

## Working multiple jobs over a day or a week: Short-term effects on sleep duration

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### ABSTRACT

Approximately 10% of the employed population in the United States works in multiple jobs. They are more likely to work long hours and in nonstandard work schedules, factors known to impact sleep duration and quality, and increase the risk of injury. In this study we used multivariate regression models to compare the duration of sleep in a 24-hour period between workers working in multiple jobs (MJHs) with single job holders (SJHs) controlling for other work schedule and demographic factors. We used data from the Bureau of Labor Statistics US American Time Use Survey (ATUS) pooled over a 9-year period (2003–2011). We found that MJHs had significantly reduced sleep duration compared with SJHs due to a number of independent factors, such as working longer hours and more often late at night. Male MJHs, working in their primary job or more than one job on the diary day, also had significantly shorter sleep durations (up to 40 minutes less on a weekend day) than male SJHs, even after controlling for all other factors. Therefore, duration of work hours, time of day working and duration of travel for work may not be the only factors to consider when understanding if male MJHs are able to fit in enough recuperative rest from their busy schedule. Work at night had the greatest impact on sleep duration for females, reducing sleep time by almost an hour compared with females who did not work at night. We also hypothesize that the high frequency or fragmentation of non-leisure activities (e.g. work and travel for work) throughout the day and between jobs may have an additional impact on the duration and quality of sleep for MJHs.

### KEYWORDS

Injury; multiple job holders; sleep duration

## Introduction

Over the past five decades there have been many changes in the nature of work in the United States, primarily driven by shifts in the economy, technological advances and globalization (Wilpert, 2009). An important component of that change has been a shift to 24/7 availability of services (Weil, 2014). Work schedules have become more varied (Presser & Gornick, 2005; McMenemy, 2007) where flexible work schedules and shift work for full-time wage workers increased dramatically from 12% of the workforce in 1985 to 28% in 2004 (BLS, 2005). These changes in the nature of work and recent economic declines have led workers to seek additional jobs for supplemental income (Tilly, 1991; Polvika, 1996); others may seek additional employment to pursue hobbies or entrepreneurial opportunities (Kopp, 1977; Kimmel & Conway, 1995; Hipple, 2010).

Multiple job holders (MJHs), defined as those working more than one job in a one-week period, now make up 10% of the US workforce and are more likely than single job holders (SJHs) to be working in part-time work, work greater than 50 hours a week, as on-call workers or independent contractors, and work the evening shift or other non-regular schedule (Marucci-Wellman et al., 2014). Although there has been limited research on the health effects for MJHs, an elevated risk of work-related fatalities was reported in Kentucky (Bush et al., 2013), and an elevated risk of work-related injuries to teens working in more than one job was found in Wisconsin (Zierold et al., 2011). Additionally, using the US National Health Interview Survey (NHIS) data pooled over 15 years (1997–2011), an elevated risk of work-related injury *and* non-work-related injury was found for MJHs compared with SJHs, even after controlling

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for usual weekly work hours (Marucci-Wellman et al., 2013).

Data from the American Time Use Survey (ATUS) have shown that MJHs working multiple jobs during a 24-hour period averaged more than two additional work hours than SJHs, participated more in work at nonstandard hours of the day (i.e. between 1700 and 2300 hours), and had more work-travel time, less sleep and less time for other household and leisure activities compared to SJHs (Marucci-Wellman et al., 2014). Using the ATUS data, Basner et al. (2014) reported that time spent working and traveling for work were the primary activities exchanged for sleep in a 24-hour time window, and that those who started work earlier in the morning slept less that same day. Since work is the predominant activity on days that we work and is usually a rigidly defined activity (e.g. our manager expects us to show up and leave at certain times), there is great opportunity for work time for MJHs to become too long or too fragmented and to occur at all hours of the day compared to a defined, routine, contiguous period that SJHs might experience. It could be suggested that MJHs are more likely to be working unusual rotating shifts in order to fit two jobs into a work day or week compared to SJHs. Work schedule guidelines, including rest breaks, have been developed for employers and employees to alleviate the potential for fatigue on the job resulting from long work hours and work at night (Dembe et al., 2005; Folkard et al., 2005; Caruso et al., 2006). However, most of these scheduling guidelines focus on flexibility afforded by a single employer, assuming that the employer can adjust the rotation or length of schedules of their employees to get work done safely around the clock. Additional work being done for an alternate employer may compromise the safety of a worker unbeknownst to either employer, and for many service workers (e.g. transport, hospital), may also compromise the safety of people around them (Marucci-Wellman et al., 2014).

A body of research has demonstrated that long and irregular work hours affect sleepiness, fatigue, impair performance and elevate the risk of a work-related injury (Smith et al., 1994; Folkard, 1997; Folkard & Tucker, 2003; Dembe et al., 2005; Folkard & Lombardi, 2006; Basner et al., 2007; Lombardi et al.,

2010; Williamson et al., 2011; Arlinghaus et al., 2012; Lombardi et al., 2012; Basner et al., 2014). Specific components of work schedules found to be related to fatigue when accumulated over consecutive shifts include: long work hours, lack of rest breaks, work during the early morning and late at night or on rotating shifts (Folkard et al., 2005; Folkard & Lombardi, 2006; Lombardi et al., 2014).

Fatigue-related performance problems arise from chronic partial sleep deprivation (e.g. reducing sleep by one hour over several nights) or short-term severe sleep restriction (e.g. a very short sleep duration the previous night) (Williamson et al., 2011). The most prominent aspect of human circadian rhythm is the pronounced 24-hour pattern of sleep and wakefulness (Akerstedt, 2003). Interruptions in the circadian rhythm, such as those which occur when one is performing night work, produce sleep debt and a homeostatic drive to sleep (Williamson et al., 2011). Day-sleep after night-work can be reduced by as much as 4 hours and is generally described as less restorative than night-sleep after day work (Kantermann et al., 2010). The reduction in sleep time and quality during episodes of night work will have a larger impact on health and safety in workers who are fighting their biologic clock which is optimized for work and sleep at certain times of the day (Roenneberg et al., 2007; Vetter et al., 2015). Other reasons for accumulating sleep debt in night workers is social jetlag (Wittmann et al., 2006), e.g. workers staying awake to maintain social relationships during the daytime hours or interruptions present at home during the day such as light and noise (Wittmann et al., 2006).

The objective of this study was to further explore the duration of sleep for MJHs compared with SJHs, using data from the ATUS. More specifically, we aimed to test whether there was a difference in the duration of sleep among MJHs compared with SJHs during the 24-hour diary period, after accounting for total work hours in the same period and time of the day that work occurred. Secondly, we explored other structural characteristics of the day which may affect the duration and quality of sleep, such as the fragmentation of activities across a 24-hour period, and the ability (or lack thereof) to sleep between jobs.

## Materials and methods

### *The American Time Use Survey*

The ATUS (2015), administered by the US Census Bureau for the Bureau of Labor Statistics (BLS), is a probability-weighted, cross-sectional survey that randomly selects one person, aged 15 years or older, from each household to be interviewed from a subset of households that have completed their eighth and final month of interviews for the Current Population Survey, the primary source of labor force statistics for the United States.

Approximately 2100 people are randomly selected to be interviewed each month (response rate for 2003–2011 ranged between 53% and 57%). The goal of ATUS is to develop nationally representative estimates of how people spend their time. Respondents are interviewed by telephone with a structured interview including demographics, work and home life characteristics. Respondents also complete a separate diary component wherein they provide the start and end times of every activity they participated in during the 24-hour period prior to the interview (starting at 0400 hours until the next 0400). Each activity recorded over the 24-hour period is coded by trained coders at the ATUS telephone center into 6-digit detailed activity codes housed in a lexicon (BLS, 2014). For the analyses in our study, these 406 lexicon activities were collapsed into 8 major categories and 17 subcategories (category designation can be found in Marucci-Wellman et al., 2014).

The 2003–2011 pooled data are available from the BLS which includes sample weights constructed so that all sample records when weighted will represent the US population on an individual day. We restricted our cohort of workers to those who reported being “Employed, at work” or “Employed, absent” in the last week, those who recorded some time working at a primary or other job on the diary day, and those aged 18 years and older (since adolescents can have very different work and lifestyles from adults, yet often work in multiple jobs).

### *Diary day work-group classification*

We classified workers as SJHs or MJHs by using a subsequent question: “In the LAST SEVEN DAYS, did you have more than one job [or business],

including part-time, evening or weekend work?” Those responding “yes” were categorized as MJHs; those responding “no” were categorized as SJHs. We then used the diary component of the interview to further classify workers into four separate diary groups for inclusion in the study depending on whether they were working in their primary job (separate groups for MJHs and SJHs, activity code 050101), at their other job (activity code 050102) or multiple jobs (primary and other jobs, activity codes 050101 and 050102) on the diary day; MJHs and SJHs who did not report working on the diary day were excluded from this study.

