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Age Differences and Social Stratification in the Long-Term Trajectories of Leisure-Time Physical Activity

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Objectives. This study assessed how and why the social stratification of leisure-time physical activity changes as adults at different points in the life course, and from different birth cohorts, grow older.

Methods. A series of multilevel models were estimated using longitudinal data from a national sample of more than 3,000 adults from the Americans' Changing Lives study.

Results. On average, rates of leisure-time physical activity increased within younger adults and decreased within middle-aged and older adults, throughout the study period. Initial Black–White differences in activity converged over time, whereas initial men advantages over women widened, particularly among older adults. Gender-based differences did not remain after accounting for differences in health; however, significant age and race differences in the trajectories of physical activity persisted, even after accounting for the effects of health and social relationships on leisure-time physical activity.

Discussion. American adults appear to be reducing their levels of physical activity relatively early in the life course and at increasingly steep rates among older age groups. The changing patterns of stratification in physical activity, as well as the associations between several time-varying predictors and physical activity, provide insight into the forces that may be responsible for these declines.

Key Words: Aging—Physical activity—Social stratification.

FOR years, research has documented strong and persistent patterns of social stratification with respect to health outcomes (Marmot, Ryff, Bumpass, Shipley, & Marks, 1997). Growing evidence, however, suggests that these patterns of social stratification of health may change with advancing age, with stratification most likely widening until late in life (House et al., 1994). In an effort to help explain why this might happen, this study examined the changing patterns of stratification in one key determinant of many health outcomes: physical activity.

Physical activity has well-documented health benefits and is considered one of the most effective measures for preventing and controlling chronic illnesses, enhancing psychological well-being, and preventing premature death (U.S. Department of Health and Human Services, 1996). However, current surveillance data indicate that approximately 50% of all adults do not meet recommended levels of regular physical activity (Centers for Disease Control and Prevention [CDC], 2007). A closer look at these data also shows substantial social stratification in rates of physical activity, with persistently higher rates among Whites (51.8%) compared with Blacks (41.3%) and higher rates among men (51.5%) compared with women (47.5%). In addition, a graded association between age and physical activity is evident, with prevalence rates highest among young adults aged 18–24 years (60.7%) and lowest among adults aged 65 years and older (39.0%) (CDC, 2007).

Although these data on the persistent stratification of physical activity rates are useful in charting our nation's progress toward its public health goals, repeated cross-sectional assessments of physical activity are insufficient in that they reveal little about within-persons changes in physical activity (Almeida, Charles, & Neupert, 2008). Assessing within-persons changes in physical activity over extended periods of time (i.e., trajectories) can add to our understanding of the stratification of health by revealing how, and why, various forms of physical activity stratification might change as adults at different points in the life course, and from different birth cohorts, grow older.

Accordingly, this study had three primary aims. The first aim was to determine whether levels of leisure-time physical activity decline in a pattern consistent with the expected onset of physical limitations imposed by the aging body or whether some other pattern of change is evident that would suggest other forces at work. The second aim of this study was to test for patterns of interpersonal differences in trajectories of leisure-time physical activity—such as race (non-Hispanic Whites vs. non-Hispanic Blacks), gender, and education differences—that might reflect the influence of social stratification processes. The final aim of this study was to assess whether health, alone, can account for age differences and the social stratification of physical activity trajectories or whether other psychosocial factors that are known to vary systematically across social strata play a significant role as well.

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Age Differences in Physical Activity Trajectories

Although cross-sectional data on physical activity has persistently shown lower rates among older adults (CDC, 2005; DiPietro, Williamson, Caspersen, & Eaker, 1993), a variety of longitudinal studies indicate that this age-related decline in physical activity is not merely due to cohort effects, but rather is largely a function of the aging process (Bijnen, Feskens, Caspersen, Mosterd, & Kromhout, 1998; Shaw & Spokane, 2008; Verbrugge, Gruber-Baldini, & Fozard, 1996). Still, current findings on age-related changes in physical activity are limited in important ways. For example, much of this previous research utilizes measures of activity that include work-related activity (e.g., Shaw & Spokane, 2008). Although it is important to consider work-related activity when attempting to gain a comprehensive assessment of individuals' levels of physical activity, it is also important to study patterns of physical activity that takes place outside of the workplace (i.e., leisure-time physical activity), as this type of activity is likely to reflect individuals' behavioral choices during their discretionary time.

In addition, despite evidence of normative age-related declines in physical activity, much of this previous longitudinal work on aging and physical activity has focused almost exclusively on samples of older adults. As a result, little is known about when during the life course declines in leisure-time physical activity tend to begin. This is an important question to address because identifying when these declines begin should provide clues as to the forces that may be causing adults to decrease their levels of participation in leisure-time physical activity.

The Social Stratification of Physical Activity Trajectories

In order to deepen our understanding of the aging-related declines in physical activity found in previous studies, a thorough examination of status-based heterogeneity in trajectories of physical activity is also needed. Such an examination represents a logical next step in the study of the social stratification of aging and health (House, Lantz, & Herd, 2005). The social stratification of aging and health refers to systematic disparities in aging-related morbidity across socially defined categories of individuals. These disparities in morbidity are thought to be largely the result of differential access to health promoting resources and differential adoption of health promoting values, attitudes, and behaviors (Abeles, 1992; House et al., 1992). This suggests that physical activity, as one of the most powerful behavioral predictors of health, is subject to the same patterns of social stratification that are commonly observed in health outcomes.

Although findings from cross-sectional studies consistently show evidence of social stratification with respect to physical activity across education levels, race, and gender (Grzywacz & Marks, 2001; Kaplan, Newsom, McFarland, & Lu, 2001; King et al., 2000; Marshall et al., 2007), it is uncertain how these systems of stratification influence long-term changes in physical activity within individuals. As a result, we currently know little about whether the size and nature of each of the major forms of stratification change over time at different points in the life course.

Based upon the concept of cumulative advantage (Ross & Wu, 1996), substantial and growing stratification in physical activity should be expected, as socially advantaged individuals—namely highly educated individuals, Whites, and men—are better able to avoid declines in physical activity as they get older. This ability to avoid declines in activity is most likely due to increased knowledge about the risks of sedentary behavior, a stronger sense of personal control and orientation toward the future, stronger social norms supporting physical activity, and more free time and financial resources to facilitate participation in leisure-time activity (McAuley et al., 2006; Mirowsky and Ross, 2003). At the same time, however, drawing from previous work on the social stratification of aging and health (House et al., 1994), it is also possible that the social stratification of physical activity trajectories narrows in the latest stages of life, as disparities in exposure to social services and psychosocial resources that may influence physical activity begin to even out.

