



Work Schedules and Sleep Patterns of Railroad Train and Engine Service Employees

SUMMARY

The Federal Railroad Administration (FRA) Office of Research and Development sponsored a project to study the work schedules and sleep patterns of U.S. railroad train and engine (T&E) service workers and to examine the relationship between these schedules and the level of alertness of the individuals working the schedules. The methodology for this study was a survey of a random sample of currently employed U.S. T&E workers who completed a background survey and kept a daily log for 2 weeks. T&E workers operate trains both between terminals and in railroad yards. There are eight types of positions in T&E service, all subject to the limitations of the Hours of Service Law if the position's duties relate to the movement of a train. Two-thirds of T&E workers hold positions with a variable start time. The median length of a work period was nearly the same for those working jobs with variable start times and those with fixed start times. Although the work time is similar for both groups, the median work start time variability is .5 hours for fixed start people and 7.1 hours for those with a variable start time. As a group, T&E employees obtain longer average daily sleep than U.S. adults but variable start time T&E workers engage in supplementary sleep on work days to manage fatigue. Differences in alertness ratings indicate that those with a fixed start time are likely to be more alert during their work periods. Effectiveness measures based on the Sleep, Activity, Fatigue and Task Effectiveness (SAFTE) model indicate that those with a variable start time were more likely to be working at a lower effectiveness level than those with a fixed start; however, the percent of time working at an unacceptable level was less than 8 percent for each group.

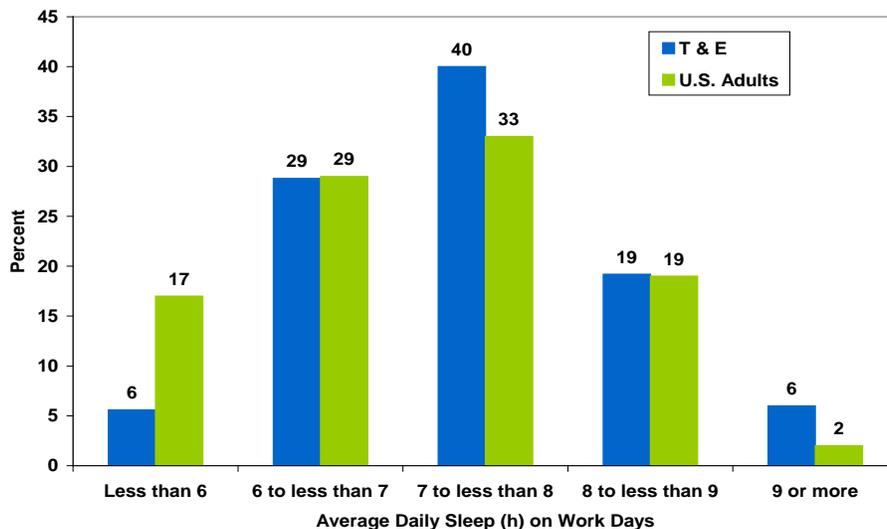


Figure 1. Daily sleep on work days for T&E and U.S. adults.

BACKGROUND

In the late 1980s, FRA sponsored a study to collect data on locomotive engineer fatigue and stress. Because this study used a sample of convenience rather than a statistical sample, the results were not necessarily representative of all U.S. locomotive engineers.

Since this initial research, FRA has sponsored surveys of other railroad worker groups. Because these more recent studies used a random sample, they provide defensible and definitive data on work/rest cycle parameters and fatigue for each group. The present study used this same methodology.

T&E employees operate trains both between terminals and in railroad yard environments. There are eight types of positions in T&E service. The locomotive engineer is in direct control of the train while the conductor is responsible for the train and its crew. A brakeman/trainman may assist the conductor while a yard foreman assists in the yard. Remote control operators and hostlers also work in the yard. All of these positions are subject to the limitations of the Hours of Service Law.

The work schedules of T&E employees may have either a regular starting time or one that varies unpredictably from day to day. Most yard operations, local freight service, and passenger and commuter operations have jobs with regular starting times. In contrast, those in road freight service often do not have a regular work schedule.