### *Time of day working*

We created two variables to account for the time of day working. The *first reported work time* was categorized into one of three time periods in the 24-hour diary period based on the first report of work (primary or other) during the diary day: (1) early morning (between 0500 and 1059), (2) early afternoon (between 1100 and 1459) or (3) late afternoon/evening/night (between 0400–0459 and/or between 1500 and 0400). If a respondent reported working at the start of the diary day (0400), we assumed that the respondent was continuing work that was begun before the onset of the diary period and was classified into the category for late afternoon/evening/night.

Since workers could begin their first episode of work early in the day and still work into the night we created a separate variable to identify *any work late at night*. Work at night was assigned as yes or no depending on whether there was any occurrence of working in the primary or other job between 2200 and 0259 on the diary day.

### *Duration of sleep time*

The dependent variable in our analyses is the total duration of sleep in the entire 24-hour diary period. This was calculated by summing all time episodes of ATUS-defined sleep activities for each individual included in the study (activity codes: 010101, 010102 and 010199).

Interviewers record the start and end time of each activity in the time use diary. The actual start and end times of the final activity in the diary are

also recorded (although it may go beyond the 0400 diary end time) and are available in the data but are not considered as part of the 24-hour “diary day” since the last activity will have inconsistent end times. In our primary analyses, comparing the mean duration of all sleep time in the 24-hour diary day period, we do not include time that occurs beyond 0400, the specified 24-hour diary end point. However, in a secondary analysis, we do use the full duration of the last activity to estimate the average length of a continuous night sleep for each work-diary group for those who report sleeping as their final activity on the diary day (for an illustration of the diary data and sleep duration calculations see examples below).

For drivers, such as this taxi driver, time spent in the main task of driving for job is coded as work in main job versus travel related to working. Commuting to or from work is considered as travel related to working and is indicated by an asterisk in the examples.

### **Duration of work or travel for work on diary day**

Since Basner et al. (2007) found that duration of time at work and time spent traveling for work in a 24-hour period are inversely related to the opportunity for and duration of sleep, we determined the duration of these two activities by summing all time episodes of work at primary (activity code 050101) and other (activity code 050102) jobs and travel for

work (activity codes: 180501, 180502 and 180589) for each individual included in the study.

### **Total number of activity episodes**

In order to provide a sense of the fragmentation of activities across the 24-hour period, we reported the mean frequency of activity episodes across the diary day, overall and for each of the 8 broad and 17 subcategories. If a worker did not participate in an activity, they contributed a count of zero to the calculation of the mean. Due to the nature of the diary data collection (0400 hours–0400 hours), a continuous overnight sleep episode would have an activity episode count of 2, one episode of early morning sleep at the start of the diary day and one episode of late night sleep at the end of the diary day (see prior examples).

### **Additional variables**

We also evaluated other variables that are known to be related to sleep: age, gender, education, presence of a spouse or partner in the household, presence of children younger than 18 years in the household, occupation category, industry category, and weekend day or weekday diary day. ATUS Occupation codes were assigned according to the US Census Bureau’s Occupation Classification System, which is based on the Standard Occupational Classification. ATUS industry codes

**Example 1:** Multiple Job Holder working Primary Job as Taxi Driver: Activity Durations

Activity	Start Time	End Time	Activity Code	Activity
1	0400	0900	010101	Sleeping=300 min
2	0900	0945	010102	Sleeplessness = 45 min
3	0945	1000	180501	Travel related to working = 15 min
4	1000	1045	050102	Work, other jobs(s) = 45 min
5	1045	1105	180501	Travel related to working = 20 min
6	1105	1110	180782	Travel related to shopping, except grocery = 5 min
7	1110	1120	070104	Shopping, except groceries, food and gas = 10 min
8	1120	1125	180782	Travel related to shopping, except grocery = 5 min
9	1125	1215	110101	Eating and drinking = 50 min
10	1215	1300	180501	Travel related to working = 45 min
11	1300	0045	050101	Work, main job = 705 min
12	0045	0100	180501	Travel related to working = 15 min
13	0100	0200	120303	Television and movies, not religious = 60 min
14a	0200	0400	010101	Sleeping = 120 min

For primary analyses sleep time is truncated at 0400. (Total duration sleeping for 24-hour period=665 min)

For secondary alternative analyses sleep time (activity 14) was not truncated at 0400: Start time 0200, End time 0900, activity code 010101 (Total duration of continuous last sleep = 420 min).

**Example 2:** Single Job Holder working on diary day: Activity Durations

Activity	Start Time	End Time	Activity Code	Activity
1	0400	0630	010101	Sleeping = 150 min
2	0630	0700	110101	Eating and drinking = 30 min
3	0700	0730	030101	Physical care for hh children = 30 min
4	0730	0745	050102	Travel related to caring for, helping children = 15 min
5	0745	0755	030112	Picking up/dropping off hh children = 10 min
6	0755	0815	180501	Travel related to working = 20 min
7	0815	1300	050101	Work, main job = 285 min
8	1300	1325	180501	Travel related to working = 25 min
9	1325	1600	010101	Sleeping = 155 min
10	1600	1615	180381	Travel related to caring for, helping children = 15 min
11	1615	1620	030112	Picking up/dropping off hh children = 5 min
12	1620	1635	180381	Travel related to caring for, helping children = 15 min
13	1635	1830	010301	Health-related self-care = 115 min
14	1830	1900	020201	Food presentation = 30 min
15	1900	1930	110101	Eating and drinking = 30 min
16	1930	2200	120303	Television and movies, not religious = 150 min
17	2200	0400	010101	Sleeping = 360 min

For primary analyses sleep time is truncated at 0400. (Total duration sleeping for 24-hour period=665 min)

For secondary alternative analyses sleep time (activity 17) was not truncated at 0400: Start time 2200, End time 0630 (Total duration of continuous sleep = 510 min)

were assigned according to the North American Industry Classification System.

### Analyses

Since we were reporting on diary activities on a single day, we reported on the average daily number of workers for each characteristic using a daily sample weight. This was obtained by dividing the annual sample weight value by the number of days in that 9-year period or 3287 days (e.g. 365 days per year; 366 days per leap year) (ATUS, 2015). Using PROC SURVEYMEANS (SAS version 9.4, SAS Institute, Cary, NC) with the DOMAIN statement, we calculated weighted average daily population estimates ( $\pm 95\%$  confidence intervals) for the four diary groups and the aforementioned variables from the structured interview and additional diary day variables.

### Multivariate model of the total daily duration of sleep

We used multivariate regression models, with PROC SURVEYREG in SAS 9.4 to determine if sleep duration on the diary day between any of the four diary work groups was significantly different after controlling for the reciprocals of sleep (e.g. work hours, travel for work hours), time of day working (e.g. first reported work time, any work late at night), and the

other factors known to be related to sleeping. Since gender and weekday versus weekend day were related to sleep duration and also related to other variables included in the model (e.g. MJH status, and varying work schedules), we stratified our analyses to explore the possibility of effect modification by these variables (Duffy et al., 2011; Wirtz et al., 2011; Burgard & Ailshire, 2013; Marucci-Wellman et al., 2014). SJHs working on the diary day were the referent group for the three MJH working groups.

Assuming that MJHs working both primary and other jobs on the diary day have the most constrained work and, hence, sleep schedule, we further investigated other aspects of the structure of activities throughout the day: (1) the overall activity episode counts during the 24-hour diary period and compared with SJHs; (2) the duration of the last sleep (which occurred through 0400 hours at the end of the diary day) and compared with SJHs; and (3) the number and duration of activities that occurred between jobs (primary/other or other/primary) including sleep duration for those who reported sleeping between jobs. These analyses were also stratified by weekday/weekend diary day and gender.

### Results

The employed population aged 18 years or older interviewed by the US Census over the 9-year period and who reported working on the diary

day included a total of 44 752 workers with 5611 (13%) MJHs and 39 141 (87%) SJHs. When weighted, this represents daily averages of 11.6 million MJHs and 89 million SJHs, aged 18 years and older, working in the United States in 2003–2011 (Table 1). These 22 961 males and 21 791 females working on the diary day represent 100.6 million workers daily (55.6 million male workers and 45 million female workers); 85.5% of males and 86.5% of females worked weekdays and 14.5% of males and 13.5% of females worked a weekend day. While MJHs comprised 10.5% of the working population on a weekday, they comprised 17.3% of the working population on a weekend day.

Similar differences were observed in the distribution of the first-reported work time on the diary day. Ten percent to 13% of workers (males/females) had a first-reported work time between 1500 and 0459 hours on weekdays, 29–30% of workers had the same category of first-reported work time on weekend days (Table 1).

On average, proportionally more females and males worked fewer than 6 hours on weekend days compared with weekdays, and proportionally more females worked fewer hours than men on both weekdays and weekend days (males 50.9% versus 14.3% weekend day/weekday respectively, females 57.4% versus 22.8% weekend day/weekday, respectively).

