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Article

Different domains of physical activity: The role of leisure, housework/care work, and paid work in socioeconomic differences in reported physical activity

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ABSTRACT:

Inequality in socioeconomic status (SES)—education, income, and occupation—may further exacerbate the health gap between the “haves” and “have nots” by shaping health behaviors such as physical activity. For example, those in higher socioeconomic positions are consistently found to engage in more physical activity according to public health reports that focus on *leisure* activity. However, previous research investigating the role of SES in shaping engagement in housework, childcare, and paid work suggests different opportunities for physical activity. This discrepancy in how researchers ask questions about physical activity and the pathways people take to healthy activity raises the question: Do socioeconomic differences in physical activity look different when we look at other domains of physical activity beyond leisure? And, does how we measure SES matter? We draw on data from the American Time Use Survey (ATUS) to assess the roles of education, income, and occupation in the amount of time individuals spend in different types of physical activity. Results demonstrate that socioeconomic differences in physical activity change depending on the activity domain and, therefore, when *all* domains of physical activity are accounted for compared to leisure-only. Further, the measurement of SES matters: key indicators of SES (education, income, and occupation) have varying associations with levels and types of physical activity. Findings from this research have important implications for the assessment of physical activity across SES, ultimately impacting survey research and public health.

1. Background

In an effort to address the rising inactivity in America, in 2008 and again in 2018, the Department of Health and Human Services (HHS) issued physical activity guidelines suggesting all able-bodied adults engage in a minimum of 150 to 300 minutes of moderate-intensity physical activity each week (U.S. Dept. HHS 2008, 2018). For decades, key data sources utilized to examine the relationship between physical activity and chronic disease morbidity and mortality all focused on leisure activity (Carlson, Densmore, Fulton, Yore, & Kohl, 2009). Research from these data sources consistently reports that those in higher socioeconomic positions—usually in terms of education or income—are found to engage in more physical activity (CDC 2014). Indeed, according to the Centers for Disease Control and Prevention (CDC), those with more education and whose family income is above the poverty level are more likely to meet federal physical activity guidelines (CDC 2014). Overall, the public health message communicated for decades is

that lower socioeconomic status (SES) individuals are at greater risk for health problems related to lack of physical activity than higher SES individuals—when leisure activity is the only activity domain considered. But what happens when physical activity in other domains is considered?

Time use research recognizes non-leisure as an important area of difference for lower- and higher-SES individuals, particularly time engaged in paid and unpaid work. The research on socioeconomic patterns in housework and dependent care—shown to be an important source of physical activity—suggests certain mechanisms like the ability to outsource housework and childcare tasks among those with more wealth may reduce time in unpaid work. In contrast, other structural forces like flexibility in professions that is stratified by SES increases time spent in unpaid work and therefore more opportunity to engage in physical activity (Greenstein, 2000; Wacjman 2014). Further, socioeconomic occupational segregation suggests different access and opportunity to physical activity while on the job for higher-SES compared

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to lower-SES individuals. Socioeconomic occupational segregation impacts physical activity habits due to differential opportunities for high- and low-SES workers to engage in activity (Church et al., 2011). Indeed, recent research has suggested educational differences in physical activity reports when these different domains (house/care and paid work) are probed in survey questions (Cusatis & Garbarski, 2018). Based on these theory and findings, we hypothesize that considering time in paid and unpaid work in the measurement of physical activity may show SES differences in where individuals access physical activity.

Further, different facets of socioeconomic status – education, income, or occupation – may impact the ways in which activity in different domains leads to more or less physical activity. Research recognizes several aspects of one's socioeconomic standing – standard of living, working condition, resource availability – work in interconnected ways to impact health (Adler et al., 1994; Krieger, Williams, & Moss, 1997). Educational attainment and income are common indicators used to assess the impact SES has on health outcomes and behaviors (Krieger et al., 1997). Yet, occupation has also been considered a key indicator of socioeconomic standing, particularly among sociological research to demonstrate social stratification (Krieger et al., 1997). All three conceptualizations have different mechanisms influencing an individuals' time spent in leisure, paid, or unpaid work.

Current public health research utilizes metabolic equivalents (METs) to create a scalar measure of moderate and vigorous physical activity, or health-benefiting activity. MET is the ratio of working metabolic rate relative to resting metabolic rate (WHO, 2012). A person is said to be engaging in health-benefiting levels of physical activity if they are exerting between 3 and 6 METS (moderate activity) and any activity exhausting more than 6 METS is considered vigorous activity (WHO, 2012). Thus, METs are used to understand and inform questions asking about physical activity to ensure data captured reflects individuals time spent in health-benefiting activity.

The literature review details current theory and empirical evidence on the ways in which differences in education, income, and occupation shape access and opportunity for time in leisure, housework/dependent care, and paid work. We draw on data from the American Time Use Survey (ATUS) to assess how occupational, educational, and income stratification in time use shapes the amount of time higher- and lower-SES individuals spend in physical activity. We also test whether different domains of physical activity result in significantly different size and direction of socioeconomic disparities in physical activity.

