender, educational attainment, income group, existence of a serious health problem, and employment status were significant predictors only for meeting the vigorous activity guideline. More men (53%) than women (37%) indicated they met the vigorous activity guideline, whereas there was no gender difference in the prevalence of respondents who met the moderate activity guideline. While there was a graded decrease in the vigorous activity with age, a quadratic pattern was observed in the moderate activity with age (i.e., moderate PA decreases with

Table 1. Physical Activity Levels by Correlates among U.S. Adults, 2005

	Total (N=981)		Met Vigorous[a] Guideline			Met Moderate[b] Guideline		
	No.[c]	%	No.[c]	% (SE)[d]	p	No.[c]	% (SE)[d]	p
Gender					<.001			.52
Male	377	38	193	53 (2.8)		186	50 (2.8)	
Female	604	62	214	37 (2.1)		281	48 (2.2)	
Race/ethnicity					.45			<.001
Black	205	21	81	42 (3.8)		91	46 (3.8)	
Hispanic	193	20	72	38 (3.9)		123	64 (3.9)	
White	553	56	238	44 (2.2)		237	44 (2.2)	
Other	30	3	16	52 (10)[u]		16	50 (10)[u]	
Age group					<.001			10. <
18-33 years	222	23	127	58 (3.7)		126	59 (3.6)	
34-49 years	286	29	131	48 (3.1)		120	41 (3.1)	
50-65 years	293	30	110	38 (3.0)		135	47 (3.1)	
Older than 65 years	169	17	36	24 (3.4)		81	49 (4.0)	
Education					<.01			.20
≤Some high school	113	12	31	27 (4.5)		57	50 (5.2)	
High school graduate	301	31	114	41 (3.1)		148	51 (3.1)	
Some college	267	27	125	48 (3.2)		132	52 (3.2)	
≥College graduate	295	30	133	47 (3.0)		128	43 (3.0)	
Income					<.01			.45
<$25,000	202	28	67	34 (3.5)		102	52 (3.6)	
$25,000-$49,999	219	30	96	44 (3.5)		100	47 (3.6)	
$50,000-$74,999	145	20	66	50 (4.5)		61	45 (4.6)	
≥$75,000	167	23	86	52 (4.0)		71	43 (4.0)	
Serious health problem					<.001			.15
Yes	186	19	47	26 (3.4)		80	43 (3.8)	
No	793	81	359	47 (1.9)		385	49 (1.9)	

age up until a point and then increases). Respondents with BMI of normal range were more actively involved in both vigorous and moderate physical activities than those in other BMI ranges.

Multivariate Analyses

After adjusting for differences in existence of a serious health problem, BMI, marital status, employment status, and smoking status, none of the five demographic variables except race/ethnicity were predictive of meeting the moderate activity guideline, whereas each of the five variables was predictive of meeting the vigorous activity guideline in the multivariable logistic regression analyses (Table 2).

Specifically, men age 18-49 years, and those who earn $50,000 or above, were more likely to participate in vigorous activity than women older than 65 years, and those who earn less than $25,000, respectively. Those with less than 12 years of education (adjusted OR=0.49) and Hispanic respondents (adjusted OR=0.62) were less likely than high school graduates and Whites, respectively, to meet the vigorous activity guideline. Interestingly, Hispanics were more likely than Whites to meet the moderate activity guideline (adjusted OR=2.09).

DISCUSSION

The current study examined differences in the correlates of vigorous-intensity and moderate-intensity activities by gender, race/ethnicity, age group, educational attainment, and income groups among a recent representative sample of U.S. adults after adjusting for differences in five confounding factors. The study contributes to the literature by (1) updating PA correlates by intensity level among U.S. adults, (2) evaluating independent effects of major demographic correlates of PA using a recent representative U.S. sample, (3) providing insight into racial/ethnic differences in physical activities, and (4) adding a perspective as to different roles of vigorous-intensity and moderate-intensity activities in reducing body weight while avoiding several confounders that contributed to inconsistent findings regarding PA correlates in the literature.

