

LIEUT.-COL. ZOLTÁN SZAKÁCS MD

**Development of an effective screening/follow-up network
for the management of sleep-alertness disorders
with substantial impact on fitness for military service**

*Author’s review of and
official judgement on the doctoral (PhD) thesis*

(THESIS BOOKLET)

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Definition of the scientific problem

Sleep-alertness disorders and sleep fragmentation-hypersomnia syndromes have an essential influence on abilities required to fulfill the duties involved by military service. The appraisal of such abilities (such as attention, long-term mental concentration, memory, and somnolence) is of utmost importance in evaluating fitness for military service. Secondary manifestations of primary sleep disorders impair the mental and physical condition of soldiers on duty, and can lead to complications – consequently, their presence forbids pursuing a military career.

In Hungary, this problem is addressed by a network established for the screening and follow-up of sleep disorders. The Center for Sleep Diagnostics & Therapy of the Central Military Hospital of the Army of the Hungarian Republic has had an integral role in the deployment and the supervision of this system. The unerring professional development of the Center – which has now been in existence for more than eight years – guarantees high-level diagnostic, therapeutic, and screening services.

The appraisal of fitness for military service as regards sleep disorders is a major assignment of the Center. Further responsibilities include the professional education of field surgeons; field screening for sleep fragmentation and hypersomnia syndromes; as well as the definition and control of professional follow-up activities in co-operation between field units and the Center. Furthermore, the Center is involved in rendering medical services in co-operation with other inpatient departments and outpatient clinics of the Central Military hospital by undertaking the diagnosis, treatment, and follow-up care of patients with sleep disorders. The Center offers consultation in special situations of civilian life, as well as in issues of importance for the military or for catastrophe medicine (such as traffic safety). Co-operating with other Hungarian research institutes and clinical departments with a similar profile is also considered essential.

The integration of the Hungarian Republic into NATO and the consequent task of raising a professional military force might create a substantial challenge for the Center. The validation of diagnoses is undertaken according to tightly-controlled protocols compatible with relevant standards developed by the European Sleep Research Society, the American Academy of Sleep Medicine, as well as with the professional guidelines adopted by Hungarian specialist colleges (of neurology and pulmonary medicine). The current level of diagnostic and therapeutic services rendered by the Center for patients with sleep disorders stands international comparison.

In an army of professional and contracted personnel, it is indispensable to guarantee the highest possible level of somatic and mental health for recruits in order to enable them to perform on par with their intellectual capacity. Appointments to operational assignments should be made by electing individuals with ample competence to meet in-service and training challenges without the risk of health compromise.

Presumably, sleep-alertness disorders are highly prevalent within the military community and therefore, our duty is to identify these abnormalities, manage afflicted patients, and discharge the unfit from service.

Research objectives

According to accumulated experience, the specialty of sleep medicine can be efficient, as well as useful for other medical fields only if its individual units (sleep ambulances, sleep laboratories and centers) are well integrated into the overall structure of the health care system.

Furthermore, the professionals working in this specialty must have the knowledge necessary to recognize sleep disorders and to choose an appropriate strategy for their diagnosis.

The primary objectives of research are as follows:

1. Development of a screening/follow-up model that affords cost-effective diagnosis, treatment, and chronic management of patients with primary sleep disorders within the population of contracted or professional military personnel.
2. Conducting epidemiological studies to determine the prevalence of sleep disorders in the Hungarian population, with a special emphasis on citizens between 20 and 50 years of age – as this age group is an important source of recruits and standby manpower potentially available for tactical operations.
3. Developing questionnaires meeting both domestic and international standards for the screening of sleep disorders with satisfactory diagnostic sensitivity and specificity.

Nevertheless, a number of preconditions must be established to accomplish these goals:

1. A standardized, state-of-the-art approach should be adopted by all levels of the health care system to guide the diagnostic and therapeutic activities of medical professionals, specialists, assistants, and nurses.
2. A well-organized management system with clearly defined professional and functional relationship is indispensable. On one hand, this system should be linked to the existing structure of the health care system, as well as it should establish its proprietary, specialist infrastructure (sleep outpatient clinics, sleep laboratories and centers, etc.).
3. In-depth protocols – meeting international standards and compatible with the structure of the Hungarian health care system – should be established for individual diagnostic categories.

Research methods

The following methods have been used to fulfill research goals:

- Review of relevant domestic and international literature, publications, and study reports; as well as the results and recommendations from recent research and novel research domains.
- Conducting multicenter, prospective studies to explore the epidemiology and the morbidity of sleep disorders, as well as the efficacy of their therapy.
- Study of pertinent legislation, relevant legal instruments, and decisions.
- Summary of corresponding and controversial facts available from relevant publications.
- Attending international and domestic conferences, symposia and other events with relevance to the research topic.
- Systematizing professional knowledge and clinical experience accumulated during my military career.
- Consultations with professionals and researchers experienced and knowledgeable in the subject were used to compare findings as well as to refine concepts.