2. Literature review

Since the Physical Activity Guidelines Advisory Committee Report in 2008, a decade of research sought to expand knowledge on the relationship between physical activity and health. The 2018 report highlights recent research that greater amounts of regular moderate-to-vigorous physical activity reduces the risk of many of the most common diseases or conditions including: heart disease, stroke, hypertension, type 2 diabetes, dementia, depression, postpartum depression, excessive weight gain, and breast, colon, endometrial, esophageal, kidney, stomach, and lung cancer. Yet less is understood about whether these health benefits look the same if activity is in different domains. Some research suggests the percent of women's active minutes are much greater in domestic physical activity compared to men, but this activity is negatively associated with leanness and may not have the same associations with health benefiting physical activity (Murphy et al., 2013). Importantly, time spent in physically demanding activity at work has been significantly associated with negative health outcomes among men who disengage in leisure physical activity, suggesting consistent moderate activity at work may not promote health (Hotlermann et al., 2012) or has no demonstrated significant relationship with health outcomes like glucoregulation (Tsenkova, Lee, and Boylan, 2017). Physical activity in unpaid and paid work still remains largely understudied.

Overall, a major barrier to leisure time physical activity among low-socioeconomic individuals are access and resource availability (Becker, 1965; Crespo, Ainsworth, Keteyian, Heath, & Smit, 1999; Gronau, 1976; McNeill, Kreuter, & Subramanian, 2006). Access is decreased because those in lower socioeconomic positions are often pulled into obligatory time in other domains like paid and unpaid work (i.e., required to work multiple jobs, care for families), leaving them with less time for leisure (Becker, 1965). Moreover, leisure time physical activity, especially vigorous activity, requires resources (i.e., gym membership, athletic equipment, team fees) that create more of a challenge and barrier for low-income individuals compared to their wealthier counterparts (Beenackers et al., 2012). In fact, individuals with low-SES were nearly one-half as likely to be members of a sporting, recreation, or outdoor club (Giles-Corti & Donovan, 2002).

Furthermore, because of constrained time and access to resources, some individuals have fewer opportunities to engage in leisure-based exercise compared to others. Research indicates that individuals with lower income and education are the least likely to exercise compared to more affluent counterparts and educational attainment is the key sociodemographic characteristic predicting moderate activity in leisure time (McInnes & Shinogle, 2011).

2.1. SES and leisure

The balance between the three identified domains of physical activity (leisure, housework and caregiving, paid work), as theorists assert, is largely impacted by socioeconomic fluctuations, marital status, and parental status (Gronau, 1976). According to the economic theory of time allocation, socioeconomic positioning is positively related to time spent in leisure, supporting an argument that socioeconomic inequality in leisure time favors higher-SES individuals (Becker, 1965). Socioeconomic status is also an important theoretical and empirical element shaping leisure time experiences, as people in higher socioeconomic positions are more likely to engage in moderately active leisure time activities compared to those in lower socioeconomic positions (Beenackers et al., 2012). This disparity becomes even more prominent when talking about vigorous physical activity, namely sports and rigorous exercise (Beenackers et al., 2012).

When assessing health disparities, family or personal income and educational attainment are common indicators used to assess the impact SES has on health outcomes and behaviors (Krieger et al., 1997). Regarding educational attainment, researchers postulate knowledge of how and where to access leisure-based physical activity due to more recent privatization of locations such as local park and recreational facilities, leads to an educational divide in utilization, resulting in physical activity disparities (Robinson & Godbey, 2010). Indeed, results demonstrate use of local recreation facilities and parks increases with education (and income) (Robinson & Godbey, 2010). Furthermore, safety issues as well as a general absence of facilities in low-SES neighborhood environments have been raised and demonstrated in qualitative research as key reasons for a lack of use of public facilities among low-socioeconomic populations (Gordon-Larsen, Nelson, & Popkin 2006). Additional research confirms disparities in use of public facilities for leisure physical activity across high and low SES, with higher-socioeconomic individuals accessing facilities for leisure physical activity significantly more (Giles-Corti & Donovan, 2002).

Early theorists recognized that income produces physical activity disparities in leisure activity because increased income results in alleviation of time from other domains, namely housework, as well as increased resource potential to dedicate to leisure (Becker, 1965; Gronau, 1976). Results from current health surveillance systems empirically confirm this association, demonstrating that as family incomes increase, the likelihood of meeting physical activity requirements significantly increases as well (CDC 2014).

National trends demonstrate lower-SES individuals engage in less leisure time physical activity compared to their higher-SES counterparts

when SES is measured as education and income (Crespo et al., 1999; Ford et al., 1991; He & Baker, 2005). Additional research on tastes point to different activity preferences during leisure time, stratified by education and income. Empirical evidence consistently illustrates individuals with lower income and educational attainment are less likely to exercise and instead spend more time in sedentary activities during their leisure time such as television watching (Ford et al., 1991; McNeill et al., 2006). In contrast, occupation, a third indicator of SES, is associated with time use such that those in lower socioeconomic situations – those who are unemployed – have more “forced” free time (Schor 2008) and, therefore, more opportunity for healthy leisure-time activity (Robinson & Godbey, 2010).

Based on findings from the current literature, we hypothesize:

(H1a.). Respondents with more education will engage in significantly more minutes of physical activity compared to respondents with less education when moderate physical activity is operationalized as *Leisure Activities*.

(H1b.). Respondents with higher family incomes will engage in significantly more minutes of physical activity compared to those with lower family incomes when moderate physical activity is operationalized as *Leisure Activities*.

(H1c.). Respondents who are unemployed will engage in significantly more minutes of physical activity compared to any other profession when moderate physical activity is operationalized as *Leisure Activities*.

2.2. SES and housework or dependent care

Theoretical foundations for socioeconomic inequalities in time spent on household activities and dependent care focus on resource availability, time constraint, and technological advancements as key structural mechanisms impacting educational, income, and occupational differences in household labor. Technological advancements in household goods or purchased services is believed to alleviate time spent in housework among individuals who are able to afford these resources (John & Shelton, 1997). In other words, resource availability perspectives assert that those with higher income and, thus, more liquid assets to outsource tasks of housework and childcare (i.e., hiring cleaning services and child care services) or purchase technological solutions (i.e., dishwashers, robotic vacuums) will not have to spend as much time compared to those individuals who are more limited in their ability to outsource domestic work (John & Shelton, 1997).