The Roles of Health, Social, and Psychological Resources

Although changes in physical activity may help shape changes in the social stratification of aging and health outcomes, it is also important to consider the potential role of health in shaping the evolving patterns of stratification with respect to physical activity trajectories. Recent research findings suggest that health, rather than age, social status, or other related psychosocial factors, is the most essential determinant of patterns of physical activity among adults (He & Baker, 2005; Janke, Davey, & Kleiber, 2006). However, the role of health as a determinant of physical activity patterns has not been comprehensively assessed within a longitudinal context. With longitudinal data, the potential confounding arising from between-persons comparisons can be reduced by examining the degree to which within-persons variations in health are associated with within-persons variations in physical activity (Almeida et al., 2008).

Moreover, because research using time-varying predictors of physical activity has been limited, it is not currently known if within-persons variations in health completely account for the social stratification of physical activity trajectories. Although the onset of health problems is likely to create significant barriers to participation in leisure-time physical activity, it is possible that important psychosocial resources also have strong influences on physical activity. For example, the literature on social support suggests that access to support can facilitate physical activity through network members providing individuals with encouragement to stay healthy or rides to an exercise facility (Eyler et al., 1999), by instilling a sense of obligation to remain healthy or by providing more potential partners with whom

one could engage in an activity such as exercise (Brownson, Baker, Housemann, Brennan, & Bacak, 2001). Furthermore, the literature on psychological coping resources suggests that resources such as control beliefs and self-esteem may be associated with physical activity because individuals with such resources are likely to be especially effortful and persistent when adopting new behaviors, such as exercise (Bandura, 1986).

Study Hypotheses

On the basis of this background, this research was guided by the following hypotheses:

1. On average, individuals will exhibit a reduction in frequency of physical activity during the study period, with rates of decline growing increasingly rapid at older ages.
2. Substantial social stratification with respect to trajectories of physical activity will be evident. In particular,

   (a) For the sample as a whole, social stratification in physical activity trajectories will expand over time, with the steepest rates of decline in physical activity observed in low-education individuals, Blacks, and women.
   (b) Changes over time in education-, race-, and gender-based stratification in the trajectories of physical activity will vary by age, with the greatest divergences observed in middle and early old age, and some narrowing of differences among the oldest old.

3. Time-varying health status will account for most, but not all, of the observed age and social status differences in physical activity trajectories, with social and psychological resources also playing important roles.

Methods

Sample

Data for this study come from four waves of a nationwide panel study, Americans' Changing Lives (House, 2008). This study began in 1986 with face-to-face interviews of a probability sample of 3,617 adults aged 25 years and over. African Americans and persons more than 60 years were each sampled at twice the rate of others in the target population. The overall response rate was 68% in 1986. Approximately 83% of surviving baseline respondents (N = 2,867) were reinterviewed in 1989. Additional interviews took place in 1994, with 2,562 respondents (83% of survivors), and in 2001–2002, with 1,787 respondents (~76% of survivors). The final analytic sample included a total of 9,757 observations of the original 3,360 non-Hispanic respondents, for an average of 2.9 observations per respondent. A total of 246 observations were omitted (2.4% of all observations) because of missing data on physical activity. Key demographic characteristics of the baseline sample appear in Table 1.

Table 1. Descriptive Statistics (Mean/SD) for Key Measures by Race and Social Stratification

Measures	Total	Black	White	Men	Women	Age (24–44)	Age (45–64)	Age (65+)	Education (<12 years)	Education (12–15 years)	Education (16+ years)
	N = 3,360	N = 1,156	N = 2,204	N = 1,254	N = 2,106	N = 1,189	N = 1,010	N = 1,161	N = 1,228	N = 1,668	N = 464
Baseline age	54.18 (17.60)	52.77 (17.33)	54.92 (17.69)	51.70 (17.46)	55.66 (17.52)	33.78 (5.59)	56.34 (6.07)	73.19 (6.36)	62.39 (15.35)	50.06 (17.18)	47.28 (16.50)
Black	0.34 (0.48)	—	—	0.31 (0.46)	0.36 (0.48)	0.37 (0.48)	0.36 (0.48)	0.30 (0.46)	0.49 (0.50)	0.28 (0.45)	0.19 (0.39)
Men	0.37 (0.48)	0.34 (0.47)	0.39 (0.49)	—	—	0.43 (0.49)	0.38 (0.49)	0.31 (0.46)	0.35 (0.48)	0.36 (0.48)	0.50 (0.50)
Education	11.58 (3.32)	10.36 (3.75)	12.22 (2.87)	11.83 (3.55)	11.43 (3.16)	13.10 (2.31)	11.42 (3.21)	10.16 (3.62)	—	—	—
Baseline physical activity	2.69 (0.83)	2.50 (0.81)	2.78 (0.82)	2.86 (0.78)	2.59 (0.84)	2.90 (0.72)	2.71 (0.82)	2.46 (0.88)	2.42 (0.83)	2.80 (0.80)	3.00 (0.71)
Died during study	0.33 (0.47)	0.37 (0.48)	0.31 (0.46)	0.35 (0.48)	0.32 (0.47)	0.05 (0.22)	0.28 (0.45)	0.68 (0.47)	0.52 (0.50)	0.24 (0.43)	0.19 (0.39)
Nonrespondent	0.22 (0.41)	0.31 (0.46)	0.17 (0.38)	0.21 (0.41)	0.22 (0.41)	0.34 (0.47)	0.20 (0.40)	0.11 (0.31)	0.21 (0.41)	0.24 (0.42)	0.17 (0.37)

Although the data for this study include oversamples of Blacks and older adults, we chose not to weight the data on the following grounds. First, although there is a consensus for weighting data in generating descriptive statistics for a given target population, there is no such agreement in multivariate analyses (Gelman, 2006). Second, the attributes (i.e., race, age) upon which unequal selection probabilities were based were explicitly included in the multivariate analyses. When sampling weights are solely a function of independent variables included in the model, unweighted ordinary least squares estimates are preferred because they are unbiased, consistent, and have smaller standard errors than weighted estimates (Winship & Radbill, 1994).

