Social Inequalities and Exercise during Adulthood: Toward an Ecological Perspective*

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Grounded in ecological theory, this study examines the association among participation in regular vigorous exercise and social status, aspects of prominent life settings, interactions between life settings, and more proximal individual resources and processes using data from the National Survey of Midlife Development in the United States (N = 3,032). Among women, a higher level of earnings was associated with more vigorous exercise, yet those women with more education had a steeper decline in exercise across adulthood. Among men, those with the lowest level of education had the steepest decline in physical activity across adulthood, and earnings did not affect exercise patterns. Less participation in vigorous exercise among blacks, in contrast to nonblacks, was explained by their tendency to live in less safe neighborhoods and having more functional health problems. Finally, contextual factors from multiple domains were independently associated with participation in regular exercise. Consistent with ecological theory, these results suggest that interventions to promote exercise habits among adults need to consider the independent and interactive effects of multiple contextual factors.

Regular physical activity has been demonstrated to promote longevity (Berkman and Breslow 1983; Fried et al. 1998; Paffenbarger et al. 1994; U.S. Department of Health and Human Services 1996), reduce rates of chronic and acute morbidity (Breslow and Breslow 1993; U.S. Department of Health and Human Services 1996), and facilitate higher levels of psychological well-being throughout adulthood (Albert 1995; Fries and Crapo 1985; Folkins and Sime 1981; Rowe and Kahn 1987; Tkachuk and Martin 1999; U.S. Department of Health and Human Services 1996). Most adults remain inactive despite widespread programming to initiate regular physical activity (Public Health Service 1991). National estimates indicate that 30 percent of American adults remain completely sedentary, and only 14–23 percent of adults engage in enough physical activity to achieve health-related benefits (Centers for Disease Control 1997; U.S. Department of Health and Human Services 1996).

Individuals in lower social status positions participate in less physical activity than their higher status counterparts. Older adults, women, blacks, and individuals of lower

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socioeconomic status are consistently found to exercise less regularly and are more likely to be completely sedentary than younger adults, men, whites, and higher socioeconomic status individuals (for reviews see Blair 1988; Centers for Disease Control 1997; Dishman 1991; King et al. 1992; U.S. Department of Health and Human Services 1996). Given this evidence, age, gender, race, and education are typically included as important covariates when developing and testing models of physical activity. However, inattentively "controlling for" social status is a major limitation in health research (Marmot, Kogevinas, and Elston 1987). Instead, Marmot and colleagues (1987) as well as others (Krieger, Williams, and Moss 1997; Williams 1990) argue that more research directly examining the effects of social status on health-related phenomena is critically needed since social status creates a broad context that shapes routine experiences that affect health-related behavior.

In this study, we seek to expand our understanding of physical activity patterns by considering exercise behavior within the broad context of social status, and examining how contextual factors from prominent life settings and more proximal individual resources and processes help account for and uniquely contribute to differences in exercise. Guided by an ecological perspective and previous research, we theorize that the often-noted declines in activity by age, and the frequently cited differences in physical activity by gender, race, and socioeconomic status do not act independently of each other. Thus, in this study we systematically examine the independent and interactive effects of age, gender, and multiple dimensions of socioeconomic status on physical activity patterns throughout adulthood. Consistent with previous scholars, we further theorize that social status partially allocates contextual resources, opportunities, and barriers at the individual, family, work, and community levels that may influence physical activity patterns. Therefore, we examine the independent effects of individual-level, family- and work-related, as well as community experiences on regular exercise, and we consider the extent to which the effects of social status operate through shaping differences in these everyday experiences.

THEORETICAL AND EMPIRICAL BACKGROUND

Ecological theory, as explicated by Bronfenbrenner and colleagues (Bronfenbrenner 1979; Bronfenbrenner and Ceci 1994; Bronfenbrenner and Morris 1998), can serve as a valuable tool for further understanding and modeling the determinants of positive health behaviors (Fitzgerald et al. 1994; McLeroy et al. 1988; Sallis and Owen 1997; Stokols 1996). Bronfenbrenner's model posits that behaviors such as physical activity are influenced by a variety of factors from multiple ecological levels (e.g., individual, microsystemic, mesosystemic, and macrosystemic) and change as a function of developmental and historical time. Consequently, using an ecological perspective, scholars can integrate a rich array of known determinants of physical activity (for reviews see Blair 1988; Dishman 1991; King et al. 1992; U.S. Department of Health and Human Services 1996) into models of exercise to better specify predictive models for different periods in the life course. In addition to being more conducive to a more comprehensive theory of health behavior, an ecological approach also has several practical benefits. Most notably, an ecological approach attenuates the possibility of "victim-blaming" (e.g., Becker 1986) by drawing attention to additional targets for intervention beyond the individual. When acted upon and changed, these socio-environmental factors frequently bring about more sustainable change in individual and population health behavior (Green and Krueter 1999; Stokols, Pelletier, and Fielding 1996).

Social Status and Physical Activity

Several personal characteristics representing individuals' relative location in status hierarchies predict participation in regular physical activity. Lower socioeconomic status, older age, being female, and being black are consistently associated with less participation in regular physical activity (for reviews see Blair 1988; Dishman 1991; King et al. 1992; U.S. Department of Health and Human Services 1996). Like previous scholars (Ross and Wu 1995; Stronegger, Freidl, and Rasky 1997), we theorize that social location in status hierarchies is an important conditioning factor for

the allocation of resources, opportunities, and constraints that influence behaviors related to health, such as exercise.

Socioeconomic status is consistently associated with health behaviors and health behavior change: Lower socioeconomic status individuals participate in fewer positive health behaviors (e.g., exercise, maintaining healthy body weight) and change their negative health behaviors (e.g., smoking) at a slower rate than higher socioeconomic status individuals (Berkman and Breslow 1983; Blaxter 1990; National Center for Health Statistics 1998; Piani and Schoenborn 1993; Ross and Wu 1995; Stronegger et al. 1997; U.S. Department of Health and Human Services 1996). Evidence from different studies however suggests that different indicators of socioeconomic status (e.g., education and earnings) may have different associations with physical activity, and that these associations may differ by gender (Cauley et al. 1991; Ford et al. 1991) or measure of physical activity (Cauley et al. 1991).

