Published in final edited form as:
Soc Sci Med. 2014 November ; 120: 126–134. doi:10.1016/j.socscimed.2014.09.010.

Not just couch potatoes or gym rats: alternative non-labor market time use patterns are associated with meeting physical activity guidelines among sedentary full-time employees

Lindsey P. Smith[a], **Shu Wen Ng**[a], and **Barry M. Popkin**[a]
Department of Nutrition, University of North Carolina, Chapel Hill, CB # 8120 University Square, 123 W. Franklin Street, Chapel Hill, NC 27516-3997, Chapel Hill, North Carolina (LPS, SWN, BMP)

Abstract

Physical activity and inactivity have distinct cardio-metabolic consequences, suggesting that combinations of activities can impact health above and beyond the effects of a single activity. However, little work has examined patterns of non-labor market time activity in the US population, particularly among full-time employees in sedentary occupations, who are at increased risk of adverse health consequences associated with a sedentary lifestyle. Identification of these patterns, and how they are related to total physical activity levels, is important for developing effective, attainable physical activity recommendations among sedentary employees, who typically have less time available for exercise. This is, especially the case for low-income employees who face the highest time and financial barriers to achieving physical activity goals.

This study uses cluster analysis to examine patterns of non-labor market time use among full-time (≥40 h/week) employed adults in sedentary occupations (<3 MET-h) on working days in the American Time Use Study. We then examine whether these patterns are associated with higher likelihood of meeting physical activity recommendations and higher overall physical activity (MET-h). We find that non-labor market time use patterns include those characterized by screen activities, housework, caregiving, sedentary leisure, and exercise. For both genders, the screen pattern was the most common and increased from 2003 to 2012, while the exercise pattern was infrequent and consistent across time. Screen, sedentary leisure, and community patterns were associated with lower likelihoods of meeting physical activity recommendations, suggesting that interventions targeting screen time may miss opportunities to improve physical activity among similarly sedentary groups. Alternately, non-labor market time use patterns characterized by housework and caregiving, represented feasible avenues for increasing overall physical activity levels, especially for those with low financial and time resources. Consideration of non-labor market time use patterns may improve strategies to increase physical activity and decrease inactivity among full-time employed adults in sedentary jobs.

Corresponding author: Barry Popkin, The Carla Chamblee Smith Distinguished Professor of Global Nutrition, Department of Nutrition, Gillings School of Global Public Health and School of Medicine, Mail: CB # 8120 University Square, Chapel Hill, NC 27516-3997, Tel: (919) 966-1732, Fax: (919) 966-9159, popkin@unc.edu.

Keywords

physical activity; sedentary behavior; inactivity; time use; exercise; race; ethnicity; low income

I. INTRODUCTION

In the US, one major strategy for preventing obesity, cardiovascular disease, cancer, and diabetes entails recommendations to increase physical activity[1–3]. Yet, despite these recommendations, daily activity levels have declined, and the majority of US adults do not achieve the recommendations of ≥30 minutes of moderate-to-vigorous physical activity (MVPA) at least five days per week[4–9].

In fact, public health experts recognize that simply meeting physical activity recommendations is inadequate[10]. Moreover, a growing body of epidemiologic evidence demonstrates that sedentary behavior has distinct adverse metabolic consequences independent of physical activity[11–14]. For example, results from Australia show that even amongst physically active adults, TV time was associated with worsening metabolic risk factors, including waist circumference, systolic blood pressure, and fasting plasma glucose[15]. In addition, exercise as a means of obesity reduction or prevention have shown limited effectiveness[16–18]. Finally, considering only whether someone achieved the MVPA recommendation or not misses individuals whose activities may not be intensive enough to meet these thresholds. While vigorous intensity activities yield the greatest health benefits[19], a dose-response relationship between physical activity and health exists such that even light-to-moderate activities are better than remaining sedentary[20].

In short, individuals should not simply be categorized into “active” or “not active” based on whether they achieve a certain threshold of physical activity. Rather, the unique physiology of inactivity, physical activity, and how these are incorporated throughout the day suggests that patterns of physical activity and inactivity matter, beyond the individual effect of any type or amount of activity alone[21]. In addition, identifying activity patterns may be useful for developing more attainable physical activity recommendations that reflect how people really spend their time, rather than a “one size fits all” approach which may be unachievable for many[22]. Building on this potentially important new understanding of the way activity and inactivity affect health, one important question is, what are patterns of (in)activity in the US population? Secondly, how are these patterns related to achieving physical activity goals?

To better describe this picture of time, cluster analysis has recently emerged as a useful methodology to characterize these multidimensional patterns of time use and physical activity in children and adolescents[22–25]. However, among US adults, most time use research has examined time spent in physical activity domains in absolute measures (minutes or hours), without taking into account the patterning of time[26–29]. Although Kolodinsky *et al.* examined patterning of time in US adults, this study did not examine energy expenditure associated with activity patterns, nor did it differentiate between labor market time and non-labor market time[30].

In addition, no research has taken into account hours worked in the labor market or occupational activity level when characterizing patterns of non-labor market time use, despite previous work showing that both employment status and occupational physical activity affect levels of sedentary activity and exercise during non-labor market hours[28; 31]. It is especially important to understand the relationship between non-labor market time use and physical activity among those who spend ≥40 h/week in the labor market (i.e. "full-time employees"), as these individuals face the highest time constraints on non-labor market time: on working days, 32% of time is spent on sleep and 31% is spent on labor market work, leaving little time to meet physical activity recommendations[28]. Even more important is identifying patterns of non-labor market time use among full-time employees in sedentary occupations, given that the majority of US employees are employed in sedentary jobs[32], occupational physical activity is declining across the globe[4; 33], and occupational inactivity has been linked to myriad adverse health consequences, including obesity, diabetes, cardiovascular disease, and mortality[32; 34–37]. Thus, one key question relates to what patterns of non-labor market time use are associated with increases in physical activity among individuals who spend ≥40 hours/week in sedentary jobs. Is exercise the only avenue to meet physical activity recommendations in this population, or are other patterns of non-labor market time use associated with increases in physical activity? Considering that lack of time poses one of the biggest barriers to exercise[38], understanding patterns of non-labor market time use can help inform effective, attainable strategies to increase physical activity among individuals with limited time availability.