Table 1. Physical Activity Levels by Correlates among U.S. Adults, 2005 (cont.)

	Total (N=981)		Met Vigorous[a] Guideline			Met Moderate[b] Guideline		
	No.[c]	%	No.[c]	% (SE)[d]	p	No.[c]	% (SE)[d]	p
BMI (kg/m2)					<.05			<.05
<18.5	15	2	3	20 (11)[u]		7	52 (13)[u]	
18.5 to <25.0	398	43	192	50 (2.7)		207	54 (2.7)	
25.0 to <30.0	314	34	127	42 (3.0)		149	47 (2.9)	
30.0 to <40.0	157	17	55	37 (4.1)		65	42 (4.2)	
≥40.0	34	4	9	32 (8.9)[u]		10	30 (8.2)[u]	
Marital status					<.001			<.05
Married	512	53	216	43 (2.3)		234	47 (2.3)	
Separated/divorced	57	16	63	44 (4.5)		61	40 (4.3)	
Widowed	115	12	21	20 (3.9)[u]		64	56 (4.7)	
Single	189	19	105	57 (3.9)		105	56 (3.9)	
Smoking status					.71			.78
Smoker	160	16	67	44 (4.3)		75	47 (4.3)	
Nonsmoker	819	84	338	43 (1.8)		390	49 (1.8)	
Employment					<.001			.14
Employed	560	59	268	48 (2.3)		262	47 (2.2)	
Out of work	37	4	15	48 (9.3)[u]		16	46 (9.3)[u]	
Student	49	5	33	70 (7.2)		28	61 (7.8)[u]	
Retired	201	21	53	28 (3.3)		90	45 (3.6)	
Homemaker	102	11	30	29 (4.7)		59	58 (5.2)	

Note. Estimates flagged with a *u* are based on fewer than 30 unweighted observations or have standard errors greater than 30% of the estimate. These estimates should be interpreted with caution as they are considered statistically unreliable.

[a]Meeting vigorous guideline = 3 or more days of exercise in the previous 7 days for at least 20 minutes that made participants sweat or breathe hard.

[b]Meeting moderate guideline = 5 or more days of exercise in the previous 7 days for at least 30 minutes which did not make participants sweat or breathe hard.

[c]Unweighted frequencies. They may not add up to the total due to missing values.

[d]Weighted percentages and standard errors.

Table 2. Logistic Regression Analyses of Physical Activity Levels among U.S. Adults, 2005

	Met Vigorous Guideline[a]		Met Moderate Guideline[b]	
	Unadjusted OR (95% CI)	Adjusted OR[c] (95% CI)	Unadjusted OR (95% CI)	Adjusted OR[c] (95% CI)
Gender				
Male	1.91 (1.44, 2.52)***	1.71 (1.25, 2.33)***	1.09 (0.83, 1.44)	1.25 (0.92, 1.71)
Female	Reference	Reference	Reference	Reference
Race/ethnicity				
Black	0.93 (0.65, 1.32)	0.72 (0.48, 1.09)	1.06 (0.75, 1.50)	1.05 (0.71, 1.56)
Hispanic	0.78 (0.54, 1.13)	0.62 (0.41, 0.95)*	2.23 (1.54, 3.24)***	2.09 (1.36, 3.21)***
White	Reference	Reference	Reference	Reference
Other	1.35 (0.60, 3.06)	1.05 (0.44, 2.52)	1.27 (0.57, 2.86)	1.14 (0.49, 2.66)
Age group				
18-33 years	4.50 (2.79, 7.26)***	2.84 (1.37, 5.88)**	1.47 (0.95, 2.25)	1.31 (0.67, 2.58)
34-49 years	2.95 (1.88, 4.62)***	2.06 (1.05, 4.03)*	0.72 (0.48, 1.07)	0.72 (0.39, 1.33)
50-65 years	2.01 (1.28, 3.15)**	1.67 (0.92, 3.03)	0.91 (0.62, 1.36)	0.94 (0.55, 1.59)
Older than 65 years	Reference	Reference	Reference	Reference
Education				
≤Some high school	0.53 (0.32, 0.89)*	0.49 (0.27, 0.89)**	0.98 (0.61, 1.57)	0.83 (0.48, 1.42)
High school graduate	Reference	Reference	Reference	Reference
Some college	1.33 (0.93, 1.90)	1.21 (0.82, 1.79)	1.05 (0.74, 1.49)	1.07 (0.74, 1.57)
≥College graduate	1.27 (0.90, 1.80)	1.29 (0.87, 1.89)	0.74 (0.53, 1.05)	0.75 (0.52, 1.09)
Income				
<$25,000	Reference	Reference	Reference	Reference
$25,000-$49,999	1.51 (1.00, 2.28)	1.48 (0.93, 2.36)	0.83 (0.55, 1.23)	0.88 (0.56, 1.37)
$50,000-$74,999	1.93 (1.22, 3.08)*	1.70 (1.00, 2.88)*	0.78 (0.49, 1.24)	0.89 (0.53, 1.49)
≥$75,000	2.08 (1.34, 3.21)*	1.76 (1.04, 3.00)*	0.71 (0.46, 1.09)	0.72 (0.43, 1.21)