### **Sleep duration on diary day**

#### **Unadjusted sleep times**

Among those working on the diary day, the average time spent sleeping was 7.78 hours. Workers slept significantly longer on a weekend day compared to a weekday, (8.35 versus 7.69 hours respectively, Table 2). MJHs working both primary and other jobs on a weekday slept significantly less than SJHs (6.77 and 7.21 hours, male/female MJHs, respectively compared with 7.67 and 7.79 hours, male/female SJHs,  $p < 0.05$ ). MJHs working only at their primary job similarly slept significantly less. MJHs working in their other job on the diary day slept more hours than any diary group and significantly more than any other MJH group, regardless of the diary day or gender. Workers with a first-reported work time of 0500–1059 slept the least, especially on weekdays

(7.62 hours) compared to those whose first-reported work time was in the late afternoon/evening/night (1500–0459, 7.78 hours,  $p < 0.05$ ) or the early afternoon (1100–1459, 8.44 hours,  $p < 0.05$ ). Those who worked any time late at night (2200 through 0300) slept approximately one-half hour less than those who did not work late at night (males, 7.23 and 7.93 (weekday/weekend day) hours versus 7.69 and 8.38 hours; females, 7.32 and 7.93 hours versus 7.83 and 8.57 hours,  $p < 0.05$ , Table 2).

#### **Adjusted sleep times**

Based on the multivariate model, MJHs working both primary and other jobs on the diary day or working only their primary job on the diary day had less sleep time than SJHs even after controlling for all other variables in the model. Specifically, males working both primary and other jobs on the diary day had 0.37 hours less sleep ( $p < 0.05$ ) on a weekday and 0.64 hours less sleep ( $p < 0.05$ ) on a weekend day than SJHs. Males working only their primary job on the diary day had 0.25 hours less sleep ( $p < 0.05$ ) on a weekday and 0.35 hours less sleep ( $p < 0.05$ ) on a weekend day than SJHs. Female MJHs working only their primary job on weekdays had statistically less sleep than SJHs (0.17 hours less,  $p < 0.05$ , Table 3).

Having a first-reported work time during the late afternoon/evening/night (1500–0459) compared with the early morning (0500–1059) additionally resulted in significantly less sleep for males on a weekday (–0.16 hours,  $p < 0.05$ ), but resulted in an increase in sleep on a weekend day (0.21 hours, Table 3). Similarly for females, there was significantly less sleep if the first-reported work start-time was in the early morning (0500–1059) compared with the early afternoon or late afternoon/evening/night for both weekday and weekend diary days (Table 3). Each additional hour spent working resulted in significantly less sleep time (both males and females and for weekday and weekend day ( $p < 0.05$ , Table 3)). For each additional hour spent traveling for work on the diary day, males slept 0.20 hours less on weekdays and 0.10 hours less on weekend days ( $p < 0.05$ ); for each


**Table 1.** Demographic and work characteristics, males versus females working on diary day and weekday versus weekend workers, The American Time Use Survey (2003–2011).

	All working on diary day						Males working on diary day (55.24%)						Females working on diary day (44.76%)					
	Weekday (M–F) <sup>a</sup>		Weekend day (Sa–Su) <sup>a</sup>		Weekday (M–F) <sup>a</sup>		Weekend day (Sa–Su) <sup>a</sup>		Weekday (M–F) <sup>a</sup>		Weekend day (Sa–Su) <sup>a</sup>		Weekday (M–F) <sup>a</sup>		Weekend day (Sa–Su) <sup>a</sup>			
	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%		
Overall	86 458 294	100.0	14 140 035	100.0	47 488 702	100.0	8 078 482	100.0	38 969 592	100.0	6 061 553	100.0						
Diary Day Work-group Classification																		
MJH: Worked only at primary job	5 095 289	5.9	1 142 963	8.1	2 690 366	5.7	621 467	7.7	2 404 924	6.2	521 496	8.6						
MJH: Worked only at other job	686 209	0.8	881 887	6.2	312 282	0.7	519 926	6.4	373 927	1.0	361 961	6.0						
MJH: Worked both primary & other jobs	3 333 181	3.9	419 826	3.0	1 864 496	3.9	237 441	2.9	1 468 685	3.8	182 385	3.0						
SJH: Worked at primary job	77 343 614	89.5	11 695 359	82.7	42 621 557	89.8	6 699 648	82.9	34 722 057	89.1	4 995 710	82.4						
First Reported Work Time on Diary Day																		
0500–1059	70 644 322	81.7	7 356 153	52.0	38 623 906	81.3	4 356 754	53.9	32 020 417	82.2	2 999 400	49.5						
1100–1459	6 000 263	6.9	2 589 405	18.3	2 872 646	6.0	1 350 925	16.7	3 127 618	8.0	1 238 481	20.4						
1500–0459	9 813 708	11.4	4 194 476	29.7	5 992 150	12.6	2 370 804	29.3	3 821 558	9.8	1 823 672	30.1						
Any Work at Night on Diary Day (between 2200 and 0300)																		
Yes	11 080 999	12.8	3 021 897	21.4	6 825 615	14.4	1 740 568	21.5	4 255 384	10.9	1 281 329	21.1						
No	75 377 295	87.2	11 118 137	78.6	40 663 086	85.6	6 337 914	78.5	34 714 208	89.1	4 780 223	78.9						
Control Variables:																		
Age, years																		
18–24	9 986 610	11.6	2 085 868	14.8	5 248 226	11.1	1 138 544	14.1	4 738 384	12.2	947 323	15.6						
25–34	19 315 489	22.3	3 012 126	21.3	11 073 883	23.3	1 786 013	22.1	8 241 606	21.1	1 226 113	20.2						
35–54	41 410 082	47.9	6 475 324	45.8	22 701 200	47.8	3 678 871	45.5	18 708 882	48.0	2 796 452	46.1						
55+	15 746 112	18.2	2 566 718	18.2	8 465 393	17.8	1 475 053	18.3	7 280 719	18.7	1 091 664	18.0						
Mean age (95% CI)	41.6 (41.4, 41.7)		41.0 (40.6, 41.3)		41.5 (41.2, 41.7)		41.0 (40.5, 41.4)		41.7 (41.4, 41.9)		40.9 (40.4, 41.4)							
Occupation of Primary Job																		
Management, business, and financial	14 953 304	17.3	2 264 807	16.0	8 728 163	18.4	1 450 456	18.0	6 225 140	16.0	814 351	13.4						
Production	5 802 422	6.7	682 731	4.8	4 057 908	8.5	489 836	6.1	1 744 514	4.5	192 895	3.2						
Service	12 127 244	14.0	2 761 884	19.5	5 363 135	11.3	1 292 448	16.0	6 764 109	17.4	1 469 436	24.2						
Sales and related	9 017 052	10.4	2 067 362	14.6	4 772 592	10.1	1 090 451	13.5	4 244 460	10.9	976 910	16.1						
Office and administrative support	11 253 763	13.0	1 273 904	9.0	2 925 936	6.2	480 153	5.9	8 327 827	21.4	793 751	13.1						
Farming, fishing, and forestry	634 450	0.7	118 388	0.8	511 697	1.1	96 694	1.2	122 753	0.3	21 695	0.4						
Construction and extraction	4 971 727	5.8	518 232	3.7	4 844 326	10.2	507 967	6.3	127 402	0.3	10 266	0.2						
Installation, maintenance, and repair	3 298 554	3.8	419 007	3.0	3 177 155	6.7	409 162	5.1	121 400	0.3	9 845	0.2						
Professional and related (ref)	19 456 406	22.5	3 231 926	22.9	8 879 217	18.7	1 560 145	19.3	10 577 189	27.1	1 671 781	27.6						
Transportation and material moving	4 943 371	5.7	801 794	5.7	4 228 572	8.9	701 170	8.7	714 799	1.8	100 623	1.7						
Industry of Primary Job																		
Agriculture, forestry, fishing, and hunting	1 541 810	1.8	357 924	2.5	1 184 534	2.5	281 378	3.5	357 276	0.9	76 546	1.3						
Mining	397 955	0.5	66 946	0.5	366 929	0.8	60 697	0.8	31 027	0.1	6 249	0.1						
Construction	6 382 117	7.4	693 781	4.9	5 835 716	12.3	635 359	7.9	546 402	1.4	58 421	4.0						
Manufacturing	10 828 359	12.5	1 178 376	8.3	7 736 681	16.3	910 535	11.3	3 091 678	7.9	267 841	4.4						
Wholesale and retail trade	11 722 745	13.6	2 463 347	17.4	6 697 314	14.1	1 386 317	17.2	5 025 431	12.9	1 077 029	17.8						
Transportation and utilities	4 267 124	4.9	727 802	5.1	3 369 810	7.1	575 091	7.1	897 314	2.3	152 711	2.5						
Information	2 276 905	2.6	350 350	2.5	1 391 658	2.9	204 642	2.5	885 246	2.3	145 707	2.4						
Financial activities	6 859 469	7.9	847 323	6.0	3 154 758	6.6	465 799	5.8	3 704 711	9.5	381 524	6.3						

(Continued)

Table 1. (Continued).