Finally, understanding non-labor market time use patterns among low-income employees is particularly important, since in addition to financial limitations and lack of access to safe spaces, low-income employees face even higher time constraints to exercise, due to juggling of jobs, childcare, transportation, and social services[31; 39–41]. Indeed, empirical evidence indicates that individuals with lower income and education are less likely to exercise and spend more time in sedentary activities like television watching[31; 42; 43]. However, one question is whether low income adults spend more time in domestic physical activities like housework or caregiving than higher income groups, who may be more likely to outsource these activities.

The primary objective of this study is to use cluster analysis to characterize patterns of non-labor market time use among full-time employed US adults in sedentary occupations on working days. A second objective is to identify whether certain non-labor market time use patterns are more common amongst low income employees. Finally, we will examine whether non-labor market time use patterns are associated with total daily activity levels, including: 1) increased likelihood of meeting recommendations for MVPA and 2) overall energy cost, as measured by metabolic equivalent hours (MET-h). By using MET-h, which incorporates both time and intensity, we are better able to identify which patterns are associated with increased physical activity, but not necessarily at the intensity required to meet recommendation thresholds.

II. METHODS

American Time Use Study (ATUS)

The methodological details of the American Time Use Survey (ATUS) have been published previously.[44] ATUS began in 2003 to develop nationally representative estimates of time use in the US. ATUS includes free-living residents of households within the US that are aged ≥15 years, except for active military personnel. From each selected household, one individual is randomly selected to participate in ATUS. Computer-assisted telephone interviews are used to interview respondents about their time use for one 24-h period, including activity and location. Participant responses are then coded into 438 distinct primary activity variables by trained staff[45]. A recent study found that this "previous day" recall method is more valid than questionnaires for assessing non-labor market time, sedentary behavior, and physical activity (correlations with accelerometry of 0.77–0.81)[46].

In the present study, data from 2003 to 2012 were pooled for adults aged 18 to 65 years working ≥40 hours/week across all jobs in sedentary occupations, sampled on a workday (n=30,133). These full-time sedentary employees represented 68% of ATUS respondents who were employed in the labor market and sampled on a workday. Respondents were excluded from analysis if the diary day was a holiday (n= 7) or they were missing > 90 minutes of activity (n= 15). To retain adequate sample sizes for race/ethnic comparisons, we excluded the small proportion reporting race/ethnicity as non-Hispanic Other (n=1674), for a final analytic sample of 28,437. The present analysis is limited to those sampled on a workday to account for the idea that time and physical activity in the labor market not only affects how much time and energy is available for non-labor market time activities, but also what individuals do during that non-labor market time.

Compendium of Physical Activities

The Compendium of Physical Activities was developed to enable the comparison of physical activity intensity levels across studies, and can be used to code the type, purpose, and intensity of 605 daily physical activities[47]. Using the Compendium of Physical Activities to ATUS, Tudor-Locke *et al.* linked assigned compendium values and their corresponding metabolic equivalent (MET) values to each ATUS primary activity[47]. Because ATUS was primarily designed to capture non-occupational activities, respondents were not asked to break their time at work into individual activities[48]. Therefore, to assign MET values to hours spent at work, occupational categories were linked to corresponding MET values using the Tecumpseh Occupational Physical Activity Questionnaire classification system, which assigns METs based on body position and intensity during work[49]. Individuals with sedentary jobs were individuals whose primary job occupation had an average of <3 MET-h and who did not report time spent in physically active (≥3 MET-h) paid employment on the interview day in either primary or secondary jobs.

Categorizing Time Use

Non-labor market time use includes time spent on any activity occurring outside the formal labor market, including domestic activities such as housework and yardwork, while exercise is defined as a subset of non-labor market time use and includes physical activity which is

intentional and undertaken with the goal of maintaining or improving physical fitness[50]. Non-labor market time activities were first aggregated from 438 distinct activity variables linked to METs values to 23 major activity sub-categories classified by ATUS[47; 48] (Supplementary Table 1). Five additional categories for transportation were determined by a combination of activity (transportation) and location (in a bike, car, etc)[47]. The goal was to aggregate activities that were similar both in terms of activity (i.e., chores vs. relaxing vs. errands) and in terms of intensity (i.e. METs), using the Centers for Disease Control guidelines to define activities as sedentary (1– 1.5 METs), light (1.6– 2.9 METs, moderate (3– 6 METs), or vigorous (>6 METs)[9]. Screen time included television and non-labor market computer use, while exercise included all sporting activities, like running, soccer, or weight lifting. For each activity category, time spent in that activity was calculated as a percentage of non-labor market time, in order to reflect non-labor market time activities independently of time worked on the interview day.

Cluster Development

Time spent in non-labor market activities was entered as a standardized percentage of non-labor market time (z-scores) for each activity, to account for non-participation and positive right skew in the distribution of time spent in some activities[51; 52]. We conducted separate cluster analyses for males and females to reflect gender-based differences in time use patterns, but found that clusters were consistent across genders. Thus we chose not to stratify by gender in order to preserve sample size for clustering.

SAS (version 9.2, Research Triangle Institute) was used to conduct 100 iterations of cluster procedures to randomly generate initial group centers and identify the center that produced the largest r^2 value, maximizing the inter- to intra-cluster variability. These initial group centers were then used as the seed values for non-hierarchical clustering using the *cluster kmeans* command in STATA (version 12 Stata Corporation, College Station, Texas), to generate a fixed number of cluster solutions (2–6). To identify the optimal number of cluster solution, we examined the Calinski-Harabasz value for each number of cluster solutions, which indicates intra-cluster homogeneity and inter-cluster heterogeneity[53]. We compared each subsequent cluster solution to the previous, less complex cluster solution. If the more complex cluster solution generated meaningful subgroups, the more complex cluster solution was chosen, as long as the Calinksi-Harabasz value was comparable and no single cluster had a membership less than 4% of the sample[54].

The cluster analysis revealed that a 6-cluster solution was optimal for both subgroups. Patterns of time use were named after their defining characteristic: Screen, Housework, Other Sedentary Leisure, Caregiving, Community, and Exercise.

Statistical analysis

All statistical analyses were performed using STATA, version 12 (Stata Corporation, College Station, Texas).

To account for missing data on household income for 8.7% of respondents, we performed a multivariate imputation using chained equations low-income (above or below the federal

poverty threshold in each year), using Stata's *mi impute* chained command, with 5 imputations.[55; 56] The imputation model included all covariates used in analysis along with additional variables associated with work hours and family income, including type of housing, industry and occupation, number of children under 18y, and household size.