Measures

Time-Varying Outcome.—The outcome variable in this study is leisure-time physical activity. This was measured with responses to three items: "How often do you work in the garden or yard?"; "How often do you engage in active sports or exercise?"; and "How often do you take walks?". Responses were coded on a 4-point scale and were used to create an index by computing a mean score across the three items at each wave. For cases with missing data on just one of the physical activity items, the index was computed by calculating the mean of the remaining two items. If data were missing on more than one item, the index was defined as missing and that observation was excluded from the analyses.

These three indicators of leisure-time physical activity should be considered cause indicators of our dependent variable, leisure-time physical activity. That is, rather than these indicators being thought of as being dependent upon the latent variable leisure-time physical activity, as is assumed in classical test theory, these indicators can be thought of as determining one's status on this latent outcome variable. As such, significant correlations between these three indicators should not necessarily be expected (Bollen & Lennox, 1991); therefore, the reporting of internal consistency reliability is unfitting.

Time-Varying Predictors.—Predictors representing health status included self-rated health, weight status, and functional status. Self-rated health was measured with responses to a single-item asking respondents to evaluate their current health on a 5-point scale. Single-item self-rated health survey items have shown good test–retest reliability (Lundberg & Manderbacka, 1996). Weight status was measured by computing each respondent's body mass index based on self-reported height and weight and then creating two dummy variables representing underweight (lowest 5% of cases) and overweight (highest 15% of cases). Functional impairment was measured with a four-level Gutman-type scale, with the lowest score indicating no impairment (i.e., not confined to bed or chair and no difficulty bathing, climbing stairs, walking, or doing heavy housework) and the highest score indicating severe impairment (i.e., currently confined to a bed or chair and/or have a lot of difficulty bathing; see Lantz, House, Mero, & Williams, 2005). Previous studies using this measure of functional impairment have shown it to have strong reliability (Kim & Durden, 2007).

Predictors representing social relationships included marital status, social integration, and social support. Marital status was coded as a dummy variable distinguishing between respondents who were married (1) and others (0). A measure of social integration was adapted from the Social Network Index of Berkman and Syme (1979) by computing a mean of responses to four questions regarding frequency of speaking with friends, neighbors, or relatives; getting together with others; involvement in meetings or programs; and attendance at religious services. The internal consistency reliability of this scale was approximately .68. Social support was operationalized using the measure of positive support of House and Kahn (1985). It was computed as a mean of responses to six questions asking the degree to which a respondent's spouse, child, and friends (a) are willing to listen when the respondent needs to talk about his or her worries or problems and (b) make him or her feel loved and cared for. The internal consistency reliability of this scale was .53.

Predictors representing psychological resources included mastery and self-esteem. Personal mastery was measured with responses to two questions from the mastery scale of Pearlin, Lieberman, Menaghan, and Mullan (1981), regarding how much one felt they were being pushed around in my life and whether they felt that there was "really no way I can solve the problems I have." Self-esteem was measured with responses to two items from the global self-esteem scale of Rosenberg (1965). These measures were coded such that higher scores represent greater mastery and more positive feelings of self-worth. The reliabilities of these scales were .48 and .63, respectively, when applying Wert's formula (Werts, Linn, & Joreskog, 1974). These reliabilities scores were somewhat low, likely due in part to the low number of items that were used to create these scales. The American's Changing Lives survey included three items from each of these scales; however, the reliability of each of these scales was higher when only two items were used. Previous research using these same measures from the ACL data has also adopted this approach (Thoits & Hewitt, 2001).

One additional time-varying covariate was included in the analyses for control purposes. Given the possible inverse association between work-related physical demands and leisure-time physical activity (Wu & Porell, 2000), and the possibility of status differences in the likelihood of working in occupations with high levels of physical demands (He & Baker, 2005), a time-varying measure of occupational type was included in all analyses as a proxy

for work-related physical activity. In particular, this measure was a dichotomous variable, distinguishing between those employed in blue-collar occupations (e.g., craftsmen, operatives, laborers) (1) and those who are either employed in white-collar occupations or not currently employed (0).

Time-Constant Variables.—Baseline age was measured continuously, in years. Race was measured as a binary variable (1 = non-Hispanic White, 0 = non-Hispanic Black). Gender was represented as a binary variable (1 = men, 0 = women). Education level at baseline was measured as a continuous variable representing the number of years of completed schooling at that time.

Data Analysis

The analyses for this study utilized hierarchical linear modeling (HLM)—with occasions of measurement nested within individuals—to estimate changes in physical activity within individuals over time (Raudenbush & Bryk, 2002). To test Hypothesis 1, we estimated a fixed effect that represented the average frequency of physical activity at the mean follow-up time for the sample as a whole (intercept) and another fixed effect representing the average intraindividual change in physical activity over time for the sample (time slope). In addition, we estimated a fixed-effect testing for age differences in average levels of physical activity across the study period and a fixed effect for age differences in individual time slopes of physical activity throughout the study period (an age by time interaction). This model also adjusted for the effects of time-varying occupational type and attrition due to death or nonresponse. Furthermore, we also estimated two random effects representing the degree to which respondents' physical activity scores at the intercept, and time slopes, deviated from the mean.

Next, Hypothesis 2 was tested by adding race, gender, and education into the models both as predictors of physical activity at the intercept and as interactions with the time slope of physical activity. In addition, interactions between baseline age and each of these social status variables were included. These tested for age differences in the social stratification of average levels of physical activity throughout the study period and were also included in three-way interactions with time to test for age differences in the social stratification of changes in physical activity. All variables involved in interactions, including time, age, race, education, and gender, were centered on their means prior to including them in the models.

To address Hypothesis 3, three sets of time-varying predictors—health-related variables, social relationship variables, and psychological resource variables—were added to the model. These predictors were specified as unconditional, fixed effects only. The estimates derived from this model represented the average relationship between an individual's health, social relationships, or psychological resources at a given wave and physical activity during the same wave. Upon entering these time-varying predictors to our model, we also examined the fixed effects representing the associations between time, age, and physical activity that were assessed in the prior stages of analysis. If previously significant associations with physical activity were no longer significant after inclusion of a set of time-varying predictors, we concluded that a given set of time-varying predictors was responsible for that association.