- Targeted search of the worldwide web for relevant material and publications.

Interim results of my research were published in various military and medical journals as papers and study reviews, as well as they were presented at scientific conferences and symposia. In 1998, I was adopted among the members of the American Sleep Academy; I have been attending the annual meetings of the Academy since then to exchange views and to deliver poster presentations. I have made efforts to contact American authors of presentations in military medicine for an exchange of professional experience.

Brief description of the study by chapters

- Chapter 1** discusses sleep-alertness disorders from the aspect of military medicine. It describes the history of exploring the physiology of sleep, along with the milestones and breakthroughs accomplished by the pioneers of this scientific domain. The chapter is concluded by an in-depth review of the epidemiology of excessive daytime sleepiness.
- Chapter 2** draws essential conclusions of the principles observed to establish the screening/follow-up network within the framework of the military medicine services of the Army of the Hungarian Republic. This network was intended for the screening, management, and follow-up of sleep-alertness disorders that substantially impair fitness for military service. Clinical experience has been accumulated through efforts by the Center for Sleep Diagnostics & Therapy of the Central Military Hospital, as well as risk management advisory boards set up by the PHARE and HIFA. Based on this experience, this chapter expounds the screening/follow-up network of military health care services in detail. It describes facilities, assignments, and equipment, along with the role of the outpatient clinics and inpatient departments of the Central Military Hospital, as well as with the position of the Center for Sleep Diagnostics & Therapy within this efficient screening/follow-up network. The connections of the network and the functioning of the system are modulated by a well-controlled structure, which has been developed over many years. In view of the experience from the last 8 years, the screening/follow-up network meets its purpose.
- Chapter 3** introduces diagnostic tools, questionnaires, and statistical methods used in epidemiological surveys, as well as the study populations explored.
- Chapter 4** recites the experience and results obtained from operating this proprietary screening/follow-up network. This system was appropriate for elucidating the epidemiological properties of primary sleep disorders with the greatest impact on fitness for military service, and it provided the means for conducting targeted screening programs. First, a randomized, crossover study was conducted to ascertain the epidemiological properties of insomnia in a normal population. Predisposing factors for insomnia include female gender, lower level of education and advanced age. Next, the prevalence of obstructive sleep apnea (the sleep disorder with the greatest public health significance) was evaluated in a target population. Grants won in the competition advertised by the Risk Management Advisory Boards set up by the PHARE and the HIFA enabled the Center for Sleep Diagnostics & Therapy to conduct a questionnaire survey in a number of military and general practices. As demonstrated by this survey, the prevalence of

sleep apnea is exceedingly high in the target population and this disorder has often been identified as the underlying factor leading to traffic accidents.

The next section of the chapter describes the screening for obstructive sleep apnea among healthy males employed in jobs that involve working in multiple shifts. The prevalence of this disorder was astoundingly high in the study population selected according to a special set of criteria. The significance of this survey is emphasized by the fact that the properties of this survey and its subjects (i.e. relatively young, healthy males working in multiple shifts) were essentially similar to the conditions of military service.

Subsequently, a model experiment initiated by the HIFA to test the feasibility of a scheme whereby an appliance for the treatment of OSAS was made available on lease. This project was implemented in co-operation by the Center for Sleep Diagnostics & Therapy and three other fellow institutions. This section summarizes the experience accumulated during the therapy of patients identified by screening. The results of questionnaire survey, diagnostic work-up and treatment outcomes are discussed. The conclusions of this model experiment convinced the HIFA to make the tested appliance continuously available – on a limited scale – for therapeutic use.

The final section describes the prevalence of hypertension among our patients treated for OSAS. It has been unequivocally demonstrated that the relative risk of hypertension is higher in severe, than in mild forms of this sleep disorder.

Chapter 5 discusses the results of our epidemiological studies in combination with a review of the international literature.

Summarized conclusions

Based on our domestic and international experience obtained during research, the Center for Sleep Diagnostics & Therapy was established in the Central Military Hospital of the Army of the Hungarian Republic. I have been in charge of this unit since 1998, under the professional guidance of Col. Peter Coves MD, head of the Neurology Department.

The Center also accommodates the headquarters of the Hungarian Sleep Society. In Hungary, the Center pioneered studies into physiological and abnormal sleep patterns (which constitute an extremely sophisticated domain of daily living) as well as the therapy of sleep disorders. In countries with high-level health care systems, the latter have been shown to be of outstanding importance in military and catastrophe medicine, as well as in general and in occupational medicine.

The Center operating in the premises of the Central Military Hospital of the Army of the Hungarian Republic has established regular work relationships with a number of military and general practices, outpatient clinics, and hospital departments. The clinical significance of sleep disorders is substantiated by their high incidence and the dangerousness of their complications.

From the aspect of military medicine, the importance of sleep disorders lies in the severe, frequent, and abrupt impairment of mental and physical performance. Sleep disorders can seriously interfere with the exercising of recruits, the training of troops, and the implementation of tactical operations.