	All working on diary day						Males working on diary day (55.24%)						Females working on diary day (44.76%)					
	Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>		Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>		Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>		Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>			
	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%	Weighted freq.	%		
Educational and health services (ref)	18 466 723	21.4	3 006 156	21.3	4 886 455	10.3	979 880	12.1	13 580 268	34.8	2 026 277	33.4						
Professional and business services	9 580 086	11.1	1 452 412	10.3	5 719 126	12.0	937 854	11.6	3 860 961	9.9	514 558	8.5						
Leisure and hospitality	5 793 615	6.7	1 777 891	12.6	2 819 987	5.9	946 159	11.7	2 973 628	7.6	831 732	13.7						
Other services	4 156 159	4.8	704 332	5.0	2 061 757	4.3	363 491	4.5	2 094 403	5.4	340 841	5.6						
Public administration	4 185 225	4.8	513 395	3.6	2 263 979	4.8	331 280	4.1	1 921 246	4.9	182 115	3.0						
Work Hours of Primary+Secondary Jobs on Diary Day																		
≤4	8 248 972	9.5	5 629 396	39.8	3 696 297	7.8	3 082 395	38.2	4 552 674	11.7	2 547 000	42.0						
4.01-6	7 405 656	8.6	1 957 247	13.8	3 077 197	6.5	1 025 062	12.7	4 328 458	11.1	932 186	15.4						
6.01-8	26 727 367	30.9	2 849 299	20.2	13 258 610	27.9	1 588 660	19.7	13 468 758	34.6	1 260 638	20.8						
8.01 to 10	29 529 050	34.2	2 102 231	14.9	17 314 107	36.5	1 261 079	15.6	12 214 943	31.3	841 151	13.9						
>10	14 547 248	16.8	1 601 862	11.3	10 142 490	21.4	1 121 285	13.9	4 404 758	11.3	480 577	7.9						
Mean Work Hours on diary day (95% CI)	8.0 (7.9, 8.0)		5.5 (5.5, 5.6)		8.4 (8.3, 8.4)		5.8 (5.7, 5.9)		7.5 (7.4, 7.5)		5.2 (5.1, 5.3)							
Presence of Child (<18) in Household (reference no)																		
Yes	36 946 494	42.7	6 017 324	42.6	20 497 912	43.2	3 425 075	42.4	16 448 582	42.2	2 592 250	42.8						
No	49 511 800	57.3	8 122 710	57.4	26 990 790	56.8	4 653 408	57.6	22 521 010	57.8	3 469 303	57.2						
Spouse or Partner Residing in Household (reference yes)																		
Yes	56 013 516	64.8	8 728 121	61.7	32 272 062	68.0	5 252 466	65.0	23 741 455	60.9	3 475 656	57.3						
No	30 444 777	35.2	5 411 913	38.3	15 216 640	32.0	2 826 017	35.0	15 228 137	39.1	2 585 897	42.7						
Highest Level of Education																		
High School Graduate or less	33 027 140	38.2	5 070 401	35.9	19 632 964	41.3	3 079 700	38.1	13 394 176	34.4	1 990 701	32.8						
Some college or Associate degree	23 469 804	27.1	4 004 431	28.3	11 828 518	24.9	2 224 796	27.5	11 641 285	29.9	1 779 635	29.4						
Bachelor's Degree or higher	29 961 350	34.7	5 065 203	35.8	16 027 219	33.8	2 773 986	34.3	13 934 131	35.8	2 291 217	37.8						

<sup>a</sup>M-F: Monday through Friday; Sa-Su: Saturday and Sunday.

**Table 2.** Mean total duration of sleep<sup>a</sup> over the 24-hour diary day (0400–0400) for work structure variables of interest by gender and weekday versus weekend (hours, unadjusted): The American Time Use Survey (2003–2011).

Total duration of sleep <sup>a</sup> over the 24-hour period (0400–0400)	All working on diary day						Males						Females											
	Weekday (M–F) <sup>b</sup>		Weekend day (Sa–Su) <sup>b</sup>		95% CI		Weekday (M–F) <sup>b</sup>		Weekend day (Sa–Su) <sup>b</sup>		95% CI		Weekday (M–F) <sup>b</sup>		Weekend day (Sa–Su) <sup>b</sup>		95% CI							
	Mean	SE	Mean	SE	Lower	Upper	Mean	SE	Mean	SE	Lower	Upper	Mean	SE	Mean	SE	Lower	Upper						
Working on Diary Day	7.69		7.67		(7.67, 7.72)	8.35		7.63		(8.30, 8.40)	7.63		7.59		(7.59, 7.66)	8.28		7.77		(7.74, 7.81)	8.43		(8.36, 8.50)	
Diary day work-group classification																								
MJH: Worked only at primary job	7.55		(7.44, 7.67)			8.05		7.44		(7.89, 8.21)	7.93		(7.26, 7.63)		(7.69, 8.16)	7.68		(7.54, 7.82)		(7.98, 8.42)				
MJH: Worked only at other job	8.42		(8.10, 8.73)			8.59		8.15		(8.43, 8.76)	8.59		(7.69, 8.62)		(8.35, 8.82)	8.64		(8.23, 9.05)		(8.38, 8.82)				
MJH: Worked both primary & other jobs	6.96		(6.85, 7.07)			7.37		6.77		(7.06, 7.68)	6.98		(6.62, 6.92)		(6.57, 7.39)	7.21		(7.05, 7.36)		(7.46, 8.29)				
SJH: Worked at primary job	7.73		(7.70, 7.75)			8.39		7.67		(8.34, 8.45)	8.34		(7.63, 7.71)		(8.26, 8.42)	7.79		(7.76, 7.83)		(8.39, 8.54)				
Time of Day Working:																								
First reported work time:																								
0500–1059 (reference)	7.62		(7.59, 7.64)			7.96		7.57		(7.90, 8.02)	7.91		(7.54, 7.61)		(7.83, 7.99)	7.67		(7.64, 7.70)		(7.94, 8.12)				
1100–1459	8.44		(8.32, 8.56)			9.13		8.49		(9.02, 9.24)	9.17		(8.31, 8.67)		(9.00, 9.34)	8.39		(8.24, 8.54)		(8.95, 9.23)				
1500–0459	7.78		(7.68, 7.88)			8.54		7.56		(8.44, 8.64)	8.47		(7.43, 7.70)		(8.32, 8.62)	8.12		(7.96, 8.28)		(8.51, 8.78)				
Any Work at Night on Diary Day (between 2200 and 0300)																								
Yes	7.26		(7.17, 7.35)			7.93		7.23		(7.82, 8.05)	7.93		(7.10, 7.35)		(7.78, 8.09)	7.32		(7.19, 7.45)		(7.78, 8.09)				
No (reference)	7.76		(7.73, 7.78)			8.46		7.69		(8.40, 8.52)	8.38		(7.66, 7.73)		(8.30, 8.46)	7.83		(7.79, 7.86)		(8.49, 8.64)				

<sup>a</sup> Lexicon activity codes: 010101, 010102, 010199.<sup>b</sup> M–F: Monday through Friday; Sa–Su: Saturday and Sunday.

**Table 3.** Difference in predicted mean sleep time (Diff MST, hours) compared with reference groups by gender and weekday versus weekend day.

	Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>		Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>	
	Diff MST	95% CI	Diff MST	95% CI	Diff MST	95% CI	Diff MST	95% CI
Intercept (Hours sleeping, Ref)	7.57 <sup>b</sup>	(7.42, 7.72)	8.19 <sup>b</sup>	(7.93, 8.46)	7.83 <sup>b</sup>	(7.72, 7.94)	8.23 <sup>b</sup>	(8.01, 8.44)
Diary Group (Ref: single job holders)								
MJH: Worked at both primary & other jobs	-0.37 <sup>b</sup>	(-0.51, -0.23)	-0.64 <sup>b</sup>	(-0.97, -0.30)	-0.12	(-0.26, 0.02)	-0.09	(-0.45, 0.26)
MJH: Worked only at other job	0.12	(-0.29, 0.54)	0.24	(-0.02, 0.49)	0.33	(-0.09, 0.75)	0.002	(-0.22, 0.23)
MJH: Worked only at primary job	-0.25 <sup>b</sup>	(-0.43, -0.07)	-0.35 <sup>b</sup>	(-0.59, -0.11)	-0.17 <sup>b</sup>	(-0.31, -0.03)	-0.20	(-0.41, 0.02)
Time of Day Working								
First reported work time (Ref: 0500-1059)								
1100-1459	0.44 <sup>b</sup>	(0.25, 0.64)	0.82 <sup>b</sup>	(0.64, 1.00)	0.34 <sup>b</sup>	(0.18, 0.50)	0.81 <sup>b</sup>	(0.63, 0.98)
1500-0459	-0.16 <sup>b</sup>	(-0.30, -0.03)	0.21 <sup>b</sup>	(0.04, 0.39)	0.27 <sup>b</sup>	(0.10, 0.44)	0.39 <sup>b</sup>	(0.22, 0.57)
Any Work on Diary Day between 2200 and 0300 (Ref: No)								
Yes	-0.20 <sup>b</sup>	(-0.33, -0.08)	-0.14	(-0.32, 0.04)	-0.51 <sup>b</sup>	(-0.64, -0.37)	-0.51 <sup>b</sup>	(-0.69, -0.33)
Reciprocals of Sleep								
Work hours primary + secondary jobs <sup>c</sup>	-0.18 <sup>b</sup>	(-0.20, -0.17)	-0.18 <sup>b</sup>	(-0.20, -0.16)	-0.14 <sup>b</sup>	(-0.15, -0.12)	-0.17 <sup>b</sup>	(-0.19, -0.14)
Travel for work on diary day	-0.20 <sup>b</sup>	(-0.24, -0.16)	-0.10 <sup>b</sup>	(-0.18, -0.03)	-0.15 <sup>b</sup>	(-0.21, -0.10)	-0.02 <sup>b</sup>	(-0.15, 0.11)
Demographic								
Age <sup>c</sup>	-0.005 <sup>b</sup>	(-0.009, -0.002)	-0.009 <sup>b</sup>	(-0.014, -0.003)	-0.013 <sup>b</sup>	(-0.016, -0.010)	-0.016 <sup>b</sup>	(-0.021, -0.010)
Occupation Group (Ref: Professional & Related)								
Transport & material moving	0.13	(-0.05, 0.32)	0.03	(-0.31, 0.37)	-	(-0.44, 0.23)	0.36	(-0.20, 0.92)
Management, business and financial	0.04	(-0.07, 0.15)	-0.21	(-0.42, 0.00)	-0.09	(-0.19, 0.002)	-0.03	(-0.24, 0.18)
Production occupations	-0.06	(-0.23, 0.10)	-0.13	(-0.49, 0.22)	0.06	(-0.13, 0.26)	0.02	(-0.47, 0.52)
Service occupations	0.20 <sup>b</sup>	(0.03, 0.37)	0.01	(-0.29, 0.31)	0.05	(-0.07, 0.17)	0.01	(-0.20, 0.22)
Sales and related	0.11	(-0.05, 0.27)	0.06	(-0.22, 0.35)	0.07	(-0.07, 0.21)	0.03	(-0.25, 0.30)
Office & admin support	0.03	(-0.13, 0.19)	-0.38 <sup>b</sup>	(-0.73, -0.03)	-0.02	(-0.12, 0.07)	-0.09	(-0.36, 0.18)
Farm, fish, & forestry	0.16	(-0.26, 0.59)	0.34	(-0.28, 0.96)	0.09	(-0.40, 0.57)	0.58 <sup>b</sup>	(0.01, 1.15)
Construction & extraction	0.003	(-0.19, 0.19)	0.05	(-0.34, 0.44)	0.23	(-0.26, 0.71)	0.37	(-0.87, 1.61)
Install, maintenance, & repair	0.03	(-0.12, 0.19)	0.07	(-0.27, 0.41)	-0.27	(-0.69, 0.16)	1.64 <sup>b</sup>	(1.09, 2.19)
Industry Group (Ref: Educ. and Health Services)								
Agriculture, forestry, fishing and hunting	0.14	(-0.13, 0.41)	0.45 <sup>b</sup>	(0.01, 0.88)	-0.27	(-0.55, 0.02)	-0.35	(-0.82, 0.12)
Mining	0.18	(-0.23, 0.58)	-0.84	(-1.71, 0.03)	-0.20	(-0.76, 0.37)	1.84	(-0.02, 3.69)
Construction	0.10	(-0.08, 0.29)	-0.01	(-0.38, 0.36)	0.02	(-0.24, 0.28)	-0.50	(-1.13, 0.13)
Manufacturing	0.002	(-0.14, 0.14)	-0.001	(-0.30, 0.30)	-0.07	(-0.21, 0.06)	0.10	(-0.27, 0.47)
Wholesale and retail trade	0.09	(-0.08, 0.26)	0.19	(-0.12, 0.50)	0.15 <sup>b</sup>	(0.02, 0.28)	0.03	(-0.24, 0.31)
Transportation and utilities	-0.10	(-0.29, 0.09)	0.16	(-0.18, 0.50)	0.02	(-0.27, 0.30)	-0.43 <sup>b</sup>	(-0.84, -0.03)
Information	0.04	(-0.15, 0.23)	0.14	(-0.30, 0.58)	0.03	(-0.17, 0.24)	-0.54	(-1.17, 0.08)
Financial activities	0.08	(-0.10, 0.25)	0.04	(-0.31, 0.38)	0.10	(-0.01, 0.21)	-0.23	(-0.50, 0.04)
Professional and business services	0.06	(-0.09, 0.21)	0.22	(-0.05, 0.48)	0.08	(-0.04, 0.19)	0.06	(-0.19, 0.30)

(Continued)



Table 3. (Continued).

	Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>		Weekday (M-F) <sup>a</sup>		Weekend day (Sa-Su) <sup>a</sup>	
	Diff MST	95% CI	Diff MST	95% CI	Diff MST	95% CI	Diff MST	95% CI
Leisure and hospitality	0.27 <sup>b</sup>	(0.05, 0.48)	0.60 <sup>b</sup>	(0.24, 0.97)	0.25 <sup>b</sup>	(0.09, 0.40)	0.24	(0.000, 0.48)
Other services	0.19	(0.01, 0.36)	0.12	(-0.21, 0.45)	0.18 <sup>b</sup>	(0.03, 0.33)	-0.01	(-0.27, 0.26)
Public administration	-0.16 <sup>b</sup>	(-0.34, 0.01)	-0.29	(-0.63, 0.05)	0.02 <sup>b</sup>	(-0.10, 0.14)	-0.19	(-0.59, 0.21)
Education (Ref: Some College or Associate Degree)								
Bachelor degree or higher	0.07	(-0.03, 0.16)	-0.12	(-0.30, 0.05)	0.01	(-0.07, 0.10)	-0.07	(-0.24, 0.10)
High school graduate or less	0.26 <sup>b</sup>	(0.17, 0.35)	0.07	(-0.10, 0.25)	0.17 <sup>b</sup>	(0.09, 0.26)	0.08	(-0.09, 0.25)
Other Fixed Factors								
Presence of child (<18) in household (Ref.: no)	-0.02	(-0.10, 0.06)	-0.27 <sup>b</sup>	(-0.42, -0.12)	-0.19 <sup>b</sup>	(-0.26, -0.12)	-0.12	(-0.26, 0.02)
Spouse or partner household (Ref.: yes)	0.10 <sup>b</sup>	(0.01, 0.19)	0.07	(-0.10, 0.23)	-0.01	(-0.07, 0.06)	0.25 <sup>b</sup>	(0.12, 0.38)

<sup>a</sup> M-F: Monday through Friday; Sa-Su: Saturday and Sunday.

<sup>b</sup> Regression coefficient significant, difference in mean sleep time between work group and reference group significant ( $p < 0.05$ ).

<sup>c</sup> Difference in hours from mean in reference group include: mean hours/day working: male (Weekday = 8.4, Weekend day = 5.8); female (Weekday = 7.5, Weekend day = 5.2); mean age: male (Weekend day = 41, Weekday = 41), female (Weekend day = 40, Weekday = 41).

additional hour spent traveling for work on a weekday, females slept 0.15 hours less ( $p < 0.05$ ).

Those with any work late at night on the diary day had less sleep time compared with no work late at night on the diary day. On a weekday, males had 0.20 hours less sleep ( $p < 0.05$ ) if they worked late at night and females had 0.51 hours less sleep ( $p < 0.05$ ); on a weekend day there was no significant difference in sleep for males working late at night, but females still had significantly less sleep if they worked late at night (0.51 hours less,  $p < 0.05$ ).

Ninety-three percent and 90% of workers reported sleeping as the final activity on the weekend and weekday diary days, respectively (Table 4). The reduced sleep duration for MJHs working both primary and other jobs on the diary day compared with SJHs also held true for the continuous duration of the last sleep episode (Table 4). On weekdays, the duration of the last sleep episodes was significantly shorter for males in this group compared to females, with both genders having significantly shorter sleep episodes than SJHs. For males working both primary and other jobs on a weekend day, there still was a reduction in sleep time compared with SJHs but it was not statistically significant.

### **Mean number of activity episodes**

MJHs working both primary and other jobs on the diary day resulted in a greater overall number of activity episodes on the diary day compared with SJHs, which indicates a higher degree of daily fragmentation (Table 5). This disparity is statistically significant overall and for males only (20.00 versus 18.37 episodes,  $p < 0.05$ ). Not only are MJHs engaging in more work episodes but they are also participating in more travel for work episodes (MJH/SJH overall 2.54 versus 1.68 episodes, respectively, male: 2.56 versus 1.73 episodes and female: 2.50 versus 1.62 episodes,  $p < 0.05$ , Table 5). MJHs also had a *lower* frequency of leisure episodes (both males and females), less episodes of sports and exercise for males and less caretaking episodes for females ( $p < 0.05$ , Table 5).

### **Activities in-between jobs for MJHs working both primary and other jobs on the diary day**

MJHs working both primary and other jobs on the diary day had very little time in-between jobs (mean 2.02 hours, Table 6). These workers also reported several non-work activities between jobs (e.g. on average 4–5 activity episodes, Table 6) with travel for work the most frequently reported activity (Table 7, 25% of activities between jobs involved traveling for work). This may result in little time left for rest or sleep in-between jobs supported by our finding that only 8% of workers working two jobs on the diary day during the week actually engaged in sleep (for an average of 3 hours) between their jobs (15% on weekend days, Table 6).