All analyses were stratified by sex to account for gender-based differences in time use[57]. The composition of each non-labor market time use pattern and mean time spent in each activity was explored. Multinomial logistic regression was used to examine the association between year, low income, and the likelihood of being in a non-labor market time use pattern. All models controlled for socio-demographic characteristics, including race/ethnicity (self-reported as non-Hispanic White, non-Hispanic Black, and Hispanic), marital status (spouse or unmarried partner present), presence of children in the household, year, and education (less than high school, high school degree and/or some college, and college degree or higher).

To explore the association between non-labor market time use patterns and total daily physical activity, we used log binomial models to test whether individuals in a certain non-labor market time use pattern were more likely to achieve MVPA recommendations, defined as reporting ≥30 minutes in activities with >3 MET-h. Linear regression was used to examine the association between non-labor market time use patterns and METs-h, defined as the sum of MET-h from all primary activities reported throughout the day, including labor market time. Models examining likelihood of meeting MVPA recommendations and MET-h also controlled for number of hours worked on the interview day, to account for total daily physical activity..

For each model, STATA's margins command was used to estimate the predicted probabilities of being in a non-labor market time use pattern, total MET-h, or likelihood of meeting MPVA recommendations, respectively. STATA's survey command and the ATUS final probability weight were used to account for distribution of the sample over days of the week and for differential response rates across demographic groups, and to adjust the sample to be nationally representative.

III. RESULTS

Sample Characteristics

Demographic characteristics of non-labor market time use patterns are presented in Table 1. Individuals in Screen, Sedentary Leisure, and Exercise patterns were more likely to be male and less likely to have a spouse or children, while those in the Housework and Caregiving patterns were more likely to be female and have children. Individuals in the Screen pattern were less likely to be non-Hispanic White and were less educated relative to other patterns.

Characteristics of Time Use Patterns

On average, men spent 8.5 h and women spent 7.9 h in labor market activities on the interview day. The proportion of respondents participating and mean time spent in non-labor market activities is presented in Table 2. The Screen pattern was the most common time use pattern in men (47%) and women (38%). Individuals in this pattern spent ≥120 min/day on

screen activities. They also spent more time on sleep and on the job than any other pattern, and spent less in more physically active activities, such as yardwork or housework, than nearly all other patterns. The Exercise pattern was primarily characterized by high levels of exercise (approximately 2 120 min/day); in this group, even those in the 25th percentile were spending 90 min/day (men) or 75 min/day (women) on exercise activities. However, the percent of respondents with this pattern was small, representing only 7% of men and 4% of women.

The Housework pattern was more common among women (20%) than men (12%). For men, the Housework pattern was comprised largely of yardwork (135 min/day), while for women, the Housework pattern was comprised primarily of food preparation (54 min/day), housework (85 min/day) as well as yardwork (53 min/day).

Other non-labor market time use patterns were consistent across genders and included Caregiving (≥160 min/day providing care to children or adults), and Community (≥160 min/day in religious or volunteer activities). The Sedentary Leisure pattern was characterized by ≥160 min/day in sedentary leisure (socializing, reading, relaxing) and ≥100 min/day sedentary transportation.

Other than the Exercise pattern, time spent on exercise was very low, at <10 min/day for both genders. Time spent on active transportation such as biking or walking was low (≤11 min/day) for both genders across all patterns. However, time spent in screen activities was high across all patterns, and higher in men (≥61 min/day) than women (≥49 min/day).

Secular Trends and Socio-economic Associations

The likelihood of being in the Screen pattern increased from 2003 to 2012 by 10% and 6% for men and women, respectively, although this increase was only statistically significant for men ($p<0.05$) (Figure 1). The likelihood of being in the Exercise pattern, or any other pattern, did not change over time.

Income level was not associated with increased or decreased likelihood of being in the Screen, Exercise, or any other pattern (Supplementary Table 2).

Associations with Physical Activity Recommendations and Energy Expenditure

In the Screen pattern, only 21% and 19% of men and women achieve MVPA recommendations, respectively. Other patterns were also associated with lower probabilities of meeting MVPA recommendations (Table 3). In fact, for both men and women, those in the Sedentary Leisure or Communities patterns were equally likely to achieve MVPA recommendations as those in the Screen pattern,

For both men and women, the Exercise pattern was associated with the highest predicted percent achieving MVPA recommendations ≥79%) ($p<0.05$) (Table 3) For both men and women, the Housework and Caregiving patterns were the only other patterns associated with increased percent achieving MVPA recommendations relative to the Screen pattern. However, the percent achieving these recommendations in both patterns was substantially lower than the Exercise pattern: among men, 58% in the Housework pattern and 40% in the

Caregiving pattern achieved MVPA recommendations, and among women, only 41% in the Housework pattern and 29% in the Caregiving pattern achieved recommendations.

Results for METs-h mirrored these results. The Screen pattern was associated with the lowest total energy expenditure (37 and 38 MET-h for men and women, respectively). For both men and women, the Exercise pattern was associated with the highest total MET-h (44 MET-h for both genders), relative to the Screen pattern ($p<0.05$). For both men and women, the Housework pattern (43 and 41 MET-h, respectively) and the Caregiving pattern (41 MET-h for both genders) were also associated with higher energy expenditure for both men and women ($p<0.05$).The Sedentary Leisure and Community patterns were associated with only slightly higher MET-h relative to the Screen pattern for both men and women, although these were statistically significant ($p<0.05$).

IV. DISCUSSION

Among full-time employed adults in sedentary jobs, patterns of non-labor market time use on working days are characterized by screen activities, sedentary leisure, housework, caregiving, community, and exercise. These results are similar to those found by Kolodinsky *et al*, who identified physical activity, work, housework, volunteering, and socializing patterns[30]. Kolodinsky's patterns included both labor market time and non-labor market time, but do not account for ways in which time spent in the labor market, as well as occupational physical activity, impose constraints on both the time and energy available for activities during non-labor market time. By restricting the sample to adults working ≥40h/ week in sedentary occupations, this study shows that within the time available outside of the labor market, distinct patterns of sedentary, active, and moderately active activities emerge.

Among these sedentary employees, the Screen pattern was the most common pattern, and the only pattern to become more common from 2000 to 2012, although the effect was only statistically significant for men. This trend could represent a shift towards increased screen time after the "Great Recession" in 2007, consistent with previous research showing that the Great Recession was linked to increases in television watching[58]. While previous work has shown that recessions are linked to increased health-promoting behaviors, like exercise[59] and home cooking[60], one recent study shows that the Great Recession failed to produce any meaningful increases in the latter[61]. The present results do not find evidence for increases in either exercise or housework, and suggest that if anything, employed US adults are becoming more sedentary. More research is needed to understand other potential drivers of this trend, such as the proliferation of screen-based social media on laptops, smartphones, and tablets, and how this trend towards increased screen time affects time spent in other activities.