Three important features are demonstrated by the previous studies that support the meaningfulness of an ecological model in the study of physical activity. First, socioeconomic status is best conceptualized as being multidimensional, and each independent dimension (e.g., education and income) has the ability to influence physical activity habits in different ways. For example, education might influence health behaviors though a greater ability to receive and interpret information regarding the health benefits of regular exercise. Earnings, on the other hand, independent of education, might promote physical activity through additional discretionary income that allows pursuing physically active hobbies during leisure time. Next, this research highlights the importance of recognizing the specific type of physical activity being studied (e.g., amount of leisure time physical activity per week versus kilocalories expended per day). Finally, multiple strands of evidence suggest that the link between socioeconomic status and health is gendered whereby education and earnings have consistent health effects among men but not women (see Marmot et al. 1987; McDonough et al. 1999). We hypothesize that a higher level of education and a higher level of earnings will be independently associated with more regular physical activity. We also hypothesize that the effects of education and earnings on exercise habits will be more pronounced among men than women.

Time is a central concept in ecological models (Bronfenbrenner 1995), and it draws our attention to the enduring context of socioeconomic status for the development and maintenance of positive health behaviors such as exercise. The "cumulative advantage" hypothesis (Ross and Wu 1996) directly addresses the issue of time by positing that the longer an individual is exposed to a protective factor, such socioeconomic advantage, the greater the health-related benefit. Scholars have found some support for the cumulative health status benefits of education (e.g., House et al. 1990; House et al. 1994; Ross and Wu 1996), however this question has not yet been considered with respect to participation in regular physical activity. Assuming that socioeconomic advantage provides cumulative benefits for continued participation in regular exercise over time, we hypothesize that a wider gap in the benefits of education and earnings will be more apparent at older ages than younger ages.

Contextual and Individual Correlates of Physical Activity

Certain recurring patterns in everyday social life exert a disproportionate amount of influence on well-being (Stokols 1996) and, presumably, on behaviors related to health. Most adults are nested within families, occupations, and communities; consequently, comprehensive models of physical activity need to consider social and environmental factors from each of these domains or settings (Bronfenbrenner 1979). Unfortunately, most health behavior research does not give adequate attention to notable contextual or ecological factors that may support or undermine participation in regular physical activity. However, researchers can use middle-range theory and empirical evidence from different fields (e.g., family studies, occupational health, urban planning) to identify high-powered leverage points (i.e., factors that exert, or potentially exert, a disproportionate amount of influence; see Stokols 1996) for influencing exercise.

The family microsystem. The family is a primary life domain for most adults. Since individuals in specific family roles, such as spouse or parent, are frequently found to participate in fewer health-risk behaviors (Chilcoat and

Breslau 1996; Horwitz and Raskin White 1991; Umberson 1987), the family is believed to be an important source of social control of behaviors related to health (Umberson 1987). Similarly, family life provides an important general context for health promoting behavior (Doherty and McCubbin 1985; Pratt 1976; Walsh 1993). Previous research, for example, has demonstrated that emotionally close family relationships and happy, stable, and satisfying marriages predict less health risk behaviors among adults (Doherty and Harkaway 1990; Franks, Campbell, and Shields 1992; Pratt 1976; Wickrama et al. 1997a). Following social control theory, we hypothesize that married individuals and parents will exercise more frequently than single or childless individuals. Consistent with family systems theory, we hypothesize that individuals in an emotionally close family and an emotionally close marriage will exercise more.

The work microsystem. The workplace is a target for implementing health promotion interventions (Public Health Service 1991), yet we lack a body of clearly defined research explicitly examining the impact and the mechanisms through which the workplace influences behavior related to health (for recent review see Eakin 1997). Nonetheless, a variety of job characteristics, particularly high decision latitude, have been found to predict fewer health-risk behaviors (House et al. 1986; Mensch and Kandel 1988; Weidner et al. 1997; Wickrama et al. 1997b). Based upon occupational stress theory (House 1981; Karasek and Theorell 1990) and previous research, we hypothesize that having more decision latitude on the job will be associated with more regular physical activity. We also hypothesize that due to time constraints, a greater number of hours worked per week will be associated with less exercise.

The work-family mesosystem. Ecological theory also contends that unique contributions to the overall context of human development are derived from interactions between two or more life settings (i.e., mesosystems; Bronfenbrenner 1979). Managing and integrating work and family is an increasingly significant task for adults today (Bielby 1992; Heckhausen 1997; Lachman and Boone-James 1997). Work-family strain has been found to be associated with more alcohol use among adults (Bromet, Dew, and Parkinson 1990; Frone, Barnes, and Farrell 1994; Frone, Russell, and Cooper 1993; Frone, Russell, and Cooper 1997), suggesting that incompatible work and family responsibilities may undermine positive health behaviors such as exercise (Backett 1992; Backett and Davison 1995). However, recent theory emphasizes the quality of fit between work and family as opposed to experiences of strains alone (Barnett 1998). That is, both the benefits (Sieber 1974) and the strains (Goode 1960) of role accumulation need to be considered when examining the health impacts of the work-family interface. Based upon recent work-family theory (Barnett 1999; Grzywacz and Marks 2000), we hypothesize that more positive spillover between work and family and less negative spillover between work and family will be associated with more regular physical activity.

The research cited here shares one common limitation. Assuming that specific health behaviors are reflections of a common latent "lifestyle" construct, researchers typically use summed indices of health-related behavior (e.g., non-smoking, non-problem alcohol use, and regular exercise) or substance use as the dependent variable. Consequently, it remains unclear what effect, if any, family, work, and work-family spillover will have specifically on physical activity, since wellness enhancing and risk-taking behaviors (e.g., regular physical activity versus substance use; Vickers, Conway, and Hervig 1990) are qualitatively different (for review, see Gochman 1997), and may not share the same contextual determinants.

Community. A wide range of community characteristics may influence an individual's ability to practice various behaviors related to health (Cheadle et al. 1999; Taylor, Repetti, and Seeman 1997). Evidence from different sources indicates that individuals who live in unsafe communities or neighborhoods are less likely to engage in regular physical activity (Centers for Disease Control 1999; Eyler et al. 1998; Ross 1993; Sallis et al. 1997). Although some reports suggest that neighborhood safety serves as a physical barrier to regular activity through fear of victimization (e.g., Centers for Disease Control 1999; Ross 1993), the mechanisms linking neighborhood safety to individual physical activity have not been adequately tested or identified. We hypothesize that living in neighborhoods characterized as unsafe will be associated with less participation in regular physical activity.