In order to gain an additional perspective regarding the nature of the age, race, gender, and education differences in the trajectories of physical activity, we carried out post hoc analyses on each model by computing "simple slopes" (Aiken & West, 1991, p. 12). These simple slopes can be used to facilitate the interpretation of statistical interactions between the stratification variables and time. When a statistical interaction is present, the nature of the association between one independent variable and the outcome varies across values of the other independent variable that is involved in the interaction. As a result, the relationship between the focal independent variable and the outcome cannot be captured with a single slope. A set of simple slopes are meant to capture the full breadth of the association between a focal independent variable and an outcome. In particular, the simple slopes in this study utilize interaction effect estimates from the HLM analyses to compute estimated intercept and slope parameters for the relationship between time and physical activity at specific baseline ages and also for the different races and genders. We also used the formula provided by Aiken and West (1991, p. 16) to estimate standard errors for each of these simple slopes so that t tests could be employed to assess if each simple slope was significantly different from 0.

Results

In accordance with Hypothesis 1, age differences in trajectories of physical activity were examined first, as shown in Table 2. Model 1 shows that, on average, physical activity declined over time ($b = -.86 \times 10^{-3}$, $p \leq .001$). This model also shows evidence of significant age differences. In particular, the main effect for age suggests that on average, levels of physical activity were lower among older adults ($b = -.01$, $p \leq .001$). The negative effect for the age by time interaction suggests that the association between time and physical activity grew increasingly negative at older ages ($b = -.04 \times 10^{-3}$, $p \leq .001$). Simple slopes for each baseline age in the sample were also computed in order to clarify the nature of this interaction between age and time. In essence, this represents the analyses of several quasi-cohorts, one for each baseline age. These analyses showed that individuals with baseline ages of 33 years or lower typically followed

Table 2. Americans' Changing Lives, 1986–2002; Physical Activity Over Time

	Physical activity									
	Model 1		Model 2		Model 3		Model 4		Model 5	
Sample size	3,360		3,360		3,360		3,360		3,343	
No. of observations	9,757		9,757		9,757		9,757		9,617	
Fixed effects										
Intercept	2.61	***	2.61	***	2.63	***	2.65	***	2.66	***
Died during study	−0.42	***	−0.37	***	−0.38	***	−0.23	***	−0.18	***
Other attrition	−0.13	***	−0.06	*	−0.06	^	−0.05	^	−0.02	
Baseline age	−0.01	***	−0.01	***	−0.01	***	−0.00	***	−0.01	***
Education			0.03	***	0.03	***	0.02	***	0.01	*
Race (White)			0.13	***	0.11	***	0.10	***	0.09	***
Gender (Men)			0.26	***	0.28	***	0.24	***	0.26	***
Time	-0.86×10^{-3}	***	-0.85×10^{-3}	***	-0.76×10^{-3}	***	-0.07×10^{-3}		-0.07×10^{-3}	
Interactions										
Died during study × time	-0.65×10^{-3}		-0.90×10^{-3}	^	-0.94×10^{-3}	^	-0.46×10^{-3}		-0.25×10^{-3}	
Other attrition × time	0.73×10^{-3}	*	0.45×10^{-3}		0.55×10^{-3}	^	0.48×10^{-3}		0.41×10^{-3}	
Baseline age × time	-0.04×10^{-3}	***	-0.04×10^{-3}	***	-0.03×10^{-3}	***	-0.02×10^{-3}	**	-0.02×10^{-3}	*
Education × time			-0.03×10^{-3}		0.00×10^{-3}		-0.02×10^{-3}		-0.02×10^{-3}	
Race (White) × time			-1.07×10^{-3}	***	-1.48×10^{-3}	***	-1.50×10^{-3}	***	-1.47×10^{-3}	***
Gender (men) × time			0.26×10^{-3}		0.50×10^{-3}	*	0.34×10^{-3}		0.19×10^{-3}	
Age × education					0.49×10^{-3}	*	0.47×10^{-3}	*	0.47×10^{-3}	*
Age × race					-3.11×10^{-3}	*	-2.36×10^{-3}	^	-2.09×10^{-3}	
Age × gender					5.95×10^{-3}	***	4.39×10^{-3}	***	4.00×10^{-3}	***
Age × education × time					0.02×10^{-4}		0.01×10^{-4}		0.01×10^{-4}	
Age × race × time					-0.06×10^{-3}	**	-0.04×10^{-3}	*	-0.05×10^{-3}	**
Age × gender × time					0.03×10^{-3}	^	0.02×10^{-3}		0.01×10^{-3}	
Time-varying predictors										
Blue collar	0.0001		−0.03		−0.02		−0.07	*	−0.05	^
SRH							0.08	***	0.07	***
Functional impairment							−0.18	***	−0.17	***
Underweight							−0.05		−0.03	
Overweight							−0.08	***	−0.09	***
Married									0.09	***
Support									0.05	***
Integration									0.11	***
Mastery									0.01	
Self-esteem									0.01	
Random effects	Variance									
Intercept, u_{0i}	.325	***	.290	***	.288	***	.231	***	.218	***
Time slope, u_{1i}	0.10×10^{-3}	***	0.10×10^{-3}	***	0.10×10^{-3}	***	0.10×10^{-3}	***	0.10×10^{-3}	***
Level 1, ε_{ij}	.263		.263		.263		.261		.251	
Deviance	20513.50		20263.88		20329.17		19702.75		19133.97	

Note: SRH = Self rated health.
*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$; ^$p \leq .10$.

positive trajectories whereas individuals with older baseline ages did not.

In accordance with Hypothesis 2, models 2 and 3 of Table 2 tested for the potential impacts of race, gender, and education on physical activity. Although Model 2 provides no evidence of education or gender differences in the trajectories of physical activity, it does suggest that declines in physical activity over time were larger among Whites than Blacks ($b = -1.07 \times 10^{-3}$, $p \leq .001$).

In Model 3, interactions between social status and age are presented. According to this model, the three-way interactions involving the time slope show that steeper declines in physical activity among Whites compared with Blacks were especially evident among older adults ($b = -.06 \times 10^{-3}$, $p \leq .01$). More specifically, the simple slopes presented in Table 3 show that for Blacks of all ages, physical activity was relatively stable over time; however, for Whites, trajectories of physical activity were stable among young adults but grew increasingly negative among older adults (see Figure 1, first panel). Also in this model, the three-way interaction between age, gender, and time is marginally significant ($b = .03 \times 10^{-3}$, $p \leq .10$). The simple slopes of this portion of Model 3 show that physical activity trajectories began declining at earlier ages, and at higher rates during later life, among women compared with men (Figure 1, second panel).