Note. OR = prevalence odds ratio; CI = confidence interval.
[a]Meeting vigorous guideline = 3 or more days of exercise in the previous 7 days for at least 20 minutes that made participants sweat or breathe hard.
[b]Meeting moderate guideline = 5 or more days of exercise in the previous 7 days for at least 30 minutes which did not make participants sweat or breathe hard.
[c]Adjusted for existence of a serious health problem, body mass index, marital status, employment status, and smoking status.

The hypothesis that each of the five demographic variables is an independent predictor of physical activity was tenable only for vigorous-intensity activity, not for moderate-intensity. Vigorous PA was less common with age and among women, Hispanics, and those with lower income or lower educational attainment compared with their counterparts. However, this was no longer true for moderate PA. None of the five demographic variables except race/ethnicity were associated with meeting the moderate activity guideline. Unlike with vigorous activity, Hispanics were more likely than Whites to engage in moderate activity in both unadjusted and adjusted logistic models, which is consistent with previous findings that examined PA including household or caregiving activities.[5,6] This clearly demonstrates the moderating effect of PA intensity, indicating that one should examine PA separately for different intensity levels. The weak or little associations of the demographic correlates with moderate PA observed in the current study also imply that most of the disparities in moderate PA among different sociodemographic groups that existed in the past might have dissipated. Future meta-analytic trend studies that investigate changes of strengths of associations (i.e., effect sizes) over time between moderate PA and its demographic correlates would be desirable to confirm the pattern of diminished differences in moderate activity among different sociodemographic groups.

The finding that Hispanics were less likely than Whites to engage in vigorous activity but more likely to engage in moderate activity warrants a discussion, especially with respect to the proportions of overweight or obese people (BMI≥25). It is a well-known fact that a greater proportion of Hispanics are overweight or obese than Whites.[22,23] During 1999-2002, the proportion of overweight or obese population age 20 years or above was 72.5% for Mexican Americans, whereas it was 63.3% for Whites and 70.7% for Blacks.[23] Between 1991 and 1998, the obesity prevalence increased by 80% for Hispanics, whereas it increased by 47.3% for Whites and by 39.2% for Blacks.[24] These

findings indicate that moderate PA might not be as effective as vigorous activity in reducing body weight. Future experimental studies using a large nonclinical multiracial/ethnic cohort of adults are warranted to investigate the effect of moderate PA on reducing body weight among adults. Although previous studies have shown that moderate or leisure-time PA may reduce blood pressure[25] and risks for systemic inflammation,[26] upper-respiratory tract infection,[27] or type 2 diabetes,[28,29] it has not been clearly shown that increased moderate PA (i.e., meeting the moderate guideline on 5 days or more) leads to reduced body weight. This provides practical implications for policymaking or application within the health realm.