Proximal Individual Resources and Processes

An individual's physical and psychological characteristics are perhaps the most proximal determinants of physical activity. In our conceptualization, we include these factors as potential proximal processes conditioned by more macrosociological processes, working through the opportunities, constraints, and relative stressors that are allocated through the social hierarchies indicated by socioeconomic status, age, gender, and race (see Williams 1990).

Physiologically, progressive reductions in maximal oxygen uptake (V_{O2} max), cardiovascular function, and declining muscle mass through adulthood are believed to interfere with individuals' abilities to participate in regular or prolonged bouts of physical activity. However, studies clearly indicate that many of the physiological declines associated with aging are the result of, not the cause of, reduced physical activity (see Goldberg, Dengel, and Hagberg 1996). This evidence suggests that the unfolding of social and psychological dynamics throughout adulthood cause reductions in physical activity (Backett and Davison 1995) that become progressively reinforced by subsequent reductions in physiological function. We hypothesize that a higher body-mass index, more functional restrictions related to activity, and reduced lung capacity will be associated with less regular vigorous exercise.

Psychological theories and models that place primary attention on individual-level beliefs, attitudes, and values (Glanz, Lewis, and Rimer 1997) typically guide health behavior research. Individual processes such as more self-efficacy (Dzewaltowski 1994; Rosenstock, Strecher, and Becker 1988), a belief that exercise is an efficient way to promote health, and a greater sense of control over health (Strickland 1978) have all been theorized and subsequently found to influence physical activity among adults (King et al. 1992; U.S. Department of Health and Human Services 1996). We draw upon existing value-expectancy theories to hypothesize that a higher level of self-efficacy, a greater belief in the health benefits of exercise, and more perceived control over health will be associated with more frequent participation in regular physical activity.

Physical Activity: An Ecological Perspective

The ecological model of physical activity during adulthood that guided this study is portrayed in Figure 1. Consistent with previous research, Figure 1 suggests that sociodemographic characteristics, including multiple aspects of socioeconomic status, have direct effects on rates of participation in regular, vigorous exercise. Additionally, our model suggests that these sociodemographic characteristics may also have indirect effects on physical exercise by influencing the characteristics of individuals' daily contexts (family, work, and community) and the interactions between these contexts (work-family interface). We also expect that the quality of these life settings will shape more proximal individual resources and processes—including functional and breathing limitations to physical activity, body mass index, environmental mastery, exercise efficacy (i.e., belief that exercise is a good way to promote health) and control over health—that, in turn, influence rates of participation in exercise.

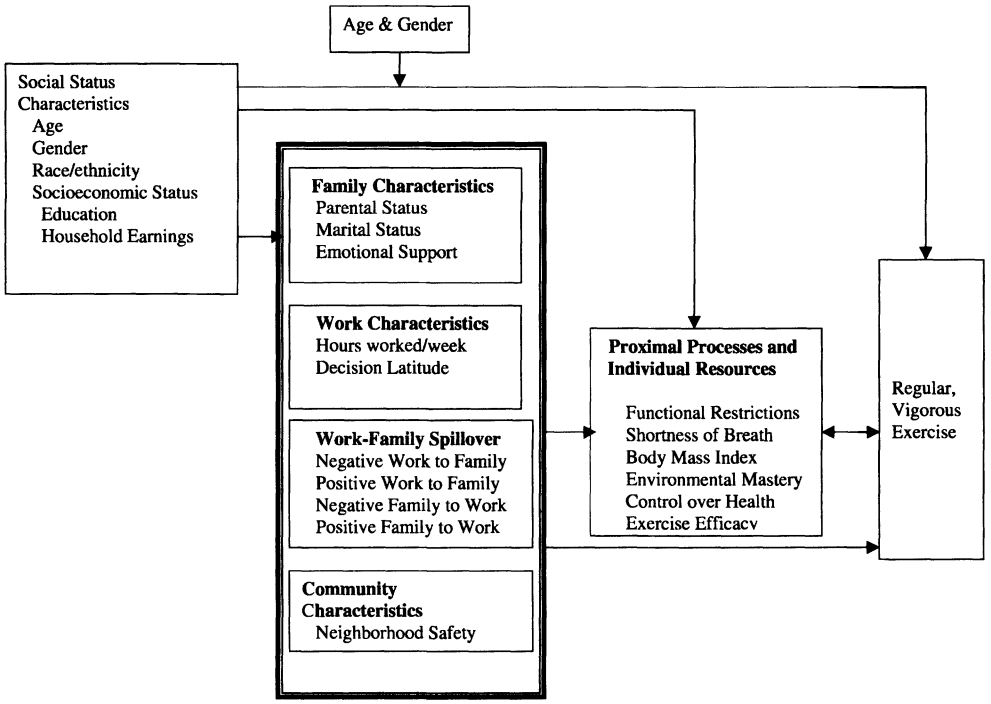
METHOD

Data

The data used for this study are from the National Survey of Midlife Development in the United States, collected in 1995 by the John D. and Catherine T. MacArthur Foundation Research Network on Successful Midlife Development (N = 3,032; 1,471 men and 1,561 women). The original purpose of the National Survey of Midlife Development was to examine patterns, predictors, and consequences of midlife development in the areas of physical health, psychological well-being, and social responsibility. Respondents are a nationally representative sample of non-institutionalized persons aged 25–74 who have telephones. The sample was obtained through random digit dialing, with an oversampling of older respondents and men made to guarantee a good distribution on the cross-classification of age and gender. Sampling weights correcting for selection probabilities and non-response allow this sample to match the composition of the U.S. population on age, sex, race, and education.

Respondents first participated in a telephone interview lasting approximately 40 min-

FIGURE 1. An Ecological Model for Regular Vigorous Physical Activity during Adulthood



utes. The response rate for the telephone questionnaire was 70 percent. Respondents to the telephone survey were then asked to complete two self-administered mailback questionnaires. The response rate for the mailback questionnaire was 86.8 percent of telephone respondents. This yielded an overall response rate of 60.8 percent for both parts of the survey (for a detailed technical report regarding field procedures, response rates, and weighting, see http://midmac.med.harvard.edu/research.html #tchrpt).