Models 4 and 5 of Table 2 address Hypothesis 3 and show the extent to which age and social status differences in the trajectories of physical activity changed after accounting for time-varying predictors. In Model 4,

Table 3. Simple Slopes

	Model 3			Model 4			Model 5		
	Intercept	*Slope*		Intercept	*Slope*		Intercept	*Slope*	
Whites									
Young	2.87	0.16×10^{-3}		2.82	0.53×10^{-3}		2.86	0.54×10^{-3}	
Midlife	2.73	0.82×10^{-3}	***	2.73	-0.23×10^{-3}		2.74	-0.22×10^{-3}	
Older	2.59	-1.79×10^{-3}	***	2.63	-1.00×10^{-3}	***	2.63	-0.97×10^{-3}	***
Blacks									
Young	2.67	0.03×10^{-3}		2.66	0.81×10^{-3}	^	2.71	0.48×10^{-3}	
Midlife	2.59	0.15×10^{-3}		2.61	0.88×10^{-3}	***	2.63	0.77×10^{-3}	**
Older	2.51	0.28×10^{-3}		2.56	0.96×10^{-3}	*	2.56	1.06×10^{-3}	**
Men									
Young	2.87	0.03×10^{-3}		2.83	0.47×10^{-3}		2.89	0.45×10^{-3}	
Midlife	2.82	-0.32×10^{-3}		2.81	0.25×10^{-3}		2.85	0.18×10^{-3}	
Older	2.78	-0.60×10^{-3}	*	2.78	0.02×10^{-3}		2.80	-0.10×10^{-3}	
Women									
Young	2.76	0.20×10^{-3}		2.73	0.72×10^{-3}	*	2.76	0.56×10^{-3}	^
Midlife	2.60	-0.59×10^{-3}	**	2.61	0.09×10^{-3}		2.63	0.08×10^{-3}	
Older	2.43	-1.37×10^{-3}	***	2.50	-0.54×10^{-3}	**	2.50	-0.39×10^{-3}	^

Note: For slope estimates, $*p \leq .05$; $**p \leq .01$; $***p \leq .001$; $\text{^}p \leq .10$.

health-related variables were added, and with the exception of being underweight, each was associated with physical activity. Furthermore, after accounting for time-varying health, the average time slope for physical activity was no longer significantly different from zero ($b = -.07 \times 10^{-3}$, not significant [ns]). Still, the age by time interaction effect persisted ($b = -.02 \times 10^{-3}$, $p \leq .01$), an indication that even after accounting for health, declines in physical activity over time were more evident among older adults.

Model 4 also shows that even after accounting for health, physical activity declines were steeper for Whites than Blacks ($b = -1.50 \times 10^{-3}$, $p \leq .001$), and this race difference was particularly evident in older ages ($b = -.04 \times 10^{-3}$, $p \leq .05$).

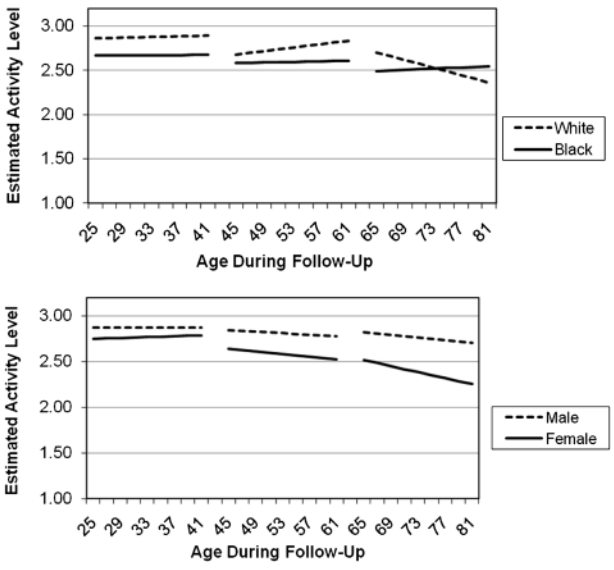

Figure 1. Physical activity over time, by age and race, and age and gender.

The simple slopes among Whites and Blacks from Model 4 (see Table 3) show that accounting for health reduces the rate of decline in physical activity among older Whites by about 44% (from $b = -1.79 \times 10^{-3}$ in Model 3 to $b = -1.00 \times 10^{-3}$ in Model 4). In contrast, increases in physical activity were actually suppressed by health among Blacks of all ages, as each of the simple slopes for Blacks in Model 4 are positive and larger than they were in Model 3.

Furthermore, Model 4 shows that after accounting for health, gender differences in the trajectories of physical activity were no longer evident. Examination of the simple slopes for gender in Model 4 suggest that after accounting for health, older women still experienced a modest decline in physical activity ($b = -0.54 \times 10^{-3}$, $p \leq .01$), whereas older men exhibited stability ($b = 0.02 \times 10^{-3}$, ns); however, apparently these slopes do not differ significantly from one another.

In Model 5, the social relationship and psychological resource variables were added. Each of the social relationship variables was positively associated with physical activity, indicating that individuals' levels of leisure-time physical activity were likely to be higher when they were married, well-integrated, and well-supported by a social network. In contrast, neither of the psychological resource variables was associated with leisure-time physical activity. Furthermore, the negative interaction between baseline age and time in Model 5 remained relatively unchanged ($b = -0.02 \times 10^{-3}$, $p \leq .05$), indicating that age differences in the slopes of physical activity were not accounted for by time-varying social and psychological resources. Race differences in the patterns of change in physical activity at different ages also did not change appreciably in Model 5 ($b = -1.47 \times 10^{-3}$, $p \leq .001$), still indicating greater declines among Whites.

Discussion

By addressing each of our primary research aims, the findings from this study help to advance our understanding of the social stratification of aging and leisure-time physical activity in American adults in several ways. The specific contributions of our findings with respect to each of our study aims and hypotheses are discussed subsequently.

Age Differences in Physical Activity Trajectories

Consistent with our first hypothesis, these findings show evidence of steady declines in leisure-time physical activity, beginning in midlife, and growing steeper at progressively older ages. Although previous research has detected a strong inverse association between age and physical activity in general (DiPietro, 2001), this study shows that an inverse association is also evident even when focusing only on physical activity that is conducted during leisure time. As such, this study suggests that with increasing age, adults are spending less of their discretionary time—which itself may actually be expanding with age—participating in physical activities.