### **Discussion**

In this study, using 24-hour activity diary data from the ATUS, we found long work hours, beginning work early in the morning and participating in work at night, were factors that significantly reduced sleep time. These findings support similar findings by others (Folkard et al., 2005; Basner et al., 2007; Luckhaupt, 2012; Basner et al., 2014; Lombardi et al., 2014). However, even after controlling for these factors, we found male MJHs working only their primary job or both primary and other jobs in a 24-hour diary period still had substantially less sleep than male SJHs. For male MJHs working normal work hours during normal times of the day, their sleep time would still be on average 40 minutes less than SJHs.

Approximately 10% of workers in the United States work more than one job every week and 3% work two or more jobs in a 24-hour period (Marucci-Wellman et al., 2013). We anticipate multiple job holding in the United States to grow substantially in the next few years as employment becomes ever more fragmented, as mid-skill full-time employees' earnings are devalued (Billitteri, 2010; Tankersley, 2014), and with the continuation of around-the-clock availability of services. If MJHs are not able to sleep long enough to recover and develop either chronic or acute sleep deprivation, they may operate in a reduced cognitive and physiological state with a greater likelihood of

**Table 4.** Mean sleep duration when sleep is recorded as the last activity of the diary day (and *not* censored at 0400) for each work diary group by gender and weekday versus weekend (hours, unadjusted): The American Time Use Survey 2003–2011.

Continuous duration of last sleep <sup>b</sup> episode of diary day (not censored at 0400) <sup>c</sup>	All working on diary day						Males			Females		
	Weekday (M–F) <sup>a</sup>		Weekend Day (Sa– Su) <sup>a</sup>		Weekday (M–F) <sup>a</sup>		Weekend Day (Sa– Su) <sup>a</sup>		Weekday (M–F) <sup>a</sup>		Weekend Day (Sa– Su) <sup>a</sup>	
	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI	
Working on Diary Day	7.70	(7.67, 7.72)	8.00	(7.95, 8.05)	7.69	(7.65, 7.73)	8.03	(7.97, 8.10)	7.70	(7.67, 7.74)	7.96	(7.89, 8.03)
Diary Day Work-group Classification												
MJH: Worked only at primary job	7.59	(7.46, 7.71)	7.79	(7.63, 7.95)	7.57	(7.37, 7.76)	7.82	(7.60, 8.04)	7.61	(7.45, 7.77)	7.76	(7.52, 8.01)
MJH: Worked only at other job	8.11	(7.86, 8.37)	7.72	(7.51, 7.94)	8.22	(7.85, 8.58)	7.67	(7.35, 7.99)	8.02	(7.67, 8.38)	7.80	(7.54, 8.06)
MJH: Worked both primary & other jobs	7.10	(6.97, 7.23)	7.78	(7.30, 8.25)	6.97	(6.81, 7.14)	7.54	(6.99, 8.09)	7.26	(7.06, 7.46)	8.06	(7.26, 8.85)
SJH: Worked at primary job	7.72	(7.70, 7.75)	8.05	(8.00, 8.10)	7.72	(7.69, 7.76)	8.10	(8.03, 8.17)	7.72	(7.69, 7.76)	7.99	(7.91, 8.06)
% of Workers Whose Last Activity on Diary Day was Sleeping (lexicon activity codes: 010101, 010102, 010199)	93.45	(93.09, 93.80)	90.30	(89.59, 91.00)	92.07	(91.54, 92.61)	89.28	(88.27, 90.29)	95.12	(94.68, 95.56)	91.64	(90.69, 92.60)
Diary Day Work-group Classification												
MJH: Worked only at primary job	92.54	(90.73, 94.34)	89.20	(86.66, 91.73)	89.48	(86.49, 92.48)	88.36	(84.63, 92.08)	95.96	(94.21, 97.70)	90.20	(86.87, 93.53)
MJH: Worked only at other job	94.44	(91.27, 97.61)	94.83	(93.01, 96.65)	93.87	(88.53, 99.21)	94.96	(92.44, 97.48)	94.92	(91.20, 98.64)	94.63	(92.07, 97.20)
MJH: Worked both primary & other jobs	93.06	(91.33, 94.80)	87.03	(82.12, 91.94)	91.64	(88.95, 94.33)	83.40	(75.62, 91.17)	94.87	(92.95, 96.80)	91.76	(87.37, 96.15)
SJH: Worked at primary job	93.51	(93.14, 93.88)	90.18	(89.39, 90.97)	92.24	(91.69, 92.79)	89.14	(88.02, 90.25)	95.07	(94.61, 95.54)	91.57	(90.50, 92.65)

<sup>a</sup> M–F: Monday through Friday; Sa–Su: Saturday and Sunday.

<sup>b</sup> Lexicon activity codes: 010101, 010102, 010199.

<sup>c</sup> The 24-hour diary is from 0400 the day before the survey to 0400 the day of the survey. If a person normally sleeps at night, the diary record will include two partial sleep episodes, i.e. sleeping normally from 2200 to 0600, the first sleep episode will be recorded between 0400 and 0600 (from the night before initiation of recording). The second sleep episode will include the time sleeping the night of the diary recording but censored at 0400 on the day of survey (e.g. 2200 to 0400). Interviewers also record the actual end time of the last activity which although after 0400 and not considered part of the diary day, can be used to calculate the continuous duration of the last sleep at night.

**Table 5.** Mean count of activity episodes per worker during 24-hour diary day (0400–0400 hours): multiple job holders (MJH) working both primary and other jobs compared with single job holders (SJH).