Measures: Dependent Variable

Although even a small amount of exercise is better than being sedentary (e.g., Kunst et al. 1999; Dunn et al. 1999; U. S. Department of Health and Human Services 1996), evidence indicates that regular exercise in 60–90 percent of an individual's target heart rate is most beneficial to overall health (American College of Sports Medicine 1990). Therefore, we constructed a continuous outcome measure of *regular vigorous exercise* using two previously validated measures (Blair 1984; Kohl et al. 1988; Washburn et al. 1990) adapted to include seasonal effects (Marmot et al. 1991). Specifically, respondents were asked: (1) "During the summer, how often do you engage in vigorous physical activity (for example, running or lifting heavy objects) long enough to work up a sweat?" and (2) "During the winter, how often do you engage in vigorous physical activity long enough to work up a sweat?" Response categories included several times a week or more (6), about once a week (5), several times a month (4), about once a month (3), less than once a month (2), or never (1). The two items were highly correlated (r = .89); consequently, we used the mean of the two items to assess regular, vigorous exercise. (See Table 1 for descriptive statistics for all analytic variables.)

Measures: Independent Variables

Social status. Age was included as a continuous variable in these analyses. Gender (1 = female) and race/ethnicity (1 = black) were included as dichotomous measures. Education represents the number of years of formal education completed and is coded as an ordinal variable as follows: 1 = 1–6 years, 2 = 7–8

TABLE 1. Descriptive statistics for all analysis variables

	M	SD	Range
Dependent Variable			
Regular, Vigorous Exercise	4.04	1.75	1–6
Social Status Characteristics			
Age	45.30	13.48	25–74
Gender (female = 1)	56.6%		
Race/Ethnicity (black = 1)	11.2%		
Educational Attainment	6.20	2.41	1–12
Household Earnings	39,254	36,172	0–300,000
Family & Work Microsystems			
Parental Status (Child < 18 = 1)	41.1%		
Marital Status (not married = 1)	31.9%		
High Spouse Emotional Support	37.3%		
Low Spouse Emotional Support	30.4%		
Family Emotional Support	3.41	.63	1–4
Currently Working For Pay (Yes = 1)	73.8%		
Hours Worked per Week[a]	43.52	15.53	1–168
Decision Latitude at Work[a]	3.62	.87	1–5
Spillover between Work & Family[a]			
Negative Work to Family	2.62	.74	1–5
Positive Work to Family	2.62	.84	1–5
Negative Family to Work	2.11	.68	1–5
Positive Family to Work	3.41	.84	1–5
Community Environment			
Neighborhood Safety	3.36	.56	1–4
Individual Proximal Processes/Resources			
Body Mass Index	26.80	5.65	9.44–64.02
Functional Restrictions from Exercise	1.44	.77	1–4
Shortness of Breath when Active	.18	.57	0–3
Environmental Mastery	15.87	3.42	3–21
Perceived Control over Health	5.36	.77	1–6
Efficacy of Exercise	3.68	.85	0–4

Source: National Survey of Midlife Development in the United States 1995.
Notes: Estimates are based on weighted data.
[a]Estimate obtained from only respondents who were working for pay when they completed the questionaire.

years, 3 = 9–12 years but no diploma or GED, 4 = GED, 5 = graduated from high school, 6 = 1–2 years of college but no degree yet, 7 = 3 or more years of college but no degree yet, 8 = graduated from a two-year college or vocational school, or associate's degree, 9 = graduated from a four- or five-year college, or bachelor's degree, 10 = some graduate school, 11 = master's degree, and 12 = doctoral or other professional degree. Household earnings were coded continuously in thousands of dollars.

Family Characteristics. Spouse emotional support measured the level of emotional support provided to the respondent from his other spouse using the mean of a 6-item index (α = .85) adapted from Schuster, Kessler, and Aseltine (1990) (e.g., "How much does your spouse or partner really care about you?" "How much can you rely on him or her for help if you have a serious problem?"). Response categories for the index items were not at all (1), a little (2), some (3), and a lot (4). Spouse emotional support was then divided into three categories to facilitate inclusion of all respondents: (1) Individuals who were unmarried, (2) married individuals with a mean response of less than 4 (i.e., low emotional support; used as the contrast category), and (3) married individuals with a mean response of 4 (i.e., high emotional support; note: 56.4% of married respondents had a mean of 4 for spouse emotional support; consequently, we chose this value for maximal variability in the measure). *Family emotional support* measured the level of emotional support provided to the respondent from his or her other family members with a parallel 4-item index (α = .83) that was included in the model as a continuous measure. *Parental status* (i.e., has a child under 18 years old = 1) was also included in our model.

Work characteristics. Decision latitude was assessed by summing responses to five items measuring the amount of control the individual has over his or her work environment and tasks, and the specialization of labor (e.g., "How often do you have a choice in deciding

how you do your tasks at work? How often do you have a choice in deciding what tasks you do at work"; $\alpha = .87$). We also included a measure of the number of hours the respondent reported working (i.e., sum of responses to two questions regarding hours worked last week in primary and additional jobs).

Work-family spillover. Negative spillover from work to family measured the respondent's perception of the extent to which work interfered with functioning at home by calculating the mean response to four items (e.g., "How often does stress at work make you irritable at home?"; $\alpha = .84$). Conversely, *positive spillover from work to family* assessed the extent to which the respondent felt that their work promoted better functioning at home (e.g., "How often do the things you do at work help you deal with personal and practical issues at home?"; $\alpha = .74$). *Negative spillover from family to work* assessed the extent to which the respondent felt their family life was interfering with their success on the job (e.g., "How often does stress at home make you irritable at work?"; $\alpha = .81$). Finally, *positive spillover from family to work* measured the extent to which respondents felt their family life helped them perform better on the job (e.g., "How often does talking with someone at home help you deal with problems at work?"; $\alpha = .73$). Response categories ranged from never (1) to all the time (5). The work-family spillover items were developed for the National Survey of Midlife Development in the United States.

Community. Perceived community safety was measured with the mean response to four items developed for the National Survey of Midlife Development in the United States: (1) "I feel safe being out alone in my neighborhood during the daytime;" (2) "I feel safe being out alone in my neighborhood at night;" (3) "I could call on a neighbor for help if I needed it;" and (4) "People in my neighborhood trust each other." Response categories for the community safety items ranged from not at all (1) to a lot (4) ($\alpha = .65$).