Physical activity in housework and dependent care is mixed when considering SES differences. Some literature suggests there are no socioeconomic divisions, whether measured by income or education, in the amount of household activity performed because of the technological advancements in cleaning and house care (Greenstein, 2000; Gregson & Lowe, 1993). However, some researchers found that financial limitations among lower-socioeconomic individuals leads to increased likelihood for engaging in health benefiting housework and care activities such as multi-tasking with child care, housework, and physical exertion for transportation (Ford et al., 1991; McNeill et al., 2006). Further, research on work and family interference, which directly impacts the amount of housework and child care one is able to provide, also produced mixed results. Higher SES individuals often have more favorable working conditions with more resources (e.g. flexibility and control over the work situation) in addition to better pay than employees with lower SES. These resources have been suggested to facilitate the possibility to combine work and family for employees with higher SES (Falkenberg, Lindfors, Chandola, & Head, 2016; Schieman, Whitestone, & Van Gundy, 2006). Yet, higher socioeconomic occupations also have more responsibility at work, higher demands, and a higher level of involvement compared to lower socioeconomic occupations (Schieman et al., 2006). Schieman et al. (2006) found that higher SES individuals reported higher levels of conflict between work

and family than lower SES individuals, suggesting the advantages in resources for higher SES individuals failed to counterbalance demands, ultimately impeding on time for housework and care. With inconclusive results in the literature, further understanding of the relationship between SES and physically active housework and child/adult care is necessary.

The literature on the relationship between SES – as defined by education, income, and occupation – and the opportunity for physical activity in housework and dependent care suggests the following hypotheses:

(H2a.). The current literature does not suggest a priori hypotheses for the relationship between physical activity in *Housework/Dependent Care* and education.

(H2b.). Respondents with lower family incomes will engage in significantly more minutes of physical activity compared to those with higher family incomes in the *Housework/Dependent Care* activity domain.

(H2c.). Since the current literature is mixed on the relationship between occupation and physical activity in *Housework/Dependent Care*, we have no a priori hypothesis with respect to being employed compared to unemployed.

2.3. SES and paid work

Sociological theory cites different mechanisms to explain the interrelatedness of features of socioeconomic status (often indicated by level of education and income) and occupation. Whether the mechanisms cited are socioeconomic power and status and reflected through high income and greater education (Grusky & Szelenyi 2011) or exploitation and domination recognizing an occupational hierarchy: owners, managers, experts, and workers that translate into social locations directly rooted in socioeconomic status (Grusky & Szelenyi 2011; Wright, 1995) or distinguished culture and taste as key bridges in the relationship between SES and paid work (Bourdieu, 1984), the recognition of socioeconomic-based segregation within occupational systems is woven through each theoretical perspective.

Socioeconomic occupational segregation impacts physical activity habits because of the different opportunities for high- and low-SES workers to engage in physical activity while on the job (Church et al., 2011). Lower-SES occupations have a greater opportunity for moderate physical activity. As previous theorists suggest, positions with more power, and therefore more social and monetary compensation, are managerial and non-manual labor occupations that often require greater levels of education. As a result, the hierarchy of occupations places non-manual labor skilled jobs higher in social and monetary capital compensation compared to professions associated with more manual labor skill (Krieger et al., 1997; Wright, 1995). Ultimately, theorists predict, and empirical evidence supports, that less educated individuals with lower salaries are more likely to work in occupations that require higher intensity physical activity. The occupations that still require more physical activity (manufacturing jobs, or craftsman positions such as plumbing, for example) are the “blue collar” occupations more closely associated with lower SES. Systematic reviews of the research confirm the higher prevalence of physical activity among low-SES individuals in their occupation (Beenacker et al., 2012).

Overall, our review of the literature on the intersection of socioeconomic impacts on time use in paid work and disparities in physical activity lead us to the following expectations:

(H3a.). Respondents with less education will engage in significantly more minutes of physical activity compared to those with more education in the *Paid Work* activity domain.

(H3b.). Respondents with lower household incomes will engage in significantly more minutes of physical activity compared to those with

Table 1
Hypotheses by physical activity domain and indicator of socioeconomic status.

	Leisure	House/Care Work	Paid Work
Education	H1a. Positive (+)	H2a. No a priori	H3a. Inverse (–)
Household Income	H1b. Positive (+)	H2b. Inverse (–)	H3b. Inverse (–)
Occupation	H1c. Unemployed (+) (vs. all others)	H2c. No a priori	H3c. Manufacturing, Maintenance, (+) Agriculture (vs. Professional)

higher family incomes in the *Paid Work* activity domain.

(H3c.) Respondents with lower-SES (Manufacturing, Maintenance, & Agriculture) occupations will engage in significantly more minutes of physical activity compared to those with higher-SES occupations in the *Paid Work* activity domain.

Table 1 summarizes the hypotheses drawn from the literature.

3. Methods

3.1. Data

Investigating SES differences in physical activity requires data on daily activities by SES and corresponding metabolic equivalents (MET). Both are available using the American Time Use Survey (ATUS) (Hofferth, Flood, & Sobek, 2018). The ATUS (2006–2008, 2010, 2012–2014; N = 86,954) is a time diary study where respondents are asked about everything they did 24 hours before the interview (BLS 2012). Stemming from the Current Population Survey (CPS), the ATUS makes use of a stratified three-stage sample design and surveys were administered via computer assisted telephone interview (CATI; BLS 2012). The sampling frame of the ATUS represents all civilian, non-institutionalized individuals residing in occupied households in the United States that are at least 15 years of age. For representativeness, a cumulative final weight is used in the analyses to account for the complex sample design employed by the ATUS (WBWT & EHWT weight).