Regardless of the potential determinants, this trend towards the increasing prevalence of the Screen pattern during non-labor market hours is worrisome, considering these participants already spend ≥8 h/day in sedentary activities during labor market hours.. Unsurprisingly, the Screen pattern was associated with the lowest likelihood of meeting MVPA recommendations, and the lowest overall energy expenditure. For those in sedentary occupations, increases in screen time are particularly troubling, since increases in screen

time may exacerbate the obesogenic effects of sedentary behavior by encouraging increased intake of high-energy, nutrient poor foods via food advertising and mindless eating[62; 63]. Although the Screen pattern was the most common, and the least active, we also found that other non-labor market time use patterns were characterized by low physical activity and high sedentary activity. Individuals in the Screen, Sedentary Leisure, and Community patterns were all less likely to meet MVPA guidelines than the average American manor woman, according to the most recent Center for Disease Control reports estimating that 52% of men and 43% of women meet MVPA guidelines[64]. In addition, on average, individuals in all patterns other than Exercise spent less than 10 min/day on exercise (although these averages likely reflect a combination of individuals who exercise [presumably >10 min/day] and those who do nothing). Perhaps more alarmingly, even those in the Exercise pattern still spent more time in sedentary activities (screen, sedentary transportation) than any other non-labor market activity other than exercise.

These findings support previous recommendations that health guidelines should not only promote physical activity, but also encourage the reduction of prolonged sitting, even amongst those who exercise[10]. One potential strategy to accomplish both these goals is to promote physical activities which can be incorporated into daily routines, such as cleaning, gardening, or mowing. In fact, there has been a growing shift towards promoting lifestyle activities over exercise[65–67], as incorporating physical activity into daily routines may be more feasible than more structured physical activity, which can require additional time, cost, or access to safe space. Our findings support this notion that non-labor market time use patterns characterized by daily lifestyle activities do increase physical activity levels. For example, individuals in the Housework cluster spent the most time in physically active non-exercise activities than any other pattern. In addition, both the Housework and Caregiving patterns were associated with nearly the same energy expenditure as those in the Exercise pattern.

One concern is that while domestic activities may increase overall activity levels, these activities are not intensive enough to achieve the moderate-to-vigorous intensity recommended for optimal health[68–70]. In fact, the findings on domestic activity and health are mixed, with several studies finding that housework and other domestic activities are unrelated or positively related to obesity[70–72], and but yet others find associations with reduced risk of cardiovascular and all-cause mortality[68; 73–75]. In the present study, we find partial evidence to support the notion that domestic activities may not be intensive enough: in this study, men in the Housework pattern appeared more likely to achieve MVPA recommendations than the general US population (58% vs. 52%, respectively,) while women in the Housework pattern appeared about equally as likely to achieve MVPA recommendations compared to the general US population (41%vs. 42%, respectively)[64]. The Caregiving pattern was associated with reduced likelihood of meeting MVPA recommendations relative to the general US population for both men and women. Although we did not explicitly examine differences between the various intensities of domestic activities, the studies that have found protective benefits of housework typically distinguish between intensive activities (usually ≥5 MET-h, such as mowing, digging, raking) vs. less intensive (cleaning, doing the laundry),finding stronger beneficial effects of the former.

Thus, as Murphy *et al.* suggest[70], recommendations which promote domestic activity should differentiate between less intensive activities, which are useful in reducing sitting time, and more intensive activities, which are more beneficial for achieving MVPA goals.

An additional benefit to intensive domestic activities is that they represent a low-cost opportunity for increasing physical activity, which is especially important among low-income populations, who typically have fewer financial and time resources available for exercise. However, we were surprised to find that low-income adults were not more likely to be in Housework or Caregiving patterns. We would have expected that low financial resources coupled with low opportunity cost would promote higher levels of home production activities, like cooking, cleaning, or caring for children[76]. In fact, we found that low income adults were not more or less likely to be in any non-labor market time use pattern, including the Screen and Exercise patterns. These results dispel the notion that low-income adults are more sedentary[77]; rather, their patterns of non-labor market time use simply reflect the overwhelmingly sedentary patterns of the US population as a whole.

Strengths and Limitations

Although single 24-hour time use diaries are a common approach to attaining time use estimates in national surveys[78], utilization of a only single 24-hour time use diary prevents analysis of how non-labor market time use patterns vary across workdays and non-work for the same individual. For example, the physical activity recommendations require 30 min of MVPA on most days (150 min/week), and we were unable to see whether participants achieved these recommendations on multiple days. In addition, restricting our sample to only those who are employed ≥40h/week in sedentary occupations precludes generalizing these results to other segments of the labor force, including those who are employed in physically active occupations, part-time employees, and those who are retired or unemployed. This restriction is particularly limiting for our observations of low-income individuals, as these individuals are those who work full-time in sedentary occupations yet still have household incomes less than the federal poverty threshold, and thus may not represent most low-income employees. More work is needed to understand patterns of non-labor market time use across income levels and employment types, and whether the relationships between time use patterns and physical activity levels are consistent across these groups. However, despite these limitations, this study provides useful insights on both low income and higher income individuals who face major time constraints on achieving physical activity guidelines, and potential patterns of non-labor market time use which may be targeted to increase physical activity.

Secondly, respondents did not report brief bouts of activity that occurred at work, such as walking from one floor to another, obscuring total work time physical activity. It seems unlikely that these bouts would contribute greatly to physical activity, since they are likely anomalous and not a typical element of a given job (or else such activities would have be incorporated into MET estimates in the Tecumpseh Occupational survey). It also seems unlikely work time physical activity bouts would vary across non-labor market time use patterns. However, it is possible that this inability to more finely categorize physical activity during work time could introduce residual confounding in the estimated association between

non-labor market time use patterns and total daily physical activity, as we could not totally control for varying intensities of physical activity during work-time.

Cluster analysis groups individuals who are similar to each other. Thus, we must also consider the possibility that non-labor market time use patterns simply reflect a pre-existing set of lifestyle preferences, priorities, or economic and social constraints, all of which would influence time allocation and health behavior decisions. If so, it would be even less likely that individuals could be shifted from one pattern to another without intervening on upstream demographic factors. For example, individuals in the Exercise pattern appeared to be a highly selective group which who were younger, childless, and unmarried. Expecting individuals with children or spouses to make time allocation decisions similar to those without seems unreasonable. Rather, working within to promote more physically active activities within pre-existing non-labor market time use patterns provides a more feasible strategy for improving activity levels across various demographics.