Physiological and psychological resources and processes. Functional restrictions to physical activity was assessed with a 4-item scale revised from the Medical Outcomes Study (Brazier et al. 1992) asking how much the respondent's health limited walking several blocks, walking one block, vigorous activity, and moderate activity ($\alpha = .92$). Response categories were not at all (1), some (2), a little (3), and a lot (4). Reduced VO_2 max was operationalized using three items adapted from the Rose Questionnaire for angina (Rose et al. 1982) assessing if respondents get *short of breath* (yes/no) while (1) "walking with other people your age on level ground;" (2) "walking at your own pace on level ground;" and (3) "washing or dressing" ($\alpha = .74$). *Body mass index* was computed using the Quetlet Index (i.e., weight/height^2).

Control over health was measured using three items adapted from the Whitehall Survey (Marmot et al. 1991), including 1) "Keeping healthy depends on things that I can do;" (2) "There are certain things I can do for myself to reduce the risk of heart attack;" and (3) "There are certain things I can do for myself to reduce the risk of getting cancer." Response categories for the control over health items ranged from strongly disagree (1) to strongly agree (6) ($\alpha = .71$).

Environmental mastery is a component of psychological well-being that assesses an individual's sense of mastery and competence in managing the surrounding environment (Ryff 1989). Environmental mastery was measured with three items: (1) "In general, I feel I am in charge of the situation in which I live;" (2) "The demands of everyday life often get me down;" and (3) "I am quite good at managing the many responsibilities of my daily life." Response categories for the environmental mastery items ranged from strongly disagree (1) to strongly agree (7) ($\alpha = .52$). Although the estimated reliability of the environmental mastery scale used in the National Survey of Midlife Development in the United States is modest, previous research has indicated that the three-item measure is strongly correlated with its highly reliable parent measure (Ryff and Keyes 1995).

Exercise efficacy assessed the extent to which respondents believe that exercise is a beneficial and preferred way of promoting health. Respondents were asked to respond to a hypothetical scenario during the telephone interview "Assume for a moment that your doctor said you had a heart condition and said you could choose either to have coronary bypass surgery or exercise at least three times a week for at least half an hour each time. Which one do you think you would choose?" Respondents were then asked, "How sure are you that this is what you would choose?" very

(1), somewhat (2), or not very sure (3). Being very sure about choosing exercise was coded 3, being somewhat sure about exercise was coded 2, being not very sure about exercise was coded 1, and choosing bypass surgery was coded 0.

Analytic Sequence

To assess our first hypotheses regarding the independent effects of various social status factors, we began by regressing our physical activity outcome on age, gender, race, education, and earnings. Then, to consider how age and gender might condition the effect of education and earnings we added interaction terms for gender X education, gender X earnings, age X education, age X earnings, age X gender X education, and age X gender X earnings interaction terms to the model (to avoid collinearity problems, we used age, education, and earnings centered on the mean in the analyses and in the construction of the interaction terms; Cronbach 1987). Unfortunately, the black sample was not large enough to allow for a consideration of higher order race interactions. Change in R^2 was used to assess if the addition of the interaction terms significantly contributed to the explanatory model (Jaccard, Turrisi, and Wan 1990). We then proceeded to add blocks of contextual experiences and individual-level characteristics to the social status model and evaluated the corresponding changes in the association between social status and physical activity.

Not all of the respondents were working for pay when they completed the telephone survey and self-administered questionnaires; consequently, some individuals were legitimately "missing" on "decision latitude," hours worked/week, and each of the work-family spillover measures. Rather than limiting the sample to employed adults only, we included a "missing flag" indicator variable for each work-related measure in the model to generate more reliable population parameter estimates (Orme and Reis 1991).

Unweighted results are reported since factors used in over-sampling were controlled in all analyses and the overall pattern of findings were similar for both weighted and unweighted analyses (Winship and Radbill 1994).

RESULTS

Social Status and Vigorous Physical Activity

Table 2 reports the results of five models estimating the impact of social status, contextual characteristics, and personal characteristics on regular, vigorous exercise. Consistent with previous reports (e.g., U. S. Department of Health and Human Services 1996), the first model in Table 2 indicates that younger individuals, men, non-blacks, those with more education, and those with higher household earnings participate in more regular physical activity. However, Model 2 further reveals that the effects of earnings on physical activity differ by gender and that the education effects differ by age and gender. Figure 2 plots the significant gender X earnings interaction and

TABLE 2. OLS Estimates of the Association between Social Status, Contextual Experiences, Individual Resources and Processes, and Regular Vigorous Exercise

	Model 1	Model 2	Model 3	Model 4	Model 5
Age[a]	−.033***	−.029***	−.025***	−.029***	−.023***
	(.002)	(.003)	(.004)	(.004)	(.004)
Gender (female = 1)	−.741***	−.758***	−.708***	−.688***	−.628***
	(.063)	(.063)	(.065)	(.065)	(.062)
Race/ethnicity (black = 1)	−.356**	−.336**	−.353**	−.285	−.162
	(.133)	(.133)	(.132)	(.132)	(.126)
Education[a]	.057***	.022	.022	.022	−.006
	(.013)	(.018)	(.018)	(.018)	(.017)
Household Earnings (thousands)[a]	.003**	.001	.0002	.0002	−.0003
	(.001)	(.001)	(.001)	(.001)	(.001)
Gender X Age[a]		−.007	−.009+	−.007	−.005
		(.005)	(.005)	(.005)	(.005)
Gender X Education[a]		.065	.053*	.046+	.034
		(.027)	(.027)	(.027)	(.025)
Gender X Earnings[a]		.003+	.004*	.004*	.003+
		(.002)	(.002)	(.002)	(.002)

TABLE 2. *(Continued)*

	Model 1	Model 2	Model 3	Model 4	Model 5
Age[a] X Education[a]		.003**	.003**	.003*	.003*
		(.001)	(.001)	(.001)	(.001)
Gender X Age[a] X Education[a]		−.005*	−.005*	−.005	−.004*
		(.002)	(.002)	(.002)	(.002)
Family & Work Microsystems					
Parental Status (Child < 18 = 1)			.074	.051	.040
			.077	.077	.073
Not Currently Married[b]			.189*	.187*	.215**
			(.084)	(.083)	(.080)
High Spouse Emotional Support[b]			.185*	.118	.089
			(.079)	(.081)	(.078)
Family Emotional Support			.120*	.024	−.036
			(.052)	(.053)	(.051)
Decision Latitude at Work[c]			.105**	.041	.040
			(.038)	(.043)	(.041)
Hours Worked/Week			.004+	.006*	.006*
			(.002)	(.003)	(.002)
Work-Family Mesosystem[c] & Community Environment					
Negative Spillover Work to Family				−.160**	−.062
				(.061)	(.059)
Positive Spillover Work to Family				.144**	.131**
				(.049)	(.046)
Negative Spillover Family to Work				.046	.093
				(.068)	(.065)
Positive Spillover Family to Work				.055	.032
				(.047)	(.045)
Neighborhood Safety				.351***	.268***
				(.061)	(.059)
Individual Proximal Processes					
Functional Restrictions					−.570***
					(.049)
Shortness of Breath					−.177**
					(.062)
Body Mass Index					−.013*
					(.006)
Environmental Mastery					.019*
					(.010)
Perceived Control over Health					.071+
					(.042)
Exercise Efficacy					.099**
					(.036)
Constant	4.50***	4.52	3.40***	2.48***	2.79***
	.045	.045	.247	.351	.447
Adjusted R^2	.138	.143	.153	.172	.253
ΔR^2	n/a	.007***	.012***	.022***	.082***