For item nonresponse, the ATUS employs a three imputation processes, therefore 11 of our 13 variables do not have any item-missing data. We address the missing data of the remaining two variables - household income (6.6% non-response N = 5,678) and health status (4.1% non-response N = 3,573) with some individuals missing both (N = 115) - by using multiple imputation with five iterations. Sensitivity analyses (not shown) comparing listwise deletion and multiple imputation methods indicated concern for Type II error under listwise deletion, therefore, multiple imputation was employed (Enders, 2010). After removing respondents under the age of 18, the analytic sample for this study is (N = 86,954).

Dependent Variables. In order to speak to how or whether SES disparities change when different domains of activity are added to what “counts” as physical activity, we develop a series of four dependent variables that account for time spent in moderate (or more) physical activity from different domains. In 2008, Tudor-Locke and colleagues assigned a MET score to each of the 438 activities recorded in the ATUS by combining information from the ATUS and the Compendium of Physical Activity. Tudor-Locke and colleagues (2009) systematically used the compendium to assign MET values to the example activities as presented in the ATUS lexicon.

The *Leisure Activity* variable mirrors current understandings of physical activity and assesses time in leisure-only activities that require at least three MET exertion. This definition and what count as leisure is informed by social studies of leisure (Pronovost, 1988).

The second domain, *House/Care Work*, captures time in moderately active housework, childcare, and adult care. These housework activities include interior cleaning, exterior cleaning, and interior arrangement. Moderately active child care is represented by four activities including playing with household and non-household children.

Paid Work includes time in occupational work for respondents whose occupation is considered moderately active. Of the 22 occupations identified in the ATUS, only four occupation types contain work that Tudor-Locke, Washington, Ainsworth, and Troiano (2009) have associated with opportunities for moderate physical activity. Scholars have hesitated to include paid work in healthy activity reports because we do not know enough about how physically active work is distributed across the workday (Spinney, Millward, & Scott, 2011). To address these distributional questions, we ran sensitivity analyses¹ to determine how different assumptions about the physically active worktime shapes estimates. Ultimately, we operationalized “Paid Work” as 50% of worktime: for individuals in occupations providing opportunities for physical activity (i.e. manufacturing, maintenance, forestry), we assume that half of their reported work time at work is moderately active (at least 3 METs).

Finally, *Full Activity* captures time in any of the activity domains established by the World Health Organization (occupational, active transportation, leisure activity, or chores/unpaid work) that requires at least three METs to perform (WHO 2012).

Socioeconomic Status. The operationalizations for each indicator of SES are rooted in previous research. Education is dichotomized as having a college education or more compared to less than college degree to facilitate comparisons to previous studies. Possessing a college degree or more is used as a key indicator of a qualification linked to knowledge acquisition and lifestyle circumstances in high-versus low-socioeconomic standing (Duncan, Daly, McDonough, & Williams, 2002). Recognizing the highest quintile of household income has been used in previous research to identify those benefiting from the growing inequality in the U.S. (Krieger et al., 1997). The ATUS does not have an income category identifying the highest quintile, but those in the \$100,000 or more categories represent about the top 15% of the sample and will be used to distinguish the socioeconomic status providing greatest access to health benefiting resources and opportunity. Finally, occupation is operationalized as four categories to juxtapose the occupations that require moderate activity with the occupations theorized to be “high SES,” (professional, managerial), and also recognize those not employed have more time availability for certain activity domains, namely leisure (0 = Unemployed; 1 = Professional, Managerial, & Sales; 3 = Manufacturing, Maintenance, & Agriculture; 4 = Other) (Grusky & Szelenyi 2011; Wright, 1995). To coincide with hypotheses, unemployed is the reference category for models predicting activity in leisure, housework, and full activities whereas professional/managerial is the reference category for the model predicting activity in paid work.

Control Variables. Gender is known to shape time spent in different domains of physical activity (Bianchi, Sayer, Milkie, & Robinson, 2012). Previous literature recognizes opportunities for healthy activity are often exacerbated by the transition to parenthood and is, therefore, important to account for as covariates to physical activity (Bianchi et al., 2012). Parenthood, presence of a young child, household size, and marital status serve as those covariates. Parental status variable is a dichotomous variable (1 = parent, 0 = not a parent). Presence of a young child (under six years old) is also dichotomous (1 = child under 6 present; 0 = not present). Household size is a continuous variable ranging from 1 to 15. Marital status is a dichotomous variable (1 = married; 0 = not married). Previous studies recognize married

¹ Sensitivity analyses are available upon request.

individuals tend to engage in more physical activity (CDC 2014; Seo & Torabi, 2007).

Measures of demographic controls previously established to predict activity habits are also included as covariates. According to Seo and Torabi (2007), gender, age, and race/ethnicity, and health status are all related to physical activity among U.S. adults. Age is a top-coded continuous variable ranging from 18 to “85 and above.” Life course literature recognizes the potential for a parabolic relationship between age and moderately physical activity, therefore, a squared term for age is included in analyses (Umberson, Williams, Powers, Liu, & Needham, 2006). Race/ethnicity is represented by a four-category variable (White, Black, Hispanic or Latino, Other). Self-rated health serves as a proxy to represent the psychological and cognitive health factors found in the literature to be associated with physical activity habits (Bauman et al., 2012; US HHS 2008). General health is modeled as a continuous variable, with higher values representing better health (1 = poor, 2 = fair, 3 = good, 4 = good, 5 = excellent). Finally, year of and day of the week of surveys are accounted for to ensure data collection or period effects do not confound results.