OBJECTIVES

The objectives of the study were to:

- Design and conduct a survey to collect work schedule and sleep data from T&E employees.
- Analyze data to characterize the work/sleep patterns and to identify work schedule-related fatigue.

METHODS

This research involved a survey of actively working T&E employees at U.S. railroads. The study used two survey instruments, a background survey and a daily log. Survey participants used the background survey to provide demographic information, descriptive data for their job type and work schedule, and a self-assessment of overall health. The daily log provided a place for recording sleep and work periods as well as

personal time on both workday and non-workdays for a 2-week period.

Mailing of the survey materials to a random sample of the 86,000 actively working T&E personnel occurred on May 9, 2008. The overall response rate was 33 percent.

RESULTS*T&E Worker Demographics*

Nearly all survey respondents indicated that they worked as a locomotive engineer (49 percent) or conductor (40 percent). Almost two-thirds reported working road freight and one-third work in yard operations. One-third worked a job that had a fixed starting time while the starting time for the remainder varied day to day.

The average age of a T&E worker is 45 years and more than 40 percent are 50 years or older. They have, on average, 17 years of T&E experience and 15 with their current employer. The more experienced T&E workers held positions with fixed starting times and the less experienced people held jobs with variable start times and irregular work schedules. Only 2 percent were women.

As a group, T&E employees take more sick days than U.S. adults, yet more than 80 percent of T&E workers rated their overall health as good or excellent. There was no difference in health ratings between those working a job with a fixed start time and those with a variable start time. However, a difference existed between these two groups in terms of number of sick days taken; 3.2 days for fixed and 6.3 days for variable start time. The higher rate of sick time for the variable start group is likely due to marking off sick to catch up on sleep.

Approximately 8 percent of T&E workers reported having sleep apnea. Two-thirds of these reported receiving treatment. This rate of sleep apnea is twice the norm for U.S. working adults.

Job Characteristics

Provisions for rest days differ between the two types of work schedules. Two-thirds of those with variable start times have no guaranteed rest days whereas almost all of those with fixed start times have at least one guaranteed rest day per week.

The median length of a work period (hours:minutes) was similar for the two types of schedules, 8:42 for fixed start and 8:39 for variable start. When limbo

time is considered, the total time increases to 8:55 for fixed start and 9:09 for variable start. The median number of work periods is 10 for both groups. Although the total work time is similar for both groups, the median work start time variability is .5 hours for fixed start people and 7.1 hours for those working jobs with a variable start time (see Table 1). In comparison with data from 1993, today's T&E jobs have more work starts in a 2-week period and have greater start time variability.

Table 1. Work start time variability (hours)

Start	Mean	Std. Dev.	Median
Fixed	3.3	5.0	.5
Variable	7.1	2.7	7.1

Management policies were the greatest source of stress for both schedule groups. The two groups had statistically different ratings for 6 of the 14 sources of job-related stress. Five of these dealt with work schedule and rest.

A total of 5.2 percent of the survey participants exceeded the new monthly statutory limit of 276 hours under the Rail Safety Improvement Act of 2008 (RSIA). Most of these work a job with a variable start time. In terms of work starts, 11.6 percent of the survey participants had work patterns that would be disallowed under RSIA.

Sleep Characteristics

As a group, T&E employees obtain longer average daily sleep on work days than U.S. adults (see Figure 1). However, sleep length alone does not necessarily predict fatigue. Primary sleep is statistically the same for fixed and variable workers. Daily sleep and the average number of sleep periods on workdays are greater for variable workers (see Figure 2). The study results suggest that variable workers engage in supplementary sleep on workdays, primarily between noon and 2 a.m., to manage fatigue (see Figure 3).

Although fixed workers make up their sleep on rest days, variable workers do not have the same opportunity due to the unpredictable nature of their schedules which prevents them from adequately planning for rest. Furthermore, variable workers without a call window report interrupted sleep from call centers.

