

Preventing sleep loss and fatigue

The effects of sleep loss on a military mission can be highly detrimental. So preventing sleep loss and fatigue is an issue that very much occupies the medical supervisors. TNO Defence, Security and Safety has accumulated a body of expertise in this field in recent years that can also be applied in fields of work outside the military domain. Anywhere, in fact, where sleep loss poses a risk to the proper performance of tasks.

The demands a mission imposes on the personnel involve the disruption of the body clock. Coupled with poor sleeping facilities, sleep loss results, which in turn leads to serious fatigue and a negative impact on fitness, performance and alertness. Military operations are 24-hour activities that often entail daytime sleeping and night-time working. Our body clocks, on the other hand, are set to sleep at night and keep us awake during the daytime.

When activity and noise in the environment and factors like heat or cold are added disturbances, the quality of sleep plummets. Efforts to get a few hours sleep in advance of working hours tend not to be effective because most people can't fall asleep in the early evening hours.

TNO Defence, Security and Safety is studying the phase shift involved in sleeping during the day and the effect of strategically dosed periods of sleep. The

team is working on the assumption that under normal circumstances everyone should have the opportunity to sleep 8 hours in a 24-hour period. Rather than extending the working period, the aim of the study is to guarantee the wakefulness of personnel and their proper performance while on duty.

As part of our research, we have already proven the use of *power naps* – periods of sleep lasting less than two hours, which can be taken to recharge your batteries – by

commercial pilots. The effect of such a nap, however, wear off quick soon so a power nap should be regarded as an emergency measure.

Stimulants

In emergency situations, when operational conditions make sleep impossible and personnel have to remain alert for long periods, the short-term use of stimulants can be life-saving. In the United States the use of stimulants such as amphetamine and modafinil is often permitted in such situations. In the Netherlands amphetamine is not a candidate for further study due to its side effects (addiction, the overestimation of one's powers, restlessness, heart palpitations). Modafinil is already recommended or used in some NATO countries by military personnel; unlike amphetamine, modafinil is not addictive. In France in particular, caffeine, too, is recommended to increase the alertness of military personnel. An evaluation of the advantages and disadvantages of both modafinil and caffeine are included in our study. In our opinion, stimulants should be used only in emergency situations for a short period. This is because when used regularly, personnel can become exhausted without noticing the warning signs.

Sleep-wake management

When making the switch from daytime to night shifts, the sleep-wake rhythm can take a number of days to adapt, especially when shifts are worked back to back or the workload is heavy. On long missions, it is evident that cumulative sleep loss can reduce personnel fitness and the mission's effectiveness. The structural management of sleep and waking is therefore necessary.

That's why, as part of our research, we are looking at mission-specific supervision plans, optimising the sleeping facilities and the proper management of mission stress and each individual's problems. Jetlag will also be examined (see panel). And we will be making recommendations about medicines that may or may not be used because medication, even that for 'common' complaints like headaches, hay fever or diarrhoea, can reduce alertness. This includes the kind of medicines bought over the counter at the chemist that have side effects, particularly when taken under circumstances more extreme than at home.

Fit-to-Fly

In a European partnership, TNO is involved in the development of sensors designed to detect when commercial pilots fall asleep on the job and raise the alarm. In Early Warning Systems like these, the reliability of the sensor data is vital. The sensor must pick up the moment at which an individual is about to fall asleep. Some systems emit a signal when the individual has been asleep for some minutes, too late in other words. If, on the other hand, the sensor is too sensitive and sends a warning too often or when nothing is afoot, the system will quickly fall into disuse.

TNO is developing a sensor for slow eye movements – a reliable method to determine whether a person is fighting sleep; this sensor is not yet simple and wearer-friendly enough to be used in practice.

We are also working on another method for commercial pilots. This alerts the individual to his or her risk of reduced cognitive functioning and alertness. It involves a *Fit-to-Fly* checklist (FTF) of



Jetlag

In the first few days after travelling across a number of time zones, it is not uncommon for a person to suffer jetlag; symptoms include disrupted sleep, diminished performance and daytime drowsiness. Adjusting one's body clock to the local time zone is the best way to get over jetlag. This can be done by going to sleep at the local *bedtime* and eating at local mealtimes. These are important stimuli that help reset the body clock to the local time.

questions about sleep that the respondent answers using a PDA. The questions address topics like sleep quality and duration in the preceding days, fitness, drowsiness, the coming activity (day/night, duration, frequency, etc.) and medicine and alcohol use. On completion, the respondent is given a personal Risk Index, and can use the PDA to find out how to reduce that risk. This teaches the respondents and their bosses how to prevent risk situations; the system can also be used for evaluation purposes.

In commercial aviation this project has already delivered improvements in work and rest schedules. Now we are working for the Royal Dutch Air Force to convert the commercial FTF to military use. As well as this new use, the FTF can, of course, also be employed in other types of situation in which safety plays a role. *Fit-to-Fly* can become *Fit-to-Work*, *Fit-to-Operate* or *Fit-for-Vigilance*.

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Normandy, 1944. Shortly after the allied landing in the midst of the violence and noise, American soldiers were sleeping, exhausted by jetlag and sleep deprivation. A former American Surgeon General, who was there, told TNO's Ries Simons that at times he found it difficult to distinguish those who were sleeping from the dead; many soldiers were killed in their sleep.