Analytic Technique. We estimate a series of ordinary least squares (OLS) regressions to examine relationships among predictors and the number of minutes spent in each domain of physical activity. Many recent studies on time use have successfully made use of OLS regression for time use data (Craig & Brown, 2017) as opposed to potentially biased tobit models; therefore, we employ OLS (Stewart, 2009). We examine significant differences in SES disparities across four models of different types of physical activity: leisure (Model a), house/care work (Model b), paid work (Model c), full activity (Model d). Importantly, we assess the impacts of SES measures net of other measures of SES, which are included as controls. Supplemental analyses were run to assess each SES indicator separately, by not including the other SES indicators in the models (see Supplemental Table 1). Finally, we estimate seemingly unrelated regressions (models available upon request), with post-hoc Wald tests for significant differences in coefficients; e.g., the effect of education on leisure time physical activity (Model a) is significantly different from the effect of education on full physical activity (Model d). Appropriate reference groups for occupation were used when comparing Models a through c to the full activity Model d.

4. results

Table 2 documents the weighted descriptive statistics for average time spent in each of the three domains of physical activity and the combination of all domains as well as demographic characteristics of the sample. Average number of minutes spent in each domain of physical activity begins to demonstrate how what “counts” as physical activity impacts the amount of time reported in healthy activity. For number of minutes reported, on average, *House/Care Work* is about 20 min more than *Leisure* and *Paid Work* demonstrates the least reported minutes (about 14 min). Including all physical activity domains in *Full Activity* yields the highest average minutes reported (about 84 min).

Table 3 presents results from OLS regressions of each of the following dependent variables: 1) *Leisure*, 2) *House/care work*, 3) *Paid work*, and 4) *Full Activity*, while simultaneously controlling for different facets of SES—education, income, and occupation—as well as other characteristics known to influence physical activity. The results demonstrate the impact of each SES measure net of other operationalizations of SES because they are included in the model as controls.

The first column in Table 3 (Model a) documents coefficients for the regression of the number of minutes reported in *Leisure* moderate physical activity on socioeconomic status and relevant covariates. Results are not consistent with Hypothesis 1a, as we find no difference between higher and lower educated individuals in leisure-based physical activity. Those with larger household incomes report significantly more minutes of leisure activity, consistent with Hypothesis 1b.

Table 2
Weighted Descriptive Statistics for the Dependent and Independent Variables in the Pooled American Time Use Surveys 2006, 2008, 2010, 2012, 2013, 2014 for Full Sample and by Gender *weighted percentages or means and standard errors in parentheses.*

	Full Sample (%/Mean)
Dependent Variables	
<i>Leisure Activity</i>	29.9 (.336)
<i>House/Care Work</i>	53.5 (.444)
<i>Paid Work</i>	13.8 (.302)
<i>Full Activity</i>	83.9 (.561)
Key Independent Variables	
<i>Gender</i>	
Female	51.6%
Male	48.4%
<i>Socioeconomic Status</i>	
<i>Educational Attainment</i>	
Less than H.S.	17.6%
H.S. Degree	29.4%
Some College	25.2%
College Degree	17.8%
College +	9.9%
<i>Household Income (in 1000's)</i>	66.3 (.256)
<i>Occupation</i>	
Unemployed	37.2%
Professional/Managerial	21.4%
Admin & Services	19.2%
Maintenance & Agriculture	16.0%
Other	6.2%
Control Variables	
<i>Age</i>	44.7 (.089)
<i>Race</i>	
White	68.3%
Hispanic	14.5%
Black	11.6%
Other (nonHisp.)	5.6%
<i>Marital Status</i>	
Married	57.0%
Not Married	43.0%
<i>Parental Status</i>	
Parent	40.6%
Not a Parent	59.4%
<i>Child Under Six</i>	
Child under 6 yr	13.6%
No Child < 6 yr	86.4%
<i>Household Size</i>	3.01 (.008)
<i>General Health</i>	3.51 (.005)
<i>Year</i>	
2006	13.7%
2007	13.9%
2008	14.0%
2010	14.2%
2012	14.6%
2013	14.7%
2014	14.8%
<i>Day of Week</i>	
Weekday	71.5%
Weekend	28.5%

Data: 2006, 2007, 2008, 2010, 2011, 2012, 2013, 2014 Pooled Sample; American Time Use Survey (ATUS), N = 86,954.

*p < .05; ** < 0.01; *** < 0.001.

Consistent with Hypothesis 1c, all professions report significantly fewer minutes in healthy leisure activity compared to their unemployed counterparts. Disparities range from 13 min for Maintenance/Agriculture occupations and 17 fewer minutes for Professional/Managerial occupations compared to unemployed.

Our second model (Model b) focuses on physical activity in house/care work activity domain. Although the literature did not suggest a priori hypotheses about the relationship between education and physical activity deriving from house/care work (Hypothesis 2a), we find that those with a college degree report about 4.1 fewer minutes in physical activity compared to their more educated counterparts. Those with higher household income report significantly fewer minutes of

Table 3

Unstandardized OLS Regression Coefficients and Standard Errors for each of Four Dependent Variables (Leisure, Housework/Dependent Care, Paid Work, Full Activity) Tracking Minutes in Moderate Physical Activity.