	All workers (18+) working on diary day: Activity episodes per worker <sup>a</sup>			Male workers (18+) working on diary day: Activity episodes per worker <sup>a</sup>			Female workers (18+) working on diary day: Activity episodes per worker <sup>a</sup>			
	MJH: Worked at both primary and other jobs			MJH: Worked at both primary and other jobs			MJH: Worked at both primary and other jobs			
	SJH	Mean	95% CI	SJH	Mean	95% CI	SJH	Mean	95% CI	
<b>Total<sup>a</sup></b>	<b>19.73*</b>	<b>(19.64, 19.82)</b>	<b>(20.47, 21.26)</b>	<b>18.37*</b>	<b>(18.26, 18.48)</b>	<b>(19.44, 20.47)</b>	<b>21.42</b>	<b>(21.29, 21.56)</b>	<b>22.03</b>	<b>(21.42, 22.63)</b>
<b>Personal Care</b>	<b>5.73</b>	<b>(5.71, 5.76)</b>	<b>(5.61, 5.81)</b>	<b>5.65</b>	<b>(5.62, 5.68)</b>	<b>(5.56, 5.83)</b>	<b>5.84</b>	<b>(5.81, 5.87)</b>	<b>5.72</b>	<b>(5.58, 5.87)</b>
Sleeping <sup>b</sup>	2.06	(2.05, 2.06)	(2.02, 2.09)	2.01	(2.00, 2.02)	(1.97, 2.05)	2.11	(2.10, 2.12)	2.11	(2.05, 2.16)
Other Personal Care <sup>c</sup>	1.63	(1.61, 1.64)	(1.59, 1.72)	1.52	(1.50, 1.54)	(1.45, 1.63)	1.76	(1.74, 1.77)	1.80	(1.71, 1.90)
Eating/Drinking <sup>d</sup>	2.05	(2.04, 2.07)	(1.93, 2.07)	2.12	(2.10, 2.14)	(2.05, 2.23)	1.97	(1.95, 1.99)	1.82	(1.72, 1.92)
<b>Household (HH) Activities</b>	<b>2.04*</b>	<b>(2.01, 2.07)</b>	<b>(1.77, 2.03)</b>	<b>1.45</b>	<b>(1.42, 1.48)</b>	<b>(1.18, 1.46)</b>	<b>2.77</b>	<b>(2.73, 2.82)</b>	<b>2.63</b>	<b>(2.41, 2.85)</b>
Housework <sup>e</sup> , Food/Drink Prep <sup>f</sup> , Animal/Pet Care <sup>g</sup> , HH Mgmt <sup>h</sup>	1.87	(1.84, 1.89)	(1.62, 1.87)	1.22	(1.20, 1.25)	(0.99, 1.24)	2.66	(2.62, 2.71)	2.54	(2.33, 2.76)
Interior/Exterior <sup>i</sup> Maintenance, Repair, Decoration <sup>k</sup>	0.17	(0.17, 0.18)	(0.12, 0.18)	0.23	(0.22, 0.24)	(0.16, 0.25)	0.11	(0.10, 0.12)	0.09	(0.06, 0.11)
<b>Caring for/Helping Household &amp; Nonhousehold Members</b>	<b>1.08*</b>	<b>(1.05, 1.10)</b>	<b>(0.82, 1.02)</b>	<b>0.74</b>	<b>(0.72, 0.77)</b>	<b>(0.65, 0.88)</b>	<b>1.49*</b>	<b>(1.45, 1.53)</b>	<b>1.11*</b>	<b>(0.95, 1.28)</b>
Children (<18 years) <sup>l</sup>	0.89	(0.87, 0.91)	(0.67, 0.86)	0.57	(0.55, 0.59)	(0.49, 0.70)	1.29	(1.25, 1.33)	0.98	(0.82, 1.14)
Adults (18+ years) <sup>m</sup>	0.18	(0.17, 0.19)	(0.13, 0.19)	0.17	(0.16, 0.18)	(0.13, 0.22)	0.19	(0.18, 0.21)	0.13	(0.10, 0.17)
<b>Work-Related Activities</b>	<b>2.46*</b>	<b>(2.44, 2.48)</b>	<b>(3.75, 3.93)</b>	<b>2.53*</b>	<b>(2.50, 2.55)</b>	<b>(3.85, 4.10)</b>	<b>2.38*</b>	<b>(2.36, 2.40)</b>	<b>3.68*</b>	<b>(3.55, 3.81)</b>
Primary Job	2.41	(2.39, 2.43)	(2.23, 2.37)	2.47	(2.45, 2.49)	(2.34, 2.55)	2.44	(2.31, 2.36)	2.12	(2.03, 2.21)
Other Job	–	–	(1.43, 1.54)	–	–	(1.41, 1.54)	1.47	–	1.49	(1.40, 1.58)
Primary Job + Other Job	2.41	(2.39, 2.43)	(3.69, 3.87)	2.47	(2.45, 2.49)	(3.79, 4.04)	2.34	(2.31, 2.36)	3.61	(3.49, 3.73)
<b>Education Activities</b>	<b>0.08</b>	<b>(0.07, 0.08)</b>	<b>(0.03, 0.08)</b>	<b>0.06</b>	<b>(0.05, 0.07)</b>	<b>(0.01, 0.08)</b>	<b>0.05</b>	<b>(0.09, 0.11)</b>	<b>0.06</b>	<b>(0.03, 0.10)</b>
<b>Participate in Sports, Exercise, &amp; Recreation</b>	<b>0.21*</b>	<b>(0.20, 0.21)</b>	<b>(0.14, 0.19)</b>	<b>0.22*</b>	<b>(0.21, 0.23)</b>	<b>(0.11, 0.18)</b>	<b>0.15*</b>	<b>(0.19, 0.21)</b>	<b>0.19</b>	<b>(0.14, 0.24)</b>
<b>Other Activities<sup>n</sup></b>	<b>3.54*</b>	<b>(3.50, 3.57)</b>	<b>(3.01, 3.27)</b>	<b>3.36*</b>	<b>(3.32, 3.40)</b>	<b>(2.86, 3.21)</b>	<b>3.03*</b>	<b>(3.70, 3.79)</b>	<b>3.27*</b>	<b>(3.08, 3.46)</b>
Other Leisure Activities <sup>o</sup>	3.05*	(3.03, 3.08)	(2.54, 2.77)	2.96*	(2.93, 3.00)	(2.48, 2.80)	2.64*	(3.12, 3.20)	2.67*	(2.51, 2.83)
Other Non-Leisure Activities <sup>p</sup>	0.48	(0.47, 0.49)	(0.43, 0.53)	0.40	(0.39, 0.41)	(0.33, 0.45)	0.39	(0.57, 0.60)	0.60	(0.51, 0.69)
<b>Travel</b>	<b>4.46*</b>	<b>(4.42, 4.49)</b>	<b>(4.87, 5.18)</b>	<b>4.23*</b>	<b>(4.18, 4.28)</b>	<b>(4.67, 5.08)</b>	<b>4.87*</b>	<b>(4.69, 4.80)</b>	<b>5.22*</b>	<b>(4.99, 5.46)</b>
Travel Related to Work <sup>q</sup>	1.68*	(1.66, 1.69)	(2.44, 2.63)	1.73*	(1.70, 1.75)	(2.44, 2.69)	1.62*	(1.60, 1.64)	2.50*	(2.34, 2.66)
Leisure Travel <sup>r</sup>	0.99*	(0.97, 1.01)	(0.79, 0.95)	1.01	(0.99, 1.04)	(0.81, 1.04)	0.92	(0.94, 0.99)	0.81*	(0.71, 0.90)
Non-Leisure Travel <sup>s</sup>	1.71*	(1.69, 1.74)	(1.39, 1.62)	1.41	(1.38, 1.45)	(1.14, 1.42)	1.28	(2.04, 2.13)	1.79*	(1.61, 1.97)
<b>NEC DataCodes</b>	<b>0.14</b>	<b>(0.14, 0.15)</b>	<b>(0.09, 0.14)</b>	<b>0.13</b>	<b>(0.12, 0.14)</b>	<b>(0.07, 0.13)</b>	<b>0.10</b>	<b>(0.15, 0.17)</b>	<b>0.14</b>	<b>(0.10, 0.17)</b>

<sup>a</sup> Activity groups where mean count of activity episodes per worker was less than 0.10 are not listed. The overall number of activity episodes per worker on the diary day is represented by the Total line. Workers who do not participate in an activity contribute a count of "0" to the calculation of the mean.

<sup>b</sup> Includes time spent sleeping, sleeplessness and sleeping NEC.

<sup>c</sup> Includes health-related self-care, personal care, washing dressing and grooming oneself, etc.

<sup>d</sup> Eating and drinking includes time spent eating and drinking (except when done as part of a work or volunteer activity), whether alone, with others, at home, at a place of purchase or somewhere else.

<sup>e</sup> Interior cleaning, laundry, sewing/repair, housework NEC.

<sup>f</sup> Food/drink preparation, presentation, clean up, food prep NEC.

<sup>g</sup> Care for animals/pets (not veterinary), and animal care NEC.

<sup>h</sup> Includes financial management, household/personal organization, mail, and email, security, and household management NEC.

<sup>i</sup> Interior arrangement, decoration, repair, build/repair furniture, heating/cooling, and interior maintenance NEC.

<sup>j</sup> Exterior cleaning, repair, improvements, decoration, and exterior maintenance NEC.

<sup>k</sup> Lawn, garden, houseplant, pond, pool, hot tub care/maintenance, and lawn/garden care NEC, self-repair/maintenance of vehicles, and vehicle repair NEC, self-repair/maintenance of appliances, tools and appliance repair NEC.



**Table 5.** (Continued).

- <sup>l</sup> Physical care, reading to, playing with (not sports), arts/crafts, playing sports, talking, organization/planning for, attending events, waiting for, picking up/dropping off, homework, school meetings, providing or obtaining medical care, other child care NEC.
- <sup>m</sup> Physical care, providing/obtaining medical care, waiting for, picking up/dropping off, organization/planning for, physical assistance, helping adults NEC.
- <sup>n</sup> Consumer purchases, professional/personal care services, household services, government services/civic obligations, socializing/relaxing/leisure, attending sports/recreational events, religious/spiritual activities, volunteer activities.
- <sup>o</sup> Shopping (not groceries/gas), socializing, attending parties/ceremony, personal meetings, social events, relaxing, tobacco/drug use, watching television/movies, listen to radio/music, playing games, computer use for leisure, arts/crafts, collecting, hobbies, reading/writing for personal interest, attending performing arts, museums, movies/film, gambling, watching live sporting events, attending religious services/events, volunteer work, telephone calls for leisure/socializing.
- <sup>p</sup> Grocery shopping, purchasing gas/food, researching purchases, using childcare services, using banking/other financial services, using health/medical/care services, using real estate services, using veterinary services, using professional personal services (e.g. cleaning, clothing repair, meal preparation, home maintenance, lawn/garden services), using police/fire services, using social services, obtaining licenses, paying fines/fees/taxes, civic obligations, telephone calls to/from service providers.
- <sup>q</sup> Travel related to working and work-related activities.
- <sup>r</sup> Travel related to eating/drinking, socializing, attending social events, relaxing, leisure, arts and entertainment, participating or attending sporting/recreational events, travel related to attending religious events, travel related to volunteer activities.
- <sup>s</sup> Travel related to personal care, household activities, caring for/helping household and non household individuals, travel related to education, travel related to consumer purchases, travel related to using financial, banking, or legal services, travel related to using real estate services, travel related to using medical, personal, health services, travel related to using household, lawn/garden, or maintenance services, travel related to using government services, travel related to civic obligations.
- \* Significant difference in mean number of activity episodes in 24-hour period (0400–0400) between MJH and SJH,  $p < 0.05$ .

**Table 6.** Mean time available between jobs, participation and duration in sleep between jobs and overall number of activities conducted between jobs: MJHs working both jobs on diary day.

	Workers (Wgt n)	Mean duration (hours)				Mean sleep duration (hours) between jobs <sup>a</sup>		Number of activities conducted between jobs	
		between jobs				Workers (Wgt n)	%	Mean	95% CI
All Workers	3 753 007	2.02	(1.88, 2.16)	307 960	8.21	3.33	(2.84, 3.81)	4.31	(4.07, 4.55)
Diary Day is WeekEnd (Sa–Su)	419 826	2.70	(2.32, 3.07)	64 286	15.31	3.27	(2.25, 4.28)	4.90	(4.17, 5.64)
Diary Day is WeekDay (M–F)	3,333 181	1.94	(1.79, 2.08)	243 673	7.31	3.34	(2.78, 3.9)	4.24	(3.98, 4.49)
Male	2 101 937	1.98	(1.78, 2.19)	183 286	8.72	3.64	(3.02, 4.25)	3.96	(3.65, 4.26)
Female	1 651 070	2.07	(1.89, 2.25)	124,673	7.55	2.87	(2.16, 3.58)	4.76	(4.39, 5.12)

<sup>a</sup>Analyses include only workers who reported sleeping between jobs.