Still, this study is among the first to estimate non-labor market time use patterns among adults in full-time, sedentary jobs, and how these patterns relate to physical activity. Additionally, we minimized subjectivity in the cluster analysis by specifying starting seeds that maximize inter-to-intra cluster variability, examining a range of final cluster solutions (2 to 6), and employing a pre-specified method for identifying optimal cluster solutions. In addition, because cluster analysis is sensitive to input variables, we included all time use activities and used standardized percentages of non-labor market time to avoid influencing cluster results.

Conclusion

This study identified patterns of non-labor market time use among full-time employed US adults in sedentary occupations, who face the greatest time constraints to achieving physical activity recommendations. We found that non-labor market time use patterns are increasingly characterized by sedentary, screen-based behaviors, and that few US adults have non-labor market time use patterns characterized by exercise. In addition, even those who exercise spend a lot of time in sedentary activities, suggesting that alternative strategies for both increasing physical activity and reducing sedentary activity are needed. However, we also identified several non-labor market time use patterns which were associated with similar levels of overall energy expenditure as those who exercise, including housework and caregiving. Lifestyle activities, and in particular more intensive domestic activities, can be incorporated into daily routines and thus may be more feasible options for meeting physical activity goals and reducing inactivity within the context of a busy life. These small shifts in physical activity that occur within pre-existing time use patterns may be more readily adopted and sustained than large-scale changes which people may struggle to initiate or continue. More research is needed to understand how non-labor market time use patterns are associated with long-term health outcomes, and whether incorporating these patterns into physical activity goals can better help individuals improve physical activity and reduce inactivity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

We thank the Carolina Population Center for training support (T32 HD007168) and for general support (R24 HD050924). We also wish to thank Dr. Phil Bardsley for assistance with the data management and programming and Mr. Tom Swasey for graphics support.

References

1. Jakicic JM, Otto AD. Physical activity considerations for the treatment and prevention of obesity. Am J Clin Nutr. 2005; 82:226S–229S. [PubMed: 16002826]
2. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans,2010. Washington, DC: 2010.
3. American Cancer Society. American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention. 2012
4. Anonymous. Details omitted for double-blind reviewing. 2012
5. Anonymous. Details omitted for double-blind reviewing. 2012
6. Spees CK, Scott JM, Taylor CA. Differences in amounts and types of physical activity by obesity status in US adults. Am J Health Behav. 2012; 36:56–65. [PubMed: 22251783]
7. Garber CE, Blissmer B, Deschenes MR, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc. 2011; 43:1334–1359. [PubMed: 21694556]
8. Zhao G, Ford ES, Li C, et al. Compliance with physical activity recommendations in US adults with diabetes. Diabet Med. 2008; 25:221–227. [PubMed: 18201213]
9. Centers for Disease Control and Prevention. Physical Activity Guidelines. 2011. http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html
10. Hamilton MT, Healy GN, Dunstan DW, et al. Too little exercise and too much sitting: inactivity physiology and the need for new recommendations on sedentary behavior. Curr Cardiovasc Risk Rep. 2008; 2:292–298. [PubMed: 22905272]
11. Owen N, Healy GN, Matthews CE, et al. Too much sitting: the population health science of sedentary behavior. Exerc Sport Sci Rev. 2010; 38:105–113. [PubMed: 20577058]
12. Bey L, Hamilton MT. Suppression of skeletal muscle lipoprotein lipase activity during physical inactivity: a molecular reason to maintain daily low-intensity activity. J Physiol. 2003; 551:673–682. [PubMed: 12815182]
13. Hamilton MT, Hamilton DG, Zderic TW. Exercise physiology versus inactivity physiology: an essential concept for understanding lipoprotein lipase regulation. Exerc Sport Sci Rev. 2004; 32:161–166. [PubMed: 15604935]
14. Dunstan DW, Salmon J, Healy GN, et al. Association of television viewing with fasting and 2-h postchallenge plasma glucose levels in adults without diagnosed diabetes. Diabetes Care. 2007; 30:516–522. [PubMed: 17327314]
15. Healy GN, Dunstan DW, Salmon J, et al. Television time and continuous metabolic risk in physically active adults. Med Sci Sports Exerc. 2008; 40:639–645. [PubMed: 18317383]
16. Ross R, Janssen I. Physical activity, total and regional obesity: dose-response considerations. Med Sci Sports Exerc. 2001; 33:S528–S529.
17. Donnelly JE, Hill JO, Jacobsen DJ, et al. Effects of a 16-month randomized controlled exercise trial on body weight and composition in young, overweight men and women: the Midwest Exercise Trial. Arch Intern Med. 2003; 163:1343–1350. [PubMed: 12796071]