	Leisure Only (a)	House/Care Work (b)	Paid Work (c)	Full Activity (d)	Diff a v. b ^a	Diff a v. c	Diff a v. d ^a	Diff b v. d ^a	Diff c v. d ^b
<i>Education</i>									
College Degree	1.13 (.805)	-4.10* (1.06)	-1.53*** (.429)	-4.16** (1.23)	***	***	***		
<i>Income</i>									
\$100K +	2.43** (.931)	-5.37*** (1.15)	2.28** (.746)	.829 (1.48)	***	**	***		
<i>Occupation</i>									
Unemployed	-	-	2.61*** (.294)	-		nc ^c			***
Professional/Managerial	-17.7*** (1.08)	-35.2*** (1.39)	-	-47.2*** (1.59)	***	nc ^c	***	***	
Maintenance & Agriculture	-13.2*** (1.36)	-25.3*** (1.72)	80.9*** (1.62)	44.0*** (2.34)	***	nc ^c	***	***	***
Other	-15.0*** (.964)	-31.2*** (1.33)	1.53*** (.193)	-40.0*** (1.50)	***	nc ^c	***	***	
<i>Gender</i>									
Female	-19.6*** (.732)	6.27*** (.928)	-4.18*** (.375)	-9.58*** (1.11)					
<i>Age</i>									
Age	-.221 (.117)	2.82*** (.146)	.232** (.073)	2.24*** (.178)					
Age-squared	.003* (.001)	-.026*** (.002)	-.003*** (.001)	-.022*** (.002)					
	Leisure (a)	House/Care Work (b)	Paid Work (c)	Full Activity (d)					
<i>Race (white)</i>									
Hispanic	-6.71*** (.953)	-4.94*** (1.32)	2.77** (.935)	-5.14** (1.66)					
Black	-13.5*** (.910)	-24.0*** (1.15)	-3.52*** (.700)	-32.9*** (1.49)					
Other	-5.50** (1.65)	-10.4*** (2.02)	-6.19 (1.15)	-12.3*** (2.57)					
Married	3.93*** (.798)	11.3*** (1.11)	.611 (.647)	11.1*** (1.34)					
Parent	2.08 (1.06)	1.69 (1.65)	1.27 (.923)	6.28** (1.89)					
Child Under Six	-10.3*** (.922)	32.7*** (1.46)	2.83*** (.874)	27.7*** (1.74)					
Household Size	-6.05 (.320)	.013 (.587)	-.863** (.254)	-1.32* (.623)					
General Health	5.28*** (.340)	4.09*** (.460)	.327 (.254)	8.23*** (.554)					

Also controlled for Year and Day of the Week of Interview.

Data: 2006, 2007, 2008, 2010, 2011, 2012, 2013, 2014 Pooled Sample; American Time Use Survey (ATUS), N = 86,954.

*p < .05; ** < 0.01; *** < 0.001.

^a The Seemingly Unrelated Regression used 'unemployed' as the reference category for occupation in order to compare across models.

^b The Seemingly Unrelated Regression used 'professional/managerial' as the reference category for occupation in order to compare across models.

^c We do not compare the coefficients for occupation for Models a and c since the hypotheses associated with each model specify different reference groups.

physical activity in house/care work, consistent with Hypothesis 2b. Although the current literature suggested conflicting findings for the association between occupational status and physical activity in house/care work (Hypothesis 2c)—that is, sometimes the association is positive, sometimes it is negative—we find that unemployed individuals report significantly more minutes in house/care work compared to any other occupation (as each of the other occupations report fewer minutes of physical activity in house/care work compared to those who are unemployed). The largest disparity is between Professional/Managerial (35 min fewer) compared to unemployed.

Model c focuses on moderate activity in the paid work activity domain (Paid Work). Recall that we assume half of all reported work time for those in occupations already documented as physically active consists of moderate physical activity. Those with a college degree or more report significantly fewer minutes per week in moderate activity at work (1.5 min) compared to those earning less than a college degree, consistent with Hypothesis 3a. However, those with higher annual income report significantly more minutes in paid work compared to those with lower income, in contrast to what was expected based on prior theory and research (Hypothesis 3b).²ⁿ Respondents in Maintenance/Agriculture report 81 more minutes in paid work compared to Professional/Managerial occupations, consistent with Hypothesis 3c that respondents in professions offering opportunity for moderate activity will report more time in moderate physical activity.

Our fourth model (Model d) adds moderately active time across all domains (Full Activity). This model considers all types of moderate physical activity simultaneously—given conflicting directional hypotheses (or lack of hypotheses) in the relationship between SES and physical activity depending on the indicator of SES and domain of

physical activity considered, Model d begins to investigate which indicators of physical activity and SES matter more in both producing and mitigating socioeconomic disparities in physical activity. In Model d, those with a college degree report significantly fewer minutes of physical activity compared to those with a college education or more; this is consistent with Hypothesis 3a and the findings for house/care and paid work (Models b and c). Household income is not significantly related to minutes of reported physical activity in Model d, which contrasts all the hypothesized associations between household income and types of physical activity (Hypotheses 1b, 2b, and 3b) as well as the findings in Models a, b, and c; it is plausible that in the full activity model, the negative association between household income and physical activity in house/care work is canceled out by the positive associations between household income and leisure and paid work physical activity. The results for Model d are consistent with Models a and b with respect to professional/managerial occupations and other occupations, as these workers report significantly fewer minutes of physical activity compared to unemployed counterparts; those in Maintenance/Agriculture professions report 44 more minutes of activity compared to the unemployed, in contrast to the findings with Models a and b. This is partially consistent with Hypothesis H1c, given this switch in the direction of the association between physical activity reported for those in Maintenance/Agriculture compared to unemployed in the Full Activity model (Model d.1). Comparing Model d.2 (using the same reference group for occupation as Model c) to Model c shows that those who work in professional/managerial occupations have the fewest minutes of physical activity compared to their unemployed, Maintenance/Agriculture, and other occupation counterparts, consistent with the results of Model c and Hypothesis H3c.