Health practitioners and policymakers have two major approaches to cope with the pandemic obesity problem: reducing energy intake and increasing energy expenditure to rectify energy imbalance. Given the overall nonsignificance of the relationships between moderate PA and the demographic correlates that are significantly related to overweight or obesity,[24,30] one could presume that increased energy expenditure through increased moderate PA in general would not be large enough to burn surplus energy. Although any level of PA will offer various physical, emotional, or mental health benefits, the perspective gained from this study suggests that we should put more emphasis on vigorous PA than moderate, especially to help halt the increasing trend of obesity. Considering that one of the most commonly reported personal barriers to PA is lack of time,[31] added emphasis on vigorous activity seems justifiable, as an equal amount of energy expenditure can be attained faster through vigorous-intensity activity than moderate-intensity activity (although it should be noted that vigorous activity is associated with higher risks for injuries, especially among the elderly).

A recent study[1] provides insight into the finding of the current study that Hispanics were more likely than Whites to engage in moderate activity. He and Baker[1] found that Hispanics were more likely than Whites to engage in work-related PA, while such a relationship was not found in leisure-time PA. Thus, the majority of the variation between Hispanics and Whites in the proportion engaging in moderate PA could be accounted for by differences in work-related activity, including household chores, rather than leisure-time activity. This implies the need for partitioning moderate PA into different types of physical activities in future studies employing multiple racial/ethnic adult participants.

The results of the current study also suggest that an energy-intake-reduction strategy might be more important than an energy-expenditure-increasing strategy in reducing obesity. A greater proportion of Blacks are obese than Whites, and a smaller proportion of people with a college degree or higher are obese than high school graduates.[22-24,30] However, there were no significant differences between Blacks and Whites and between the two different educational attainments in vigorous and moderate physical activities. This indicates that PA might account for a very limited portion of the BMI differences between people of different races/ethnicities and education. Future quantitative research is warranted to determine relative contributions of the two approaches in reducing obesity: energy intake reduction versus energy expenditure increase.

The findings of the current study should be interpreted in light of the following limitations. First, although common in PA studies, the use of self-reported measures may have biased the results. Second, causality cannot be inferred from the current findings because this study used a cross-sectional survey design. Third, although not many, some subgroup analyses yielded large standard errors because of small cell sizes. These estimates should be interpreted with caution, as they are considered statistically unreliable. Lastly, like all other studies using a sample, the results reported in this study are subject to measurement errors.

Despite these limitations, the study contributes to the literature in several ways. It not only updates correlates of both levels of PA among a representative sample of U.S. adults, but also evaluates independent effects of major demographic correlates of both levels of PA in a multivariate model. In addition, in making these parameter estimates, the study avoided several confounders that contributed to inconsistent findings in the literature. It also provided insight into the differences between Hispanics and Whites in their physical activities and, further, into the different roles of vigorous and moderate activities in reducing body weight.

Translation to Health Education Practice

The findings of this study indicate that the majority of U.S. adults still fail to meet recommended PA guidelines. Health practitioners and professionals should continue to make every effort to help more people adopt and adhere to active lifestyles. The results further indicate the need for different approaches for different PA intensity levels. The overall nonsignificant associations between moderate PA and the demographic correlates that are significantly related to overweight or obesity imply that increased energy expenditure through increased moderate PA would not be large enough to burn surplus energy. Given the lack of evidence about the efficacy of moderate-intensity PA on reducing body weight, health practitioners need to be cautious against providing expectation that people could lose substantial weight by engaging in moderate PA. If an individual sees no substantial weight loss after months of walking for half an hour almost every day, he or she might choose to not walk any longer because his or her main motive for the activity was weight loss. It would be desirable to inform people who are more interested in moderate PA of its evidence-based benefits such as reduced risk of cardiovascular disease and type 2 diabetes, in addition to other physical, emotional, and mental health benefits. To help those who are overweight or obese lose weight, health practitioners and professionals should place more emphasis on vigorous-intensity than moderate-intensity activity; pay increased attention to preventing injuries from vigorous activity; and diversify enjoyable vigorous activities for various demographic groups, especially among women and minorities.

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