18. Church TS, Martin CK, Thompson AM, et al. Changes in weight, waist circumference and compensatory responses with different doses of exercise among sedentary, overweight postmenopausal women. PLoS One. 2009; 4:18.
19. Lee I-M, Paffenbarger RS. Associations of Light, Moderate, and Vigorous Intensity Physical Activity with Longevity The Harvard Alumni Health Study. Am J Epidemiol. 2000; 151:293–299. [PubMed: 10670554]
20. Blair SN, Connelly JC. How much physical activity should we do? The case for moderate amounts and intensities of physical activity. Res Q Exerc Sport. 1996; 67:193–205. [PubMed: 8835998]
21. Tudor-Locke C, Schuna JM Jr. Steps to preventing type 2 diabetes: exercise, walk more, or sit less? Front Endocrinol. 2012; 3:00142.
22. Ferrar K, Chang C, Li M, et al. Adolescent time use clusters: a systematic review. J Adolesc Health. 2013; 52:259–270. [PubMed: 23299015]
23. Ferrar K, Olds T, Maher C, et al. Time use clusters of New Zealand adolescents are associated with weight status, diet and ethnicity. Aust N Z J Public Health. 2013; 37:39–46. [PubMed: 23379804]
24. Liu J, Kim J, Colabianchi N, et al. Co-varying patterns of physical activity and sedentary behaviors and their long-term maintenance among adolescents. J Phys Act Health. 2010; 7:465–474. [PubMed: 20683088]
25. Nelson MC, Gordon-Larsen P, Adair LS, et al. Adolescent physical activity and sedentary behavior: patterning and long-term maintenance. Am J Prev Med. 2005; 28:259–266. [PubMed: 15766613]
26. Colman G, Dave D. Exercise, physical activity, and exertion over the business cycle. Soc Sci Med. 2013
27. Millward H, Spinney JE, Scott D. Durations and Domains of Daily Aerobic Activity: Evidence from the 2010 Canadian Time-Use Survey. J Phys Act Health. 2013; 10:10. [PubMed: 23324481]
28. Tudor-Locke C, Leonardi C, Johnson WD, et al. Time spent in physical activity and sedentary behaviors on the working day: the American time use survey. J Occup Environ Med. 2011; 53:1382–1387. [PubMed: 22104979]
29. Zick CD, Stevens RB, Bryant WK. Time use choices and healthy body weight: A multivariate analysis of data from the American Time use Survey. Int J Behav Nutr Phys Act. 2011; 8:84. [PubMed: 21810246]
30. Kolodinsky JM, Goldstein AB. Time Use and Food Pattern Influences on Obesity. Obesity. 2011
31. McInnes, MM.; Shinogle, JA. Economic Aspects of Obesity. University of Chicago Press; 2011. Physical activity: Economic and policy factors; p. 249-282.
32. Church TS, Thomas DM, Tudor-Locke C, et al. Trends over 5 decades in US occupation468 related physical activity and their associations with obesity. PLoS One. 2011; 6:e19657. [PubMed: 21647427]
33. Hallal PC, Andersen LB, Bull FC, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. The Lancet. 2012; 380:247–257.
34. Hu G, Qiao Q, Silventoinen K, et al. Occupational, commuting, and leisure-time physical activity in relation to risk for type 2 diabetes in middle-aged Finnish men and women. Diabetologia. 2003; 46:322–329. [PubMed: 12687329]
35. Hu FB, Li TY, Colditz GA, et al. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. JAMA. 2003; 289:1785–1791. [PubMed: 12684356]
36. Salonen JT, Slater JS, Tuomilehto J, et al. Leisure time and occupational physical activity: risk of death from ischemic heart disease. Am J Epidemiol. 1988; 127:87–94. [PubMed: 3337078]
37. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: a review of prospective studies. Int J Epidemiol. 2012 dys078.
38. Brownson RC, Hoehner CM, Day K, et al. Measuring the built environment for physical activity: state of the science. Am J Prev Med. 2009; 36:S99–S123. e112. [PubMed: 19285216]
39. Jabs J, Devine CM, Bisogni CA, et al. Trying to find the quickest way: employed mothers' constructions of time for food. J Nutr Educ Behav. 2007; 39:18–25. [PubMed: 17276323]

40. Jabs J, Devine CM. Time scarcity and food choices: an overview. Appetite. 2006; 47:196–204. [PubMed: 16698116]
41. Brownson RC, Baker EA, Housemann RA, et al. Environmental and policy determinants of physical activity in the United States. Am J Public Health. 2001; 91:1995–2003. [PubMed: 11726382]
42. Anonymous. Details omitted for double-blind reviewing. 2012
43. Mullahy J, Robert SA. No time to lose: time constraints and physical activity in the production of health. Rev Econ Househ. 2010; 8:409–432.
44. Hamermesh DS, Frazis H, Stewart J. Data watch: The american time use survey. J Econ Perspect. 2005; 19:221–232.
45. U.S. Census Bureau. American Time Use Survey User's Guide: Understanding ATUS from 2003 to 2012. Bureau of Labor Statistics; 2013.
46. Matthews CE, Keadle SK, Sampson J, et al. Validation of a previous-day recall measure of active and sedentary behaviors. Med Sci Sports Exerc. 2013; 45:1629–1638. [PubMed: 23863547]
47. Tudor-Locke C, Washington TL, Ainsworth BE, et al. Linking the American Time Use Survey (ATUS) and the Compendium of Physical Activities: methods and rationale. J Phys Act Health. 2009; 6:347–353. [PubMed: 19564664]
48. Shelley KJ. Developing the American time use survey activity classification system. Monthly Lab Rev. 2005; 128:3.
49. Ainsworth BE, Richardson MT, Jacobs DR Jr, et al. Accuracy of Recall of Occupational Physical Activity by Questionnaire. J Clin Epidemiol. 1999; 52:219–227. [PubMed: 10210239]
50. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public health reports. 1985; 100:126. [PubMed: 3920711]
51. Sharma S, Kumar A. Cluster Analysis and Factor Analysis. In. The Handbook of Marketing Research: Uses, Misuses, and Future Advances. 2006:365–393.
52. Milligan GW, Cooper MC. A study of standardization of variables in cluster analysis. Journal of classification. 1988; 5:181–204.
53. Caliński T, Harabasz J. A dendrite method for cluster analysis. Communications in Statistics. 1974; 3:1–27.
54. Anonymous. Details omitted for double-blind reviewing. 2012
55. Schafer JL. Multiple imputation: a primer. Statistical Methods in Medical Research. 1999; 8:3–15. [PubMed: 10347857]
56. StataCorp. Stata Multiple-Imputation Reference Manual, Release. Vol. 13. College Station, Texas: Stata Press; 2013.
57. Bianchi SM, Milkie MA, Sayer LC, et al. Is anyone doing the housework? Trends in the gender division of household labor. Soc Forces. 2000; 79:191–228.
58. Aguiar M, Hurst E, Karabarbounis L. Time use during the Great Recession. Am Econ Rev. 2013; 103:1664–1696.
59. Ruhm CJ. Healthy living in hard times. J Health Econ. 2005; 24:341–363. [PubMed: 15721049]
60. Edwards, R. American time use over the business cycle; Prepared for Session 114 of the Annual Meeting of the Population Association of America; 2008.
61. Anonymous. Details omitted for double-blind reviewing. 2012
62. Boulos R, Vikre EK, Oppenheimer S, et al. ObesiTV: how television is influencing the obesity epidemic. Physiol Behav. 2012; 107:146–153. [PubMed: 22677722]
63. Moray J, Fu A, Brill K, et al. Viewing television while eating impairs the ability to accurately estimate total amount of food consumed. Bariatr Surg Pract Patient Care. 2007; 2:71–76.
64. Centers for Disease Control and Prevention. [accessed April 2014] Facts about Physical Activity. 2014. http://www.cdc.gov/physicalactivity/data/facts.html
65. Nationa Heart L, and Blood Institute Guide to Physical Activity. https://www.nhlbi.nih.gov/health/public/heart/obesity/lose_wt/phy_act.htm
66. UK National Health Service: Change4Life Campaign. Get Going Every Day. 2014 http://www.nhs.uk/change4life/pages/get-going-every-day.aspx May 2014).