The final columns in Table 3 display results from post-hoc Wald's test of seemingly unrelated regressions to examine significant differences for each of the three measures of SES across definitions of what "counts" as physical activity. We find significant differences in the

² When education and occupation are removed from the model the relationship reverses, with lower incomes reporting significantly more (not shown).

effects of education, income, and occupation across the different domains of physical activity. First, comparing the effect of SES measures in the leisure model to the house/care work model, all three measures – education, income, and occupation – have a significantly different impact on leisure compared to house/care work (Model a v. b). The negative effect of having a college degree (vs. less than a college degree) on physical activity in house/care work is significantly different from its null effect in the leisure alone model. The positive effect of higher household income (v. lower household income) on leisure activity is significantly different than the negative effect on house/care work, while the negative effects of each type of occupation (compared to being unemployed) are significantly stronger for house/care work physical activity than leisure activity.

Second, comparing the effect of three SES measures in leisure only model and the paid work model (Model a v. c), again all three measures of SES have a significantly different impact on leisure than on paid work. The negative effect of having a college degree (vs. less than a college degree) on physical activity in paid work is significantly different from its null effect in the leisure alone model, while the positive effect of having a household income over \$100,000 (vs. less than \$100,000) is stronger and significantly different than its positive impact on paid work physical activity. (We do not compare occupation coefficients here because of the different reference groups of interest that are compatible with the outlined hypotheses.)

We then assess whether there are significant differences on the impact of three SES measures in reporting each type of physical activity compared to the full model. Starting with leisure only compared to full activity (Model a v. d), the negative effect of having a college degree (vs. less than a college degree) on physical activity in the full model is significantly different from its null effect in the leisure alone model. The negative effects of being professional/managerial and other (vs. unemployed) are stronger in the full activity model than their negative effects in the leisure model alone, while the positive effect of maintenance and agriculture in the full model is significantly different from its negative effect in the leisure alone model. The effects for occupation are the same when comparing house/care work to full activity (b vs. d) as in the a vs. d comparison. In addition, the negative effect of income on physical activity in house/care work is significantly stronger than in its null effect in the full activity model. Finally, the positive effects of being unemployed or working in maintenance/agriculture versus being professional/managerial are stronger in the full activity compared to paid work models (Model c vs. d).

5. Discussion

Inequality in education, income, and occupation is known to exacerbate the gap between the health “haves” and “have nots” by shaping health behaviors such as physical activity (Adler & Newman, 2002). This study sought to demonstrate how socioeconomic characteristics are associated with different levels of physical activity across different activity domains (leisure, unpaid housework and care, paid work). Through regressions predicting three different domains of physical activity and one composite of all domains of activity, this study demonstrates that three key indicators of socioeconomic status (SES) (education, income, occupation) yield different results in whether higher or lower SES individuals are engaging in more physical activity, net of the other measures of SES. Through post hoc tests of seemingly unrelated regressions, this study indicates whether the relationships between different indicators of SES and different conceptualizations of physical activity are significantly different from one another.

Widening the scope of how moderate physical activity is achieved draws attention to the unique pathways individuals take to at least 3 metabolic equivalents (METs), or the amount of energy required to expend in order to be health benefiting. Results suggest individuals in different socioeconomic positions access physical activity through different socially patterned opportunities.

For *income*, previous research cites financial freedoms and purchasing power as the key mechanisms that provide higher-SES individuals resources necessary to aide health behaviors like physical activity (Adler & Newman, 2002). Of all domains, leisure activities likely require the most financial investment (e.g. gym memberships, recreational equipment, team fees) and results for household income support this. Our results show those with greater purchasing power (higher income) report significantly more physical activity in leisure and paid work, while those with lower incomes report significantly more physical activity in house/care work. These results support hypotheses based on previous research suggesting higher-SES positioned individuals have greater access and opportunity for leisure time. Yet in contrast to expectations, we find that those with higher income report more hours per week in physical activity when paid work is the physical activity measure (Hypothesis 3b). Interestingly, our supplemental model (not shown) predicting paid work without controlling for education or occupation adheres to the hypothesis (Hypothesis 3b) that higher-income individuals are reporting significantly fewer minutes of paid work activity. This may suggest some multicollinearity occurring when all three indicators of SES are included, such that the effect of income on physical activity, once education and occupation are controlled, is markedly different compared to when they are not controlled. Further, the differences should be placed in context of an entire day of work. Though statically significant, the substantive difference of 2.3 min may not be as meaningful. Still, this may be an example of discontinuity in indicators of SES status between occupation and income; though maintenance and manufacturing occupations are socially low in the occupational hierarchy, often these occupations pay higher wage than other professions, resulting in higher household income. Therefore, these individuals are at a higher status according to their income than where their occupation places them. Therefore, the relationship between household income and reports of leisure and paid work operate in the reverse of how literature and previous research suggest. In this case, household income is not a straightforward indicator of higher versus lower socioeconomic position.