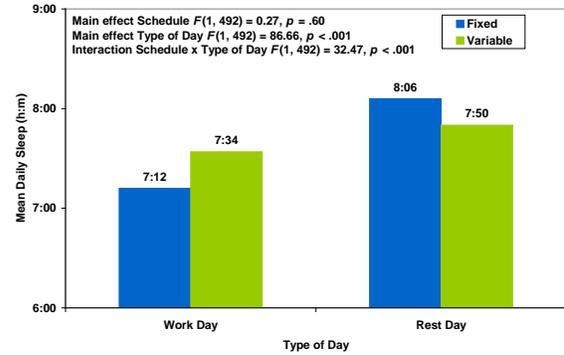


Figure 2. Daily sleep by type of day and schedule

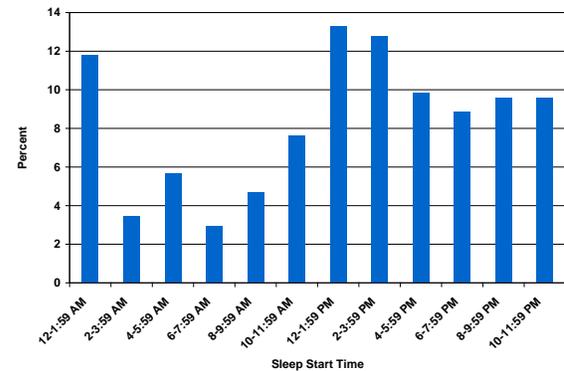


Figure 3. Supplementary work day sleep start times for variable start workers

For all of the sleep quality ratings on the survey variable workers consistently rate their sleep quality lower than fixed workers. Compared with fixed workers, variable workers report higher stress ratings related to work schedule and rest. Participants also rate away-from-home sleep of poorer quality than sleep at home. Away-from-home primary sleep is significantly shorter than sleep at home. Because variable workers engage in away-from-home sleep to a greater extent than fixed workers, they are at an increased risk for fatigue at away terminals.

Alertness

More than 60 percent of the fixed start people reported that they were frequently or always alert at work while only 43 percent of the variable start people reported this level of alertness. Self-ratings of alertness from the daily logs confirmed this difference. Differences in alertness ratings between the start and end of the work period also existed based on the length of the work period. This was particularly pronounced for work periods of 9 hours or more.

Effectiveness

This study used the SAFTE model to predict effectiveness, or lack of fatigue, during time at work. T&E workers with a variable start time were more likely to be working at a lower effectiveness level than those with a fixed start; however, the percent of time working at an unacceptable effectiveness level was less than 8 percent for both groups. Although the portion of total work time at low effectiveness is small, the total number of labor-hours at low effectiveness exceeds 10 million annually for the industry.

CONCLUSIONS

Key findings of the study include the following:

- T&E workers with variable start jobs mark off sick at twice the rate of their counterparts in fixed start jobs, yet both groups give similar ratings to their overall health. Their rate of sick days is also considerably higher than that for U.S. adult males. A possible explanation is that T&E workers with variable start times mark off sick to recover from fatigue because they lack guaranteed rest days.
- The reported rate of diagnosis of sleep apnea among T&E workers is higher than that of U.S. working adult males, perhaps as a result of industry education and wellness programs. Yet 25 percent of the study participants reported receiving no fatigue education. The opportunity exists for the industry to expand its education efforts on this important subject.
- The lack of guaranteed rest days for those holding jobs with variable start times and the high level of variability in their work start times undoubtedly account for work schedules being a major source of work-related stress.
- Overall, T&E workers get more total sleep on workdays than U.S. adults. Frequently, T&E workers with variable start time jobs have multiple sleep periods in a day due to their erratic work schedule and sleep at an

away-from-home location. This compromises the quality of their sleep and its restorative value, as reflected in their sleep quality ratings.

- Although the effectiveness analysis indicates that T&E workers spend a small portion of their work time at a compromised level of effectiveness, the total industry exposure, based on number of T&E labor-hours annually, justifies attention to the issue of fatigue among T&E workers.

On the basis of the experience of this study, several methodological changes should be a part of future studies of this nature. The recommended changes include the following:

- Provide definitions for interim release and limbo time.
- Provide for ratings of multiple work periods in one day.
- Provide a way to capture sleep interruptions.

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