67. United States Department of Agriculture. [accessed May 2014] Tips for Increasing Physical Activity. 2014. http://www.choosemyplate.gov/physical-activity/increase-physical-activity.html
68. Stamatakis E, Hamer M, Lawlor DA. Physical activity, mortality, and cardiovascular disease: is domestic physical activity beneficial? The Scottish Health Survey—1995, 1998, and 2003. Am J Epidemiol. 2009; 169:1191–1200. [PubMed: 19329529]
69. Lawlor D, Taylor M, Bedford C, et al. Is housework good for health? Levels of physical activity and factors associated with activity in elderly women. Results from the British Women's Heart and Health Study. J Epidemiol Community Health. 2002; 56:473–478. [PubMed: 12011209]
70. Murphy MH, Donnelly P, Breslin G, et al. Does doing housework keep you healthy? The contribution of domestic physical activity to meeting current recommendations for health. BMC Public Health. 2013; 13:966. [PubMed: 24139277]
71. Stamatakis E, Hirani V, Rennie K. Moderate-to-vigorous physical activity and sedentary behaviours in relation to body mass index-defined and waist circumference-defined obesity. Br J Nutr. 2009; 101:765–773. [PubMed: 18680630]
72. Abu-Omar K, Rutten A. Relation of leisure time, occupational, domestic, and commuting physical activity to health indicators in Europe. Prev Med. 2008; 47:319–323. [PubMed: 18455785]
73. Besson H, Ekelund U, Brage S, et al. Relationship between subdomains of total physical activity and mortality. Med Sci Sports Exerc. 2008; 40:1909–1915. [PubMed: 18845964]
74. Martinez-Gomez D, Guallar-Castillon P, Leon-Munoz LM, et al. Household physical activity and mortality in older adults: a national cohort study in Spain. Prev Med. 2014; 61:14–19. [PubMed: 24440158]
75. Haapanen N, Miilunpalo S, Vuori I, et al. Characteristics of leisure time physical activity associated with decreased risk of premature all-cause and cardiovascular disease mortality in middle553 aged men. Am J Epidemiol. 1996; 143:870–880. [PubMed: 8610700]
76. Becker GS. A Theory of the Allocation of Time. The Economic Journal. 1965; 75:493–517.
77. Lantz PM, House JS, Lepkowski JM, et al. Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. JAMA. 1998; 279:1703–1708. [PubMed: 9624022]
78. Fisher K, Gershuny J, Gauthier AH. Multinational Time Use Study: User's Guide and Documentation. 2011 http://www.timeuse.org/files/cckpub/858/mtus-user-guide-r4.pdf.

HIGHLIGHTS

- Physical activity guidelines should consider patterns of activity and inactivity.
- Screen-dominated patterns increased over time.
- Non-screen patterns are also associated with very low physical activity.
- Housework and caregiving patterns improve chances of meeting guidelines.
- Effective guidelines must be achievable within the context of a busy life.

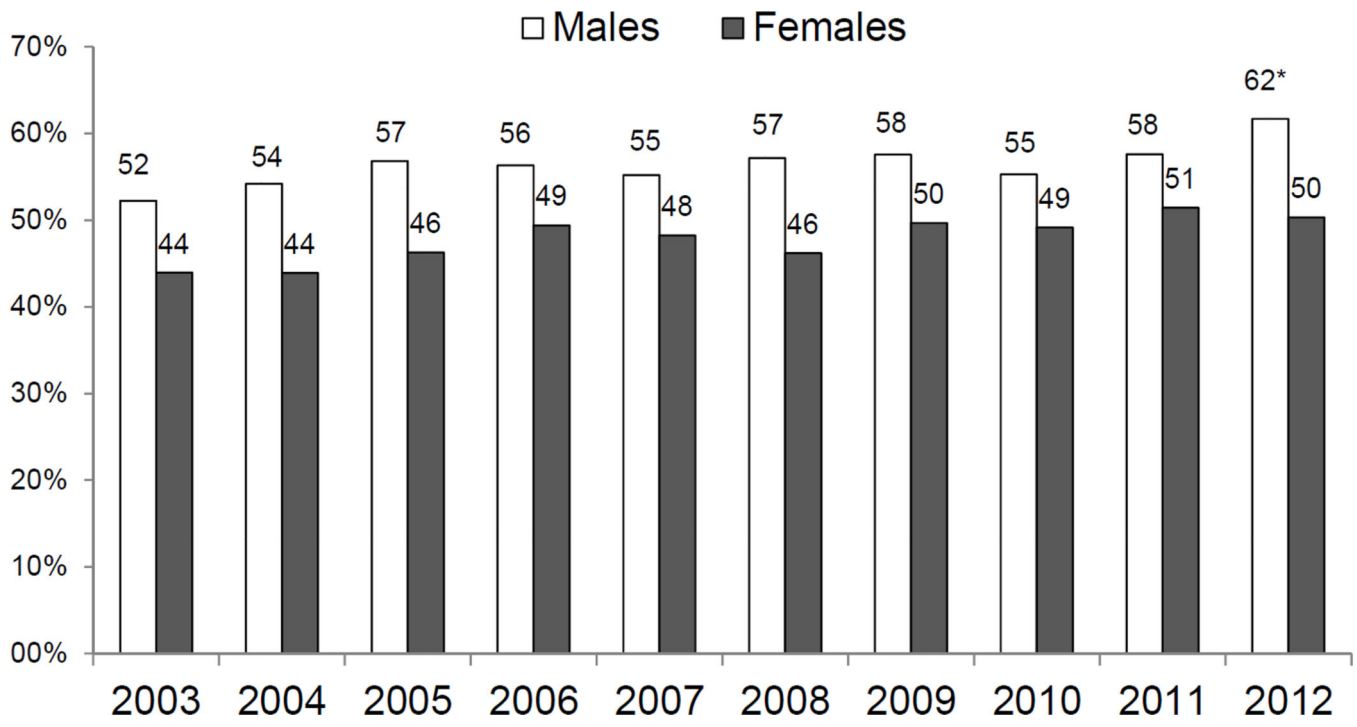

Figure 1. Predicted Percent of Men and Women in Screen Pattern Increased from 2003–2012

Predicted percents from multinomial logistic regression for non-labor market time use pattern, adjusting for age, education, income, marital status, presence of children in the household, and race/ethnicity, among working age adults with sedentary jobs, working ≥40h/week, sampled on a working day.