$+ p \leq .10$; $* p \leq .05$; $** p \leq .01$; $*** p \leq .001$ (two-tailed)

Source: National Survey of Midlife Development in the United States, 1995.

Note: Numbers in parentheses are standard errors. Estimates are based on unweighted data.

[a]Variables have been centered on the mean to avoid collinearity problems.

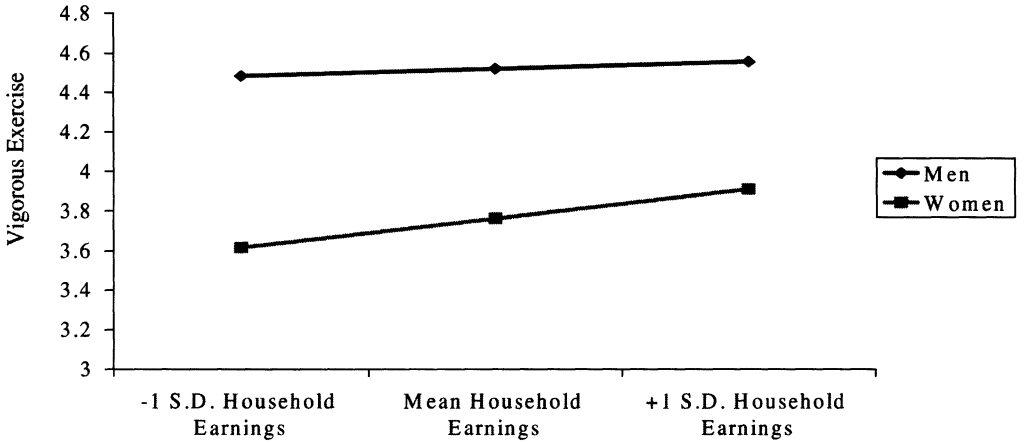
[b]In contrast to married individuals with low emotional support.

[c]Estimates only relevant to employed individuals. Missing indicator flag variables for work-related variables were also included in models 3–5.

indicates that a higher level of household earnings is associated with more vigorous exercise among women but not men.

To interpret the significant three-way gender X age X education interaction effect, we plotted the predicted mean levels of regular exercise by age, education, and gender (see Figure 3). The most salient education differences between men and women in physical activity across adulthood are the direction of the association in early adulthood and the rate of decline with age. In contrast to the frequently reported positive association between more physical activity and higher education, these results indicate that men with the lowest level of education have the highest level of regular, vigorous exercise during young adulthood, while the most educated men exercise least

FIGURE 2. Vigorous Exercise by Household Earnings and Gender



during the younger years. However, the age-related decline in vigorous exercise is steepest among the least educated men and most gradual for the best educated. This leads to age-related trajectories in physical activity among men that converge in midlife (i.e., 50–55) and then proceed to provide an advantage in physical activity during later adulthood to those with the highest education. By contrast, among women, having a high level of education is associated with more vigorous exercise in young adulthood, but this benefit is attenuated in later adulthood. Counter to the cumulative advantage hypothesis, the slope of age-related decline in exercise among women is the least steep for those with the lowest level of education and greatest among those with the highest level of education. The age X earnings, and the gender X age X earnings interaction terms did not contribute to the model in preliminary analyses, so they are not included in Model 2.

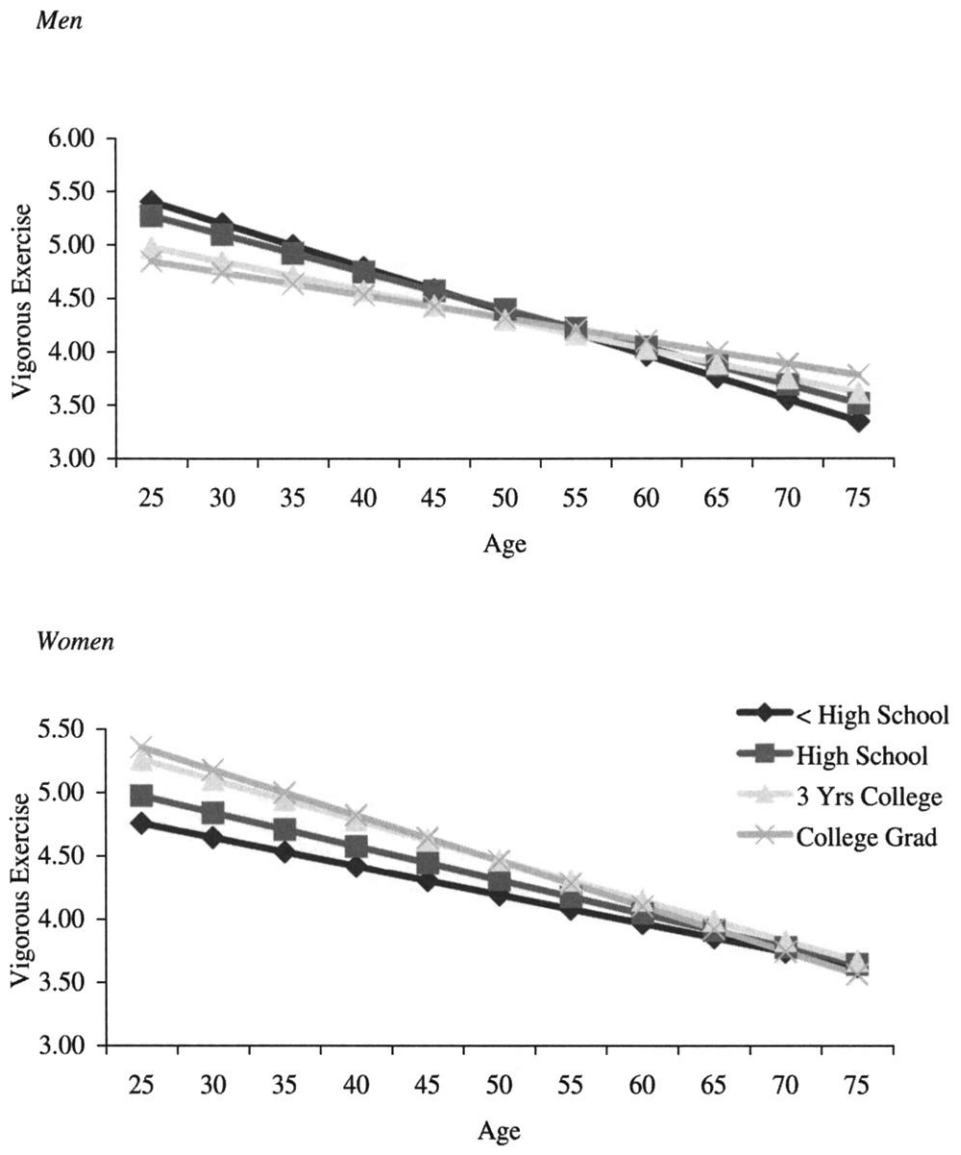
Collectively this evidence provides mixed support for our social status hypotheses. Consistent with the cumulative advantage hypothesis and our hypothesis anticipating that socioeconomic advantage would be most applicable to men, we find that advanced education contributes to a slower decline in physical activity among men than women. However, contrary to the cumulative advantage hypothesis, women with a college education have a steeper decline than women with less education. Additionally, a higher level of household earnings appears to promote regular, vigorous exercise among women only (contrary to our gender hypothesis), and the benefit of higher earnings does not accumulate with age (contrary to our cumulative advantage hypothesis). It is also noteworthy that blacks reported significantly less vigorous physical exercise than non-blacks, even controlling for major dimensions of socioeconomic status.