The age-related patterns of physical activity found in the current study are also informative in that they show that stable or increasing levels of activity over time were evident in adults up to the baseline age of approximately 33 years, with adults older than age 33 at baseline exhibiting trajectories that were increasingly negative. This is a novel finding because it gives some indication of when during the life course adults may begin a trajectory of declining activity. If these findings are accurate, this transition from stable and increasing rates of physical activity to stable and decreasing rates appears to occur somewhere between young adulthood and midlife (Staudinger & Bluck, 2001). This transition is earlier in the life course than would be expected if declines in physical activity were due only to the onset of health and functional problems and therefore suggests that other forces may also be responsible for impeding on adults' leisure-time physical activities. For example, perhaps it is a lack of discretionary time due to increasing work and family responsibilities that commonly occur during this point in the life course that accounts for this pattern of early decline.

The Social Stratification of Physical Activity Trajectories

Supporting our second hypothesis, the current findings provide evidence of significant social stratification with regard to trajectories of physical activity. For instance, consistent with the theory of cumulative advantage (Ross & Wu, 1996), it appears as if gender differences in physical activity tend to widen over time for middle-aged and older adults, with no evidence of a narrowing of differences in later life. Our findings suggest that much of the excess decline in leisure-time physical activity among women is due to gender differences in time-varying health factors, as inclusion of health-related variables to the model reduced the simple slope for older women by more than 60% (from -1.37×10^{-3} to -0.54×10^{-3}). A further explanation for this pattern of gender differences—not directly examined in the current study—may involve differences in the kinds of health conditions that men and women experience as they age (Verbrugge, 1985). For example, arthritis, a condition that would be expected to limit physical activity substantially, is much more common in older women compared with older men. In any case, such findings indicate that the increased rate of decline among women could possibly be prevented by attending to the specific health-related barriers that women face when trying to maintain an active lifestyle.

Regarding race, the current findings show evidence of cumulating advantages among Whites, but only among the youngest adults in our sample. Beginning in midlife, these physical activity advantages among Whites compared with Blacks appear to narrow, dissipate, and even reverse as individuals are followed over time in later life. Such a convergence of leisure-time physical activity levels between Whites and Blacks during late life suggests that, at least with respect to race, disparities in this behavioral risk factor do not seem to cumulate over the entire life course but rather diminish during later life, a pattern that may help to explain the late life convergence in health outcomes found by House et al. (1994).

Indications of such a finding were reported in previous research based on the Americans' Changing Lives data, but the time period examined in that research was only 8 years, and the sample was restricted to adults aged 50 years and older (Janke et al., 2006). By examining adults of all ages more than a 16-year period, the current study has found that this narrowing of race differences in physical activity was restricted to those adults who were middle aged and older at baseline. Examination of the simple slopes in Blacks and Whites indicates that this convergence is largely due to severe declines in rates of physical activity among older Whites, whereas these rates among Blacks remain fairly stable. Furthermore, these race differences in the trajectories of physical activity do not appear to be accounted for by race differences in health, social relationship factors, or psychological resources.

It is not clear why older Whites would exhibit such great declines in activity whereas older Blacks remain stable. From a broad perspective, this convergence may suggest that increasing age may actually serve to "level the playing field" with respect to health behaviors (House et al., 1994). Moreover, we must consider the possibility that the stability we found in physical activity levels among Blacks across the life course is partially due to our sample including a disproportionately high number of healthy—and physically active—elderly Blacks. In other words, it may be that the expected age-related declines among Blacks are not evident because Blacks who decreased their levels of physical activity are likely to have died. In consideration of this possibility, we included control variables identifying participants

who died during follow-up, as well as participants who dropped out of the study. However, we were not able to control for the possibility that healthy older Blacks were disproportionately selected into the sample at the outset of the study (this is a problem often referred to as "left truncation"; see Liang et al., 2008).

One additional explanation for the pattern of decline among older Whites that was not examined in the current study involves the literature on social control (Tucker, Klein, & Elliott, 2004). In essence, social control refers to direct efforts by social network members to influence the behavior of other network members. With respect to physical activity during later life, social control may take the form of a friend or family member encouraging an older adult to exercise or go for a walk. The measures of social support included in this study only assessed the respondent's access to emotional support and did not capture the degree to which network members directly encouraged physical activity. Thus, it is possible that the initial advantage of Whites with regard to physical activity rates was partially the result of Whites having been subject to more social control efforts than Blacks, with this increased level of social control dissipating during later life when societal expectations for physical activity among older adults diminish greatly. This possibility should be examined empirically in future research.

The Roles of Health, Social, and Psychological Resources

Regarding our third hypothesis, our findings indicate that whereas health largely accounts for gender-based stratification of physical activity trajectories, other factors besides health are likely to be responsible for race-based stratification. In this regard, additional research on the role of psychological and social relationship factors in shaping the social stratification of aging and leisure-time physical activity is warranted. Our measures of psychological and social relationship factors each suffered from poor or moderate reliability scores (ranging from .48 to .68), perhaps attenuating their associations with physical activity. Indeed, our findings failed to provide evidence of an association between time-varying psychological resources and leisure-time physical activity. This may mean that psychological resources actually have little impact on changes in leisure-time physical activity, and its social stratification, once the effects of health and social relationships are considered; however, these nonsignificant findings may also reflect weaknesses in the reliability and validity of these psychological measures.

Our findings regarding social relationship factors expand on cross-sectional research that has linked social resources and physical activity (Eyler et al., 1999) by indicating that adults' levels of leisure-time physical activity are higher during times when they are married, well-integrated, and well-supported by their social networks, as opposed to when they are less well-integrated in a social network. At the same time, however, the association between social relationships and leisure-time physical activity does not appear to account for the observed age-related decline in this behavior, perhaps because some dimensions of social networks decline with age (e.g., contact with friends), whereas other dimensions increase (e.g., received support) (Shaw, Krause, Liang, & Bennett, 2007).