* Within gender, predicted probability of screen pattern is significantly different than in 2003, $p < 0.05$

Soc Sci Med. Author manuscript; available in PMC 2015 May 01.

Table 1

Socio-demographic Characteristics by Non-Labor Market Time Use Pattern (N= 28,437)[†]

	Screen	Housework	Sedentary Leisure	Caregiving	Community	Exercise	*p*
Sex							<0.01
Male, %	60	42	54	47	58	69	
Female, %	40	58	46	53	42	31	
Age group							<0.01
18–34 y, %	32	20	34	38	21	37	
35–49 y, %	37	44	38	51	46	39	
50–65 y, %	31	35	28	11	33	23	
Marital status							<0.01
No Spouse, %	35	28	40	19	28	38	
Spouse, %	65	72	60	81	72	61	
Presence of Children <18y							<0.01
No Child, %	64	58	63	12	52	64	
≥ 1 Child, %	36	42	37	88	48	36	
Race/ethnicity							<0.01
NH White, %	76	80	76	80	78	81	
NH Black, %	11	8	13	9	15	7	
Hispanic, %	13	12	11	12	7	12	
Education							<0.01
<HS, %	7	6	4	3	4	4	
HS, %	46	45	41	38	33	33	
College Degree, %	47	50	54	58	63	62	
Income level							<0.01
Above Poverty Threshold	93	94	94	93	96	95	
Below Poverty Threshold	7	6	6	7	4	5	

[†]Adjusted Wald tests were used to compare the proportion of participants in socio-demographic categories across time use patterns.

Soc Sci Med. Author manuscript; available in PMC 2015 May 01.

Table 2

Unadjusted mean time spent in select activities by non-labor market time pattern (N=28,437)

Males

	Screen	Housework	Sedentary Leisure	Caregiving	Community	Exercise
Percent in pattern	47%	12%	18%	10%	5%	7%
	Min/day (SE)	Min/day (SD)	Min/day (SD)	Min/day (SD)	Min/day (SD)	Min/day (SD)
Sleep	483 (2)	436* (3)	409* (3)	441* (3)	435* (5)	436* (4)
Screen time	147 (2)	106* (3)	61* (2)	76* (2)	68* (4)	83* (3)
Sedentary Leisure	31 (1)	47* (2)	171* (3)	38* (2)	51* (3)	44* (2)
Eating	67 (1)	66 (1)	65 (1)	63* (1)	63 (2)	66* (2)
Community	1 (0.1)	3* (0.3)	3* (0.3)	4* (0.6)	167* (4)	4* (1)
Sedentary transportation	61 (1)	68* (2)	116* (2)	78* (2)	88* (3)	83* (3)
Food preparation	10 (3)	29* (1)	10 (0.5)	20* (1)	10 (1)	12* (1)
Caregiving	8 (0.2)	15* (1)	11* (1)	168* (3)	19* (1)	12* (1)
Active transportation	3 (0.1)	3 (0.3)	11* (1)	3* (0.3)	3 0.5)	5* (0.5)
Housework	3 (0.2)	43* (2)	4* (0.3)	8* (0.7)	7* (2)	6* (1)
Yardwork	15 (0.5)	135* (4)	16* (1)	15 (1)	18* (2)	21* (1)
Exercise	4 (0.2)	6* (0.5)	6* (0.4)	5* (0.4)	5 (0.8)	127* (3)

Females

	Screen	Housework	Sedentary Leisure	Caregiving	Community	Exercise

Percent in pattern	38%	20%	20%	14%	4%	4%
	Min/day (SD)	Min/day (SD)	Min/day (SD)	Min/day (SD)	Min/day (SD)	Min/day (SD)
Sleep	495 (2)	449* (2)	421* (3)	449* (2)	444* (5)	444* (5)
Screen time	134 (2)	89* (2)	49* (2)	59* (2)	52* (3)	69* (4)
Sedentary Leisure	32 (1)	51* (2)	161* (3)	34 (1)	49* (4)	53* (3)
Eating	62 (1)	58* (1)	56* (1)	52* (1)	54* (3)	64 (3)
Community	2 (0.2)	4* (0.3)	3* (0.3)	3* (0.3)	162* (5)	4 (1)
Sedentary transportation	61 (1)	64* (1)	105* (2)	78* (1)	85* (3)	76* (2)
Food preparation	21 (0.5)	54* (1)	16* (1)	35* (1)	25 (2)	21 (1)
Caregiving	9 (0.3)	18* (1)	14* (1)	167* (3)	19* (2)	11 (1)
Active transportation	3 (0.2)	3* (0.2)	9 (0.7)	3 (0.2)	3 (1)	5* (1)
Housework	9 (0.4)	85* (2)	11* (1)	17* (1)	18* (2)	14* (2)
Yardwork	12 (0.4)	53 (2)	14 (1)	11 (1)	20 (2)	17 (1)
Exercise	4 (0.2)	6* (0.4)	6* (0.3)	5 (0.4)	7* (1.4)	113* (3.3)

*From unadjusted linear regression, mean min/day significantly different from Screen time pattern, p<0.05

Table 3

Associations of Non-Labor Market Time Patterns with Daily Physical Activity (N=28,437)[†]

Predicted percent achieving ≥30 min/day moderate-to-vigorous physical activity				
	Men (N=X)		Women (N=)	
	Predicted %	SE	Predicted %	SE
Screen	21	0.6	19	0.7
Housework	58*	1.5	41*	1.3
Sedentary Leisure	21	0.9	20	1.0
Caregiving	40*	1.6	29*	1.4
Community	22	2.0	22	2.4
Exercise	79*	1.6	81*	2.1
Predicted total daily MET-h				
	Men		Women	
	Predicted MET-h	SE	Predicted MET-h	SE
Screen	38	0.1	37	0.1
Housework	43*	0.2	41*	0.1
Sedentary Leisure	39*	0.2	39*	0.1
Caregiving	41*	0.2	41*	0.1
Community	39*	0.2	39*	0.3
Exercise	44*	0.2	44*	0.3

[†]From log binomial models (moderate-to-vigorous physical activity) and linear regression (total daily METh), controlling for total hours worked in the formal labor market on interview day, marital status, presence of children in the household, year, race/ethnicity, income, and education.

*Significantly different than Screen time use pattern, $p<0.05$