Contextual Characteristics and Regular Physical Activity

Results reported in Table 2, Model 3 also indicate contextual factors from multiple contexts, and multiple levels are notable correlates of regular physical activity. In contrast to individuals in marriages characterized by a low level of spouse emotional support, single individuals and individuals with a high level of spouse emotional support participate in more vigorous exercise. Also consistent with our family systems-based hypothesis, we find that a higher level of family emotional support was also independently associated with more regular exercise. Paralleling other reports using health behavior scales as outcomes, our results also indicate that a higher level of decision latitude among currently employed respondents was associated with more regular, vigorous exercise. Contrary to our hypothesis, trend evidence indicate that working more hours was associated with more regular exercise. Collectively, these results support the ecological perspective suggesting that factors from multiple contexts of daily life influence behavior and development.

Higher order contextual factors, such as the

FIGURE 3. Education in Vigorous Exercise by Gender and Age



Source: National Survey of Midlife Development in the United States, 1995

quality of fit between work and family and the community environment, are also important correlates of physical activity among adults. Table 2, Model 4 indicates that a lower level of negative spillover from work to family and a higher level of positive spillover from work to family is associated with more regular exercise. Additional analyses (not shown) further indicated that these dimensions of the work-family interface completely explained the association between family and spouse emotional support and physical activity. That is, a higher level of family and spouse emotional support is associated with more positive and less negative spillover from work to family, which in turn is associated with more healthy activity habits. Moreover, once the quality of the work-family fit was controlled in the

model, we find that working more, rather than fewer, hours per week was associated with more regular exercise. Finally, consistent with our hypothesis, analyses indicated that respondents who perceived their neighborhoods as more safe participated in more regular, vigorous exercise than individuals in less safe communities. Moreover, neighborhood safety partly explains the race/ethnicity effect; that is, blacks are less likely than non-blacks to report living in a safe neighborhood, and, in turn, participate in less regular physical activity.

Proximal Resources & Processes and Regular Physical Activity

Building from ecological theory, we expected that important individual resources and processes would be independently associated with physical activity and might also partially account for the associations between social status and contextual experiences and exercise behavior (see Table 2, Model 5). Consistent with a large body of previous research, we find that physiological declines, including increased body mass index, physical activity limitations due to functional impairment, and shortness of breath associated with physical activity are associated with less participation in regular exercise. Similarly, consistent with our hypotheses guided by value-expectancy theories of health behavior, we find that greater environmental mastery (a proxy for self-efficacy), more perceived control over health (trend), and a higher level of exercise efficacy were associated with more regular physical activity.

The persistent race/ethnicity effect evidenced in all previous models is completely explained in the full biopsychosocial model of exercise (i.e., Table 2, Model 5). African Americans reported higher levels of body mass index, more functional limitations related to activity, and greater shortness of breath than whites, and this accounted for the remaining exercise differences between blacks and non-blacks. Likewise, educational differences in physical activity among women were completely explained by these individual-level resources. Women with a better education were in better physical condition, and had a higher level of each of the psychological resources conducive to healthy exercise habits. Finally, a higher level of negative spillover from work to family appears to be indirectly associated with lower physical activity through its association with a lower level of environmental mastery.

DISCUSSION, SUMMARY, AND CONCLUSIONS

The overall goal of this study was to use ecological theory to systematically examine the complex associations between multiple social status characteristics and participation in regular, vigorous exercise. We also wanted to explore the degree to which everyday contextual factors in family, work, and community, as well as more proximal individual resources and processes might help account for and also uniquely contribute to differences in exercise behavior during adulthood.

Results from this study replicate and extend previous research in several important ways. First, with regard to socioeconomic status, our descriptive findings replicate others indicating that higher levels of earnings and education were both independently associated with more exercise among some population subgroups of adults. Consistent with some conceptualizations of social inequality, these results suggest that health practitioners need to recognize multiple dimensions of socioeconomic position when formulating and implementing strategies to eliminate health inequalities. If socioeconomic status is viewed in terms of education alone, interventions targeting income-related determinants of physical activity will remain unrecognized or under-prioritized.