Study Limitations

In considering future research in this area, the key methodological limitations of this study should also be considered. First, the potential confounding of aging and cohort effects must be kept in mind. This study followed individuals from different birth cohorts over time, meaning that age variations were observed both within and between persons. Readers should be clear not to attribute findings of age differences in this study solely to changes within persons over the life course, as these differences could also reflect differences between distinct birth cohorts that could be relevant to physical activity (Lynch, 2003). For example, because national recommendations promoting participation in regular physical activity did not begin appearing until the 1950's (Talbot, Fleg, and Metter, 2003), it is likely that older cohorts were less aware of the benefits of physical activity and thus have been subject to less encouragement for engaging in leisure-time physical activity, compared with younger cohorts of adults, throughout their lifetimes. Similarly, our findings of age differences in the social stratification of leisure-time physical activity must be assessed in light of possible cohort effects. For example, it is possible that our findings of less racial stratification at increased ages could be partially a reflection of the widespread lack of leisure-time physical activity among both Blacks and Whites of the older cohorts, rather than an aging-related leveling of physical activity patterns.

As an additional limitation, our examination of race differences in aging and physical activity has, out of necessity, restricted its focus on Blacks versus Whites. A comprehensive analysis of race differences in physical activity requires that attention also be given to other racial/ethnic groups. Unfortunately, the data available for the current study did not include sufficient numbers of cases in these groups to allow for a rigorous analysis of these differences.

Also, because of potential limitations with our measure of leisure-time physical activity, further research examining the social stratification of leisure-time physical activity trajectories should be carried out using different measures of physical activity. Of particular concern with this measure is the possibility that some of the items used may be differentially relevant to persons from different social groups residing in different living environments, such as suburban or rural settings. Because residential location

is likely to be associated with social groupings, such as race/ethnicity, it may be that items like gardening or yard work are not equally relevant to different racial groups, perhaps partially confounding apparent race differences in activity.

Although these limitations raise plenty of questions for future research, the findings from the current study advance our understanding of the social stratification of physical activity and may bring us a step closer to understanding the social stratification of aging and health. On the basis of our findings, we can conclude that many Americans are reducing the frequency with which they participate in leisure-time physical activity relatively early in the life course, with especially precipitous declines observed among older Americans—and older Whites and older women in particular. Although changing health and social relationship factors appear to be strong influences on leisure-time physical activity, with health accounting for some of the observed patterns of stratification, the convergence of Black–White differences in physical activity in late life remains unaccounted for. This unaccounted for convergence perhaps indicates the influence of cultural differences in social control with respect to physical activity, an unmeasured survivor effect, or a leveling due to the onset of health limitations experienced by both groups that were not measured in this study.

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References

Abeles, R. P. (1992). Social stratification and aging: Contemporaneous and cumulative effects. In K. W. Schaie, D. Blazer, & J. S. House (Eds.), *Aging, health behaviors, and health outcomes* (pp. 33–37). Hillsdale, NJ: Lawrence Erlbaum Associates.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage.

Almeida, D. M., Charles, S. T., & Neupert, S. D. (2008). Commentary: Assessing health behaviors across individuals, situations, and time. In K. W. Schaie & R. P. Abeles (Eds.), *Social structure and aging individuals* (pp. 97–111). New York: Springer.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Clinical and Social Psychology*, *4*, 359–373.

Berkman, L. F., & Syme, S. L. (1979). Social networks, host resistance, and mortality: A nine-year follow-up study of Alameda County residents. *American Journal of Epidemiology*, *109*, 186–204.

Bijnen, F. C. H., Feskens, E. J. M., Caspersen, C. J., Mosterd, W. L., & Kromhout, D. (1998). Age, period, and cohort effects on physical activity among elderly men during 10 years of follow-up: The Zutphen Elderly Study. *Journal of Gerontology: Medical Sciences*, *53A*, M235–M241.

Bollen, K. B., & Lennox, R. (1991). Conventional wisdom on measurement: A structural equation perspective. *Psychological Bulletin*, *110*, 305–314. doi:10.1037/0033-2909.110.2.305.

Brownson, R. C., Baker, E. A., Housemann, R. A., Brennan, L. K., & Bacak, S. J. (2001). Environmental and policy determinants of physical activity in the United States. *American Journal of Public Health*, *91*, 1995–2003. doi:10.2105/AJPH.91.12.1995.

Centers for Disease Control and Prevention. (2005). Trends in leisure-time physical inactivity by age, sex, and race/ethnicity—United States, 1994-2004. *MMWR: Morbidity and Mortality Weekly Report*, *54*, 991–994.

Centers for Disease Control and Prevention. (2007). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

DiPietro, L. (2001). Physical activity in aging: Changes in patterns and their relationship to health and function. *Journal of Gerontology: Medical Sciences*, *56*, 13–22.

DiPietro, L., Williamson, D. F., Caspersen, C. J., & Eaker, E. (1993). The descriptive epidemiology of selected physical activities and body weight among adults trying to lose weight: The Behavioral Risk Factor Surveillance System Survey, 1989. *International Journal of Obesity*, *17*, 69–76.

Eyler, A. A., Brownson, R. C., Donatelle, R. J., King, A. C., Brown, D., & Sallis, J. F. (1999). Physical activity social support and middle- and older-aged minority women: Results from a US survey. *Social Science and Medicine*, *49*, 781–789. doi:10.1016/S0277-9536(99)00137-9.

Gelman, A. (2006). Prior distributions for variance parameters in hierarchical models (comment on article by Browne and Draper). *Bayesian Analysis*, *1*, 515–534.

Grzywacz, J. G., & Marks, N. F. (2001). Social inequalities and exercise during adulthood: Toward an ecological perspective. *Journal of Health and Social Behavior*, *42*, 202–220. doi:10.2307/3090178.

He, X., & Baker, D. W. (2005). Differences in leisure-time, household, and work-related physical activity by race, ethnicity, and education. *Journal of General Internal Medicine*, *20*, 259–266. doi:10.1111/j.1525-1497.2005.40198.x.

House, J. S. (2008). *Americans' Changing Lives: Waves I, II, III, and IV, 1986, 1989, 1994, and 2002 [Computer file]*. Ann Arbor, MI: Survey Research Center, Institute for Social Research, University of Michigan (producer) and Inter-University Consortium for Political and Social Research (distributor).

House, J. S., & Kahn, R. L. (1985). Measures and concepts of social support. In S. Cohen & S. L. Syme (Eds.), *Social support and health* (pp. 83–108). New York: Academic Press.

House, J. S., Kessler, R. C., Herzog, A. R., Mero, R. P., Kinney, A. M., & Breslow, M. J. (1992). Social stratification, age and health. In K. W. Schaie, D. Blazer, & J. S. House (Eds.), *Aging, health behaviors, and health outcomes* (pp. 1–32). Hillsdale, NJ: Lawrence Erlbaum Associates.

