CRITICAL INCIDENTS (HUMAN ERRORS) RELATED TO SLEEP AND SLEEPINESS: A COGNITIVE ENERGETICAL APPROACH

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Objectives: Several studies have related human errors and accidents to reduced performance attributed to sleepiness. However, cognitive energetical theory suggests that reduced performance is related to lack of available energy (e.g. different aspects of fatigue) that also affects the motivation to recruit cognitive resources. The main objective of this study was to examine whether different aspects of fatigue (including sleepiness) and motivation could predict self reported incidents (human errors) among train-drivers. A second objective was to test the assumptions of cognitive energetical theory by investigating whether motivation could be predicted from aspects of fatigue and sleepiness (as indicators of available energy) and from sleep complaints (as a mechanism of reducing available energy).

Method: A questionnaire was distributed to all train-drivers (n=402) employed by Swedish Rail in Stockholm. A total of 290 subjects (72%) completed the questionnaire. Motivation and aspects of fatigue (depression/anxiety, mental exhaustion and sleepiness) were index variables calculated as the mean from several items. Sleep complaints were items describing insufficient sleep and index variables describing sleep quality and difficulty awakening related to different days (days off, day- (beginning 09:00-12:00), morning- (06:00-09:00), early morning- (03:00-06:00) and nightshift (beginning before 01:00 or ending after 03:00) days). Incidents were defined as a critical error (related to cognitive function) that could result in an accident at least once the last year. An incident index was calculated as a combined score from five different incidents (signal passed at danger, overseen vital information and aspects of handling the safety system - Automatic Train Control (ATC)). Subjects were divided into one "incident group" (at least one incident during the last year, n=203) and one "no incidents" group (n=87).

Results: Train-drivers in the incident group showed more complaints with: lack of motivation, sleepiness, mental exhaustion and depression/anxiety symptoms. A stepwise Multiple Regression Analysis (MRA) with aspects of fatigue and motivation as independent variables, and incidents as the dependent variable, showed that less motivation (β=0.34) and sleepiness (β=0.20) predicted incidents with 20% of explained variance (p<0.001). An MRA with aspects of fatigue as independent variables and motivation as the dependent variable showed that depression/anxiety symptoms (β=0.45) and sleepiness (β=0.14) predicted less motivation with 27% of explained variance (p<0.001). Another MRA with sleep complaints as independent variables and motivation as the dependent variable showed that difficulty awakening before early morning shifts (β=0.29) and difficulty awakening after night shifts (β=0.24) predicted less motivation with 20% of explained variance (p<0.001). Sleepiness was also subjected to an MRA with sleep complaints as independent variables. Difficulty awakening after night shifts (β=0.37), difficulty awakening before early morning shifts (β=0.28) and poor sleep quality on days off (β=0.20) predicted sleepiness with 37% of explained variance (p<0.001).

Conclusion: Prediction of incidents was successful with a relatively high degree of explained variance (20%) and the assumptions of cognitive energetical theory were supported by the results. Motivation was associated with indicators of available energy (depression/anxiety and sleepiness) and mechanisms of reducing energy (sleep complaints). Sleep complaints associated with motivation were similar to those associated with sleepiness and suggests difficulty awakening (especially before early morning- and after night shifts) as the critical factor. Motivation was to some extent associated with sleepiness but, regression analyses suggest that sleepiness and motivation constituted two independent factors that were related to critical incidents.

SELF REPORTED INCIDENTS WERE RELATED TO SLEEPINESS AND MOTIVATION WITH SLEEP COMPLAINTS AS A COMMON DENOMINATOR

Keywords: safety, motivation, train-drivers