Equally important however are our new results indicating that age and gender condition associations between education and regular exercise. This pattern of results is noteworthy for several reasons. First, since the slope between education and the rate of participation in vigorous exercise is different depending upon age and gender (Krieger et al. 1997), these results raise caution regarding the unexamined inclusion of education merely as a linear covariate in studies of physical activity. These results also suggest that targets for physical activity interventions may need to change depending upon the age, gender, and education of the target population. For example, interventions targeting poorly educated young men may need to focus on maintaining physical activity habits, while interventions targeting poorly educated young women may need to

focus on initiating exercise habits. Finally, these results again remind scholars that survey questions about physical activity may tap different meanings for different groups of individuals. That is, it is possible that the counter-intuitive education-exercise association among young men is capturing occupation-based physical activity that may yield less notable health gains than regular aerobic-forms of exercise, which may have more health benefits.

We also think that the explanatory power of the social status model is worthy of attention. Although our final model only accounted for 25 percent of the variance in vigorous exercise, social status factors provided most of the explanatory power (i.e., 14 percent). Consistent with an ecological perspective, this evidence suggests that models that integrate theory and concepts from across disciplines (e.g., social status and behavioral intention) will generate more comprehensive explanations for behavior and may facilitate more successful interventions to change behavior.

It is also interesting to note that contextual experiences and physiological resources explained education-level differences in exercise among younger women. These results partially support the hypothesis that social status conditions the resources and experiences that facilitate participation in positive health-related behaviors (e.g., Ross and Wu 1995). This everyday interactional perspective of the socioeconomic status and health behavior relation is markedly different from assumptions regarding the absence of important health related benefits of exercise (e.g., the Health Behavior Model) that may accompany higher levels of education. Although the pattern of results for education among men supports the cumulative advantage hypothesis and theory suggesting that the health effects of socioeconomic status are gendered (Marmot et al. 1987; McDonough et al. 1999), none of the contextual experiences or individual-level resources could explain men's educational trajectories across adulthood. Perhaps the persistent education effect among men can be attributed to the confounded nature of physical activity in men's occupations (see Eakin 1997). That is, men who have a low education may find themselves in working-class jobs that become less physically demanding as they spend more time on the job, while men with more education may work their way into jobs that provide the flexibility, opportunity, and the expectation of regular physical activity (e.g., golf outings with clients, on-site fitness facilities, company sponsored gym memberships).

The contextual effects found in this study extend previous health behavior research. First, in contrast to several studies using health behavior indices, this study found that different aspects of work and family were specifically associated with physical activity. Perhaps even more importantly, however, this study demonstrated how overlooked aspects of work and family may influence different health-related behaviors. For example, the work-family literature has been dominated by studies exploring the effects of work-family conflict (Barnett 1998), and this research frequently finds that work-family conflict is associated with behaviors and conditions (e.g., alcohol abuse and depression; Frone, Russell and Cooper 1997) that undermine regular exercise (King et al. 1992). However, the evidence reported in this study indicate that more positive spillover from work to family (a dimension not typically considered) has the most robust association with greater frequency of regular physical activity.

The pattern of findings surrounding race/ethnicity in these models is also an important contribution to the exercise literature. The fact that blacks were consistently found to exercise less than non-blacks, independent of education and earnings, suggests that race is not an adequate proxy for socioeconomic status, and that other factors pertaining to race are contributing to differences in physical activity patterns. Consistent with a recent biopsychosocial model of racism as a stressor (Clark et al. 1999), our results suggest that contextual factors from the social environment such as neighborhood safety may directly and indirectly undermine exercise habits. Inadequate street lighting at a modest level or witnessing violent crime in your neighborhood at an extreme level are direct physical barriers to outdoor regular, vigorous activity, while the threat of victimization (e.g., Ross 1993) and compromised feelings of mastery or control are important psychological barriers. These physical and psychological barriers to physical activity may set into motion reductions in physical activity habits which become further reinforced by corresponding reductions in physiological functioning and ultimately undermine health. Although these linkages are supported theoret-

ically (Clark et al. 1999), we could not evaluate these causal pathways with the current cross-sectional data.

We also feel the persistence of the robust age effect on exercise should not go unnoticed. Overall, in these data about 32 percent of respondents aged 25–35 indicated they participated in vigorous exercise several times a week or more, while 28 percent of those 45–54, and 18 percent of those aged 65–74 did. After adjusting for so many contextual and individual factors, including declines in physiological capacity, we might have expected this effect to diminish more substantially.

In an attempt to further unpack the persistent age effect in these analyses, we ran a series of post-hoc analyses including two- and three-way interactions terms between age, gender, and the contextual correlates. Only one of all the possible interaction terms emerged significant; paralleling other reports (Potts et al. 1992; Rakowski et al. 1987; Zimmerman and Connor 1989), the two-way interaction between age and family emotional support was significant ($p \leq .05$), suggesting that family support was associated with more regular exercise among older adults than younger adults. In all the post-hoc models we examined, the negative association between age and exercise persisted. What other experiences undermine participation in regular exercise as adults traverse the life course?

We acknowledge the limits of these cross-sectional data when interpreting age-effects in our analyses. That is we cannot differentiate true "age" (i.e., developmental) from "cohort" or "period" effects. For example, the oldest group in this sample would have been at the height of midlife when the Surgeon General announced the first Healthy People objectives in 1979. Since original messages about exercise during this period targeted reducing cardiovascular disease (particularly among men), it might be that highly educated young and middle-aged men from these cohorts responded to such social marketing and this is reflected in contemporary age-related physical activity patterns. Not all birth cohorts might be expected to report the same levels of physical activity at young and old ages.

Consideration of these results must also be tempered by additional limitations of the study. For example, the data were all self-reported; consequently, some of the associations in this study may be due to common method variance or endogeneity. Additionally, a more stringent operationalization of ecological theory would require measures from additional levels and sources (e.g., self-report of decision latitude supplemented by a rating of decision latitude for a respondent's occupational category). Moreover, a comprehensive ecological model, informed by other middle range theories, might further include a myriad of other possible interactions.

Nonetheless, our results support the value of employing an ecological perspective when attempting to understand health behavior. We find that, indeed, different aspects of social status were independently associated with exercise, and that the influence of some status factors varied by gender and age. We also find that contextual experiences in family and work life, the quality of the work-family interface, and the community environment were all directly or indirectly associated with exercise habits and added significantly to the explanatory power of our model. In short, our results support a biopsychosocial perspective of physical activity during adulthood, and they suggest that future health behavior research needs to consider determinants from multiple contexts and multiple levels of the human ecology.

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