**Table 7.** Ten most frequent activities and mean duration time spent (minutes) in each activity between jobs for MJHs working both primary and other jobs on diary day.

	% of Activities	Mean duration (minutes)	95% CI
All activities	100.0	36	(35, 37)
Travel related to working	25.4	28	(26, 30)
Eating and drinking	8.9	35	(32, 38)
Washing, dressing and grooming oneself	6.9	25	(23, 28)
Travel related to shopping (except grocery shopping)	4.0	20	(17, 23)
Television and movies (not religious)	3.6	74	(66, 82)
Food and drink preparation	3.4	28	(25, 31)
Socializing and communicating with others	3.3	45	(37, 52)
Travel related to eating and drinking	2.4	20	(16, 24)
Travel related to caring for and helping hh children	2.3	26	(21, 31)
Sleeping	2.2	199	(170, 228)

errors and accidents (Van Dongen et al., 2003; Kantermann et al., 2010; Williamson et al., 2011). This lack of recuperative rest may compromise the safety of not only themselves but also the safety of those around them. Additionally, short sleep duration is related not only to safety outcomes, but is also linked to increases in all-cause mortality (Cappuccio et al., 2010) and several chronic disease outcomes, such as diabetes (Gottlieb et al., 2005), hypertension (Gangwisch et al., 2006), cardiovascular disease (Ayas et al., 2003) and increases in BMI (Lombardi et al., 2012).

Proportionally, more MJHs than SJHs work long hours and late at night, highlighting the cumulative effect of multiple factors related to loss of sleep for MJHs. For instance, using the model coefficients in Table 3, a male MJH working two jobs in a 24-hour period, beginning the first job in the morning and the other late at night, and working greater than 12 hours that day, will sleep approximately 2.3 hours less than a regularly scheduled SJH, working between 0900 hours and 1700 hours. MJHs are more likely to adopt the unusual work schedule presented in this example than SJHs, are more likely to experience schedule

constraints and, therefore, may have compounding sleep deficits resulting in chronically less sleep.

The finding that sleep deficits remained for male MJHs compared with SJHs, even after controlling for many covariates related to reduced sleep, merits further attention. We were able to also explore the fragmentation and accumulation of activities over the 24-hour period. We found that MJHs had a higher frequency of work activity episodes, associated with a significantly higher frequency of travel for work activity episodes, and a lower frequency of leisure activity episodes throughout the day. While this analysis was based on counts alone with no time component, in our prior study we found similar results based on duration of time – for example the mean duration of time spent in leisure activities was also significantly lower for MJHs compared with SJHs (Marucci-Wellman et al., 2014). The findings presented here may suggest the potential for the accumulation or fragmenting of the non-leisure activities throughout the day to have an additional impact on sleep and leisure. The lack of substantial rest in-between jobs, and fewer leisure activities overall, combined with more travel for work and

work at night, especially if repeated for several days or weeks, may result in less sleep and reduced sleep quality for these workers, leading to fatigue and increased risk of adverse safety outcomes.

We also found that when working both primary and other jobs in a 24-hour period, workers had very little break time in-between jobs, about 2 hours on average. Very few workers slept during this time period and when they did sleep, it was only for a short duration. Instead, many workers spent time traveling from one job to another, among other activities (besides rest or sleep) between jobs. A large proportion of this group was also working late at night (33.5% MJHs working both primary and other jobs compared with 12.9% SJHs, data not shown) when most people are sleeping.

In addition, while mean sleep duration on a weekend day was always longer than on a weekday, male MJHs working both their primary and other jobs on a weekend day had the largest reduction in sleep time compared with SJHs. Weekends and non-workdays are often a time when workers retreat back to their natural sleep-wake times. The finding of a further reduction in sleep on weekend days for males working both primary and other jobs in a 24-hour period may reflect a possible move toward a state of chronic sleep reduction.

Female MJHs working only their primary job on a weekday (44% of all female MJHs) also had statistically significant reduced sleep time compared with female SJHs, after controlling for other variables related to sleep time. However, for the other female MJH diary groups, sleep time was not significantly different than SJHs in the multivariate model, indicating that the crude loss of sleep time (e.g. approximately 0.58 hours less sleep for females working both jobs on a weekday compared with SJHs) may be due to lack of statistical power or a stronger association of other factors related to sleep time in the model – such as working late at night. Females in general sleep more time than males, while working less in the traditional sense (with more part-time work), but are the primary caretakers of the family, engaging more in housework and caretaking activities (Burgard & Ailshire, 2013). In our study, females accumulated on average 1.6 times more of these activities over a 24-hour period compared to males.

We have become a 24/7 working time society without fully understanding the effects on workers' health and safety and public safety. Shifts in the economy (e.g. the recent recession) have forced many workers out of full-time jobs, or their earnings devalued (i.e. they have not had inflationary increases in pay). In order to make the earnings they were accustomed to prior to the recession, they may engage in more work, sacrificing time that normally would have been spent sleeping. We now know that workers who work multiple jobs, and especially those working long hours at odd times of the day, are going to sleep significantly less than SJHs and are, therefore, more likely to end up chronically sleep deprived which is known to result in errors or accidents in addition to other health consequences. Yet individuals may not realize when they are experiencing sleep deprivation at the level where performance degrades and risks are elevated. Consequently, they are not likely to reduce risk on their own by scheduling work better so they can sleep more (Van Dongen et al., 2003).

### **Benefits and limitations**

The ATUS is the largest annual survey of daily activities in the United States. It is strategically designed to report nationally representative time use for each day of the week and year and does not rely on a proxy response, which is important for reporting of certain activities that may not be as prominent or easily defined by others in a household, such as sleep time. Using this rich data source, we were able to effectively compare sleep duration for workers who work in multiple jobs to those who work in one job during the week, and to explore episodes of daily non-work activities in-between work episodes. Finally, the ATUS provides data pooled over many years, which streamlines the analyses, and includes weights that are comparable across years.

However, due to the structure of the survey, our findings were limited to work and sleep in only one 24-hour period. We could not determine the weekly representation of time use for MJHs. That is, some MJHs may have been working in multiple jobs for several days over a one-week period, but were surveyed on a day when they did not work,

and yet others may only work part time on alternating days in different jobs over the week. We anticipate that these two very different weekly work schedules would yield different patterns of daily activities which we were not able to study and could result in different sleep patterns. Additionally, sleep episodes could be very different from one day to another over a one-week period. There was no way for us to explore this using the 24-hour time frame of this survey.

Also while the total sleep duration represents the sum of the duration of all sleep episodes over a 24-hour period, because of the way the data are collected, we cannot truly identify whether an individual's total sleep time in a 24-hour period was comprised of one continuous sleep or separate episodes of sleep. The diary data are collected over a 24-hour period which begins at 0400 hours the day of the survey and retrospectively collects information on all activities 24 hours before that, i.e. 0400 to 0400. Since most people are sleeping at 0400 – even if they have a good long continuous sleep every night (e.g. 2200 to 0600) – the 24-hour sleep recorded in the ATUS diary data will appear as two fragmented episodes, e.g. 0400–0600 and 2200–0400 and these amounts contribute to two separate days' sleep instead of one continuous sleep.

However, since the ATUS data do provide the full duration of the last activity episode (even if it extends past 0400 hours), we were able compare the duration of the last episodes of sleep that occurred on a diary day between MJH and SJH and found similar reductions in sleep for MJHs compared with SJHs. However, we can only present this information for workers who were sleeping for their last activity recorded in the diary.

Finally, the representativeness of the findings may be compromised due to ATUS low response rates (53–57%) and ATUS sleep time is likely an overestimate compared with other studies due to the inclusion of certain pre- and post-sleep activities in the grouped lexicon (e.g. time spent falling asleep, waking up) (Basner et al., 2007). Related to this, self-reported sleep time has been reported to overestimate sleep time (Lombardi et al., 2010) and those who do not have time to sleep (or those sleeping the least) may be less likely to volunteer to be interviewed, which also would contribute to an overestimate of sleep.

## Conclusion

We have shown here that MJHs engage in significantly less sleep than SJHs. Duration of work hours and time of day working and duration of travel for work may not be the only factors to consider when understanding if MJHs are able to fit in enough recuperative rest from their busy schedule.

Employment in the United States has changed dramatically over the last few decades and there is reason to believe that many workers may adopt multiple jobs to increase earnings. However, without guidance on how to safely schedule the additional workload, adopting another job is likely to reduce sleep time and may put workers and the public at higher risk of fatigue-related adverse safety events leading to injury.

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## Declaration of interest

The authors declare they have no financial or personal relationships with other people or organizations that inappropriately influenced their work.

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