House, J. S., Lantz, P. M., & Herd, P. (2005). Continuity and change in the social stratification of aging and health over the life course: Evidence from a nationally representative longitudinal study from 1986 to 2001/2002 (Americans' Changing Lives study). *Journal of Gerontology: Social Sciences*, *60*, S15–S26.

House, J. S., Lepkowski, J. M., Kinney, A. M., Mero, R. P., Kessler, R. C., & Herzog, A. R. (1994). The social stratification of aging and health. *Journal of Health and Social Behavior*, *35*, 213–234. doi:10.2307/2137277.

Janke, M., Davey, A., & Kleiber, D. (2006). Modeling change in older adults' leisure activities. *Leisure Sciences*, *28*, 285–303.

Kaplan, M. S., Newsom, J. T., McFarland, B. H., & Lu, L. (2001). Demographic and psychosocial correlates of physical activity in late life. *American Journal of Preventive Medicine*, *21*, 306–312. doi:10.1016/S0749-3797(01)00364-6.

Kim, J., & Durden, E. (2007). Socioeconomic status and age trajectories of health. *Social Science and Medicine*, *65*, 2489–2502. doi:10.1016/j.socscimed.2007.07.022.

King, A. C., Castro, C., Wilcox, S., Eyler, A. A., Sallis, J. F., & Brownson, R. C. (2000). Personal and environmental factors associated with physical inactivity among different racial-ethnic groups of U.S. middle-aged and older-aged women. *Health Psychology*, *19*, 354–364. doi:10.1037/0278-6133.19.4.354.

Lantz, P. M., House, J. S., Mero, R. P., & Williams, D. R. (2005). Stress, life events, and socioeconomic disparities in health: Results from the Americans' Changing Lives study. *Journal of Health and Social Behavior*, *46*, 274–288. doi:10.1177/002214650504600305.

Liang, J., Bennett, J. M., Shaw, B. A., Quiñones, A. R., Ye, W., & Ofstedal, M. B. (2008). Gender differences in functional status in middle and older ages: Are there any age variations? *Journal of Gerontology: Social Sciences*, *63B*, S282–S292.

Lundberg, O., & Manderbacka, K. (1996). Assessing reliability of a measure of self-rated health. *Scandinavian Journal of Public Health*, *24*, 218–224. doi:10.1177/140349489602400314.

Lynch, S. M. (2003). Cohort and life-course patterns in the relationship between education and health: A hierarchical approach. *Demography*, *40*, 309–331. doi:10.1353/dem.2003.0016.

Marmot, M., Ryff, C. D., Bumpass, L. L., Shipley, M., & Marks, N. F. (1997). Social inequalities in health: Next questions and converging evidence. *Social Science and Medicine*, *44*, 901–910. doi:10.1016/S0277-9536(96)00194-3.

Marshall, S. J., Jones, D. A., Ainsworth, B. E., Reis, J. P., Levy, S. S., & Macera, C. A. (2007). Race/ethnicity, social class, and leisure-time physical inactivity. *Medicine & Science in Sports and Exercise*, *39*, 44–51. doi:10.1249/00005768-200505001-01689.

McAuley, E., Konopack, J. F., Morris, K. S., Motl, R. W., Hu, L., Doerksen, S. E., & Rosengren, K. (2006). Physical activity and functional limitations in older women: Influence of self-efficacy. *Journal of Gerontology: Psychological Sciences*, *61*, P270–P277.

Mirowsky, J., & Ross, C. E. (2003). *Education, social status and health*. New York: Aldine de Gruyter.

Pearlin, L. I., Lieberman, M. A., Menaghan, E. G., & Mullan, J. T. (1981). The stress process. *Journal of Health and Social Behavior*, *22*, 337–356. doi:10.2307/2136676.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierachical linear models*. Thousand Oaks, CA: Sage.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Ross, C. E., & Wu, C.-L. (1996). Education, age, and the cumulative advantage in health. *Journal of Health and Social Behavior*, *37*, 104–20. doi:10.2307/2137234.

Shaw, B. A., Krause, N., Liang, J., & Bennett, J. (2007). Tracking changes in social relations throughout late life. *Journal of Gerontology: Social Sciences*, *62B*, S90–S99.

Shaw, B. A., & Spokane, L. S. (2008). Examining the association between education level and physical activity changes during early old age. *Journal of Aging and Health*, *20*, 767–787. doi:10.1177/0898264308321081.

Staudinger, U. M., & Bluck, S. (2001). A view of midlife development from life-span theory. In M. E. Lachman (Ed.), *Handbook of Midlife Development* (pp. 3–39). New York: Wiley.

Talbot, L. A., Fleg, J. L., & Metter, E. J. (2003). Secular trends in leisure-time physical activity in men and women across four decades. *Preventive Medicine*, *37*, 52–60. doi:10.1016/S0091-7435(03)00058-6.

Thoits, P. A., & Hewitt, L. N. (2001). Volunteer work and well-being. *Journal of Health and Social Behavior*, *42*, 115–131. doi:10.2307/3090173.

Tucker, J. S., Klein, D. J., & Elliott, M. N. (2004). Social control of health behaviors: A comparison of young, middle-aged, and older adults. *Journal of Gerontology: Psychological Sciences*, *59*, P147–P150.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention National Center for Chronic Disease Prevention and Health Promotion.

Verbrugge, L. M. (1985). Gender and health: An update on hypotheses and evidence. *Journal of Health and Social Behavior*, *26*, 156–182. doi:10.2307/2136750.

Verbrugge, L. M., Gruber-Baldini, A. L., & Fozard, J. L. (1996). Age differences and age changes in activities: Baltimore Longitudinal Study of Aging. *Journal of Gerontology: Social Sciences*, *51B*, S30–S41.

Werts, C. E., Linn, R. L., & Joreskog, K. G. (1974). Intraclass reliability estimates: Testing structural assumptions. *Educational and Psychological Measurement*, *34*, 25–33. doi:10.1177/001316447403400104.

Winship, C., & Radbill, L. (1994). Sampling weights and regression analysis. *Sociological Methods and Research*, *23*, 230–257. doi:10.1177/0049124194023002004.

Wu, B., & Porell, F. (2000). Job characteristics and leisure physical activity. *Journal of Aging and Health*, *12*, 539–559. doi:10.1177/089826430001200405.