

Highlights: Effects of Sleep Schedules on Commercial Motor Vehicle Driver Performance

This report presents results of a study on the effects of rest and recovery cycles and partial sleep deprivation on commercial motor vehicle (CMV) driver performance. The study was a collaborative effort, performed by the Division of Neuropsychiatry, Walter Reed Army Institute of Research and the Johns Hopkins Bayview Medical Center. Funding was provided by the FMCSA, the Federal Aviation Administration, and the Federal Railroad Administration. A draft final report of this study has been available in the Hours-of-Service docket, #FMCSA-97-2350, entry #2010 since June 2000.

Although it is known that sleep debt impairs performance on a variety of tasks (including those related to driving), the quantitative relationship between hours of sleep and performance during waking hours is not well known. This is problematic because inadequate daily sleep, rather than the complete absence of sleep, probably accounts for most drowsiness in CMV drivers, as well as in other workers. If a quantitative relationship could be developed between total sleep time and subsequent performance, it could lead to improvements in operational safety and performance effectiveness.

This project was comprised of a field study and a laboratory study. In the field study, wrist actigraphy was used to determine amounts of sleep taken by long- versus short-haul drivers during and outside the work shift. In the laboratory study, the effects of different amounts of nightly time in bed (3, 5, 7, or 9 hours) on subsequent performance (cognitive tasks and simulated driving) was measured. Participants were bus and truck drivers holding a valid Commercial Drivers License. The data were analyzed and used to refine a numerical model to predict performance on the basis of prior sleep.

Major findings from the field study include:

- Drivers with more opportunity to sleep (i.e., longer off-duty time) slept more. Short-haul drivers were more likely to obtain their sleep in a single sleep period.
- Both long- and short-haul drivers averaged approximately 7 ½ hours of sleep per night,

which is within normal limits for adults.

- There was significant day-to-day variability in sleep duration in both the long-haul and the short-haul groups.
- Long-haul drivers obtained almost half of their daily sleep during work-shift hours, mainly sleeper-berth time. This may suggest that they spend a significant portion of the work shift in a state of partial sleep deprivation until the opportunity to obtain recovery sleep presents itself.

Major findings from the laboratory study include:

- There were statistically significant relationships between participants' daytime performance on several types of tasks and the amount of sleep they had obtained the previous night.
- There was not a strong relationship between lapses in alertness, as defined by changes in brain wave patterns, and accidents on the simulated driving task.
- Across the seven consecutive days of testing, performance of drivers in the 7-hour group (who averaged 6.28 hours of actual sleep, which is slightly less than population norms) was measurably poorer than performance of drivers in the 9-hour group (who averaged 7.93 hours of actual sleep, which is within normal limits). This suggests that individuals were not able to adapt to, or compensate for, even mild reductions in total sleep time.
- After more severe sleep restriction (e.g., the 3-hr group), recovery of performance was not complete after 3 consecutive nights of recovery sleep (with 8 hours spent in bed on each night).
- Daytime alertness and performance capacity is a function not only of an individual's circadian rhythm, time since the last sleep period, and duration of the last sleep period, but is also a function of his/her sleep history, extending back for at least several days.

The entire 446-page report (Report Number DOT-MC-00-133) is available from the FMCSA, by contacting the attendant at 202-366-4009 or by sending an e-mail request to:

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