The impacts of *education* on health are known to derive from knowledge and life skills that allow better-educated persons to gain access and information on physical activity-promoting resources (Adler & Newman, 2002). Results from the paid work domain support this assertion: more educated individuals are not accessing physical activity in paid work because their degree qualifications and skills place them in occupations that do not require labor-intensive work, confirming Hypothesis 3a. Importantly, the difference, though statistically significant, is only 1.5 minutes and may not be substantively significant when in the context of a full day of paid work. Similarly, more educated people are found to report significantly fewer minutes in the housework and dependent care domain, contrary to Hypothesis 2a where we did not have a priori expectations due to mixed results in previous studies. Our results may provide evidence that those with more education have the skills and knowledge for outsourcing housework and childcare or for creating efficiencies in these activity domains that result in less moderate physical activity spent. The results for leisure activity and education were null (in contrast to the expected positive relationship). These results may reflect the declining trends in leisure, regardless of education (Schor 2008). Future research would benefit from unpacking the relationship between education and leisure physical activity.

Third, for *occupation*, research suggests lower-status jobs expose workers to both physical and psychosocial risks that influence health behaviors like physical activity (Adler & Newman, 2002). In other words, the labor-intensive professions that require more physical activity while on the job leads individuals to retreat from healthy activity in other domains. Further, research on time availability suggests those who are unemployed have more time for leisure-time activity (Hypothesis 1c). Our results confirm the time use assertion, all other occupations engaged in significantly fewer minutes of leisure-only physical activity. Despite no a priori hypothesis for the relationship

between occupation and house/care work, results demonstrate unemployed individuals are those reporting significantly more house/care work physical activity compared to all other occupations. This suggests the time use theory for leisure activity may extend to house/care work; those who are not in the labor force have more time available for activity in non-paid work domains or are out of the labor force due to these unpaid care work demands. For paid work, results demonstrate that those who are in manufacturing/agriculture, unemployed, and other occupations are accessing physical activity significantly more than those in managerial/professional occupations (and orders of magnitude more for those in maintenance/agriculture), which supports **Hypothesis 3b** and is completely unrepresented in leisure-only conceptualizations of physical activity. This study supports previous literature suggesting those in manual labor jobs are accessing physical activity in paid work compared to any other profession and the unemployed.

Results for full activity and associated post hoc results between leisure and full activity speak to the nuanced physical activity guidelines (2018) placing more emphasis on *any* moderate-intensity activity. When *any* moderate-intensity activity is the focus, those with more education report less activity, income differences are no longer significant, and those in professional/managerial occupations report the least amount of physical activity compared to all others; those in maintenance and agriculture report more compared to those who are unemployed. Each of these relationships between measures of SES and physical activity is *different* than when leisure-only activity is assessed. And we can see the pathways through which this occurs by examining these relationships when the type of physical activity measured as the outcomes is part of what comprises that full activity: house/care work and paid work.

This project demonstrates the impacts of SES on physical activity function differently depending on how SES is measured – education, income, occupation. Scholars investigating social intersections with health have argued that SES is a complex construct and that different aspects may both support and detract from physical health (Braveman et al., 2005). For instance, while greater levels of education may provide knowledge that enhances understanding about the importance of physical activity for overall health, it may also tie individuals to longer hours at professional jobs that tend to be more sedentary. Evidence from this analysis demonstrates that key indicators of SES do not all have uniform influences on physical activity levels, thus, “one size does not fit all” when it comes to thinking about SES and health (p.2879 Braveman et al., 2005).

Finally, when estimates of physical activity time across all activities (*Full Activity*) are examined, we see evidence that suggests lower-SES individuals spend more time in physical activity compared with higher-SES individuals. This is not what is documented by leisure-only conceptualizations of physical activity. National statistics, grounded in leisure-time activity measures, report that SES disparities in physical activity favor *high-SES individuals*. However, results from this study show that when we account for *all* health-benefiting activity, those with less education are engaging in significantly more activity, there is no difference by household income³ and those in manufacturing, maintenance, and agricultural occupations report significantly more physical activity.

Our results should be interpreted with some important limitations in mind. One limitation concerns assumptions about minutes spent in moderately active paid work tasks. The ATUS measures time at paid work but does not specify the types of activities performed while on the job. We used occupation information and previous research linking occupations and physical activity to test assumptions about how paid

³ And in supplemental models where education and occupation are not controlled for, those with lower-income reports significantly more minutes of physical activity compared to higher-income individuals (7.22 min).

work might shape time in physical activity. Our analysis demonstrates physical activity on the job is important in overall reports of physical activity. This comes as no surprise since time use experts document that the majority of most people's time is spent at paid work (Robinson & Godbey, 2010). Our models assume that half of reported work time is moderately active in an effort to avoid assumptions that all work time or no work time is moderately active. While our analysis shows that including some moderately active work time has the potential to show SES differences, we are not suggesting our estimates accurately capture the size of SES differences when paid work is incorporated into analyses. Our goal, rather, is to demonstrate that including information about physical activity in paid work highlights different opportunities for physical activity that are accessed in different ways depending on SES. Accurate measurement of physical activity at paid work has been a gap in the time use and physical activity literature for years and should be a priority for future research.

The reliance on self-reported physical activity responses rooted in leisure activities points to SES disparities in physical activity that favor higher-SES individuals, but these results suggest lower-SES individuals access physical activity in other domains, namely housework, dependent care, and paid work. Underrepresenting pathways to physical activity in current physical activity statistics continues to reify social ideas of SES disparities in physical activity. Results from this study offer evidence for directed promotion of physical activity through different activity domains based on one's educational attainment, household income, and occupation that focus on time use and go beyond leisure time physical activity.

Conflicts of interest

None.

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Appendix A. Supplementary data

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