In consideration of the above, establishing diagnostic, and management capacity for all forms of sleep disorders has been regarded as important and has been pursued during the development of the profile of the Center:

1. Chronic daytime sleepiness with the resulting attention deficit is an extremely common abnormality, which substantially interferes with job performance and quality of life. As demonstrated by our research, the subjective complaint of chronic daytime sleepiness is most commonly underlied by chronic sleep deprivation – a major cause of excessive somnolence.
2. Disregarding sleep deprivation is among the most common errors made by military strategists. During tactical operations, troops are often driven into sleep deprivation in order to accomplish intended goals rapidly. Exhaustion resulting from sleep deprivation can lead to errors in judgment and to wrong decisions – all of which could be avoided through the prevention of sleep deprivation.
3. Even in peacekeeping missions, military service (especially guarding and defense tasks, as well as transportation) is extremely demanding on servicemen. Sleep deprivation jeopardizes completing such tasks at an appropriate level. As demonstrated by a review of the literature, performance loss after 23 hours of vigilance is comparable to that resulting from excessive alcohol abuse.
4. The greatest catastrophes resulting from human error have occurred during periods where vigilance is at its ebb, owing to the circadian fluctuation of mental alertness (especially in the early morning hours). During these periods, individuals working in multiple shifts can run into trouble, especially when afflicted by sleep deprivation or some form of primary sleep disorders. The likelihood of wrong decisions and mistakes are extremely high during these periods. Preventive efforts should focus on disease states causing hypersomnia; however, a competent screening/follow-up network is indispensable to the recognition of these disorders.
5. In addition to fulfilling its original purpose, the screening/follow-up network – as a method and a utility – can meet the requirements of large-scale epidemiological studies. Experience from the latter shows that the screening/follow-up network can handle large populations efficiently. It is able to identify afflicted patients rapidly, as well as to deliver appropriate therapy and follow-up care at an adequate level.

New scientific achievements

I have accomplished my research goals. Using the research methods referred to above, I have demonstrated that my working hypotheses were substantiated and instrumental to the expedient conduct of research efforts.

Summarizing research results discussed in this dissertation, the following are regarded as new scientific achievements:

1. An efficient screening/follow-up network has been established within the framework of military health care services for the cost-effective diagnosis, management, and follow-up of primary sleep disorders among contracted and professional army personnel, in conformity with international standards.
2. It has been demonstrated by epidemiological studies that sleep disorders are highly prevalent within the 20-to-50-years-old age group of the Hungarian population, that is, among citizens mobilizable for military operations. The incidence of obstructive sleep apnea has been shown to be similarly high (12.8 per cent) among males working in multiple shifts; whereas it was 5.4 per cent in the target group defined by morbidity statistics. The prevalence of sleep deficiency exceeds 9.3 per cent in the normal popu-

lation. Insomnia is more common among females, the elderly, and in less educated populations.

3. A battery of questionnaires has been developed in conformity with domestic conditions and international standards for the screening of sleep disorders with satisfactory diagnostic sensitivity and specificity.

Practical use of the knowledge discussed in the dissertation, recommendations

Having enlarged on the research that has accumulated the knowledge discussed herein, the following recommendations are made for the practical implementation of conclusions within the Army of the Hungarian Republic:

1. It is recommended to supplement the evaluation of the fitness of contracted as well as professional servicemen with screening for sleep-alertness disorders.
2. A questionnaire designed for the screening of such disorders should always be administered during the preliminary evaluation of fitness for military service.
3. The questionnaire method should be combined with sleep polygraphy during the preliminary evaluation of fitness for special assignments.
4. Sleep polygraphy is necessary following extraordinary events, where the involvement of attention deficit and falling asleep can be assumed.
5. Sleep polygraphy is recommended as a component of the periodic evaluation of fitness for service in personnel with a special military assignment.
6. The following screening tools are recommended for use for the purposes listed above: the questionnaire developed for the screening of sleep-dependent respiratory problems by the Center for Sleep Diagnostics & Therapy of the Central Military Hospital of the Army of the Hungarian Republic; the questionnaire developed by the International Restless Leg Study Group; and the Ullanlinna Narcolepsy Scale.

Issues for further investigation

Further intensification and escalation of research is especially important in the following domains:

1. To supplement knowledge on sleep-dependent respiratory disorders, the morbidity, mortality, and prevalence of the other two, major categories of primary sleep disorders (i.e. sleep-dependent motion disorders and narcolepsy with undue somnolence) should be appraised using the established screening/follow-up network. This research should determine the seriousness of these disorders in relation to age, gender, and population subsets; whereas its results could modify the interpretation of the results of the evaluation of fitness for military service.
2. Extensive implementation of research results in practice is necessary both in the evaluation of fitness for military service, as well as during the organization of shifts and service assignments.
3. In line with earlier research activities, our Center intends to participate in international studies investigating the usefulness of preventing sleep-alertness disorders related to the artificial derangement of the circadian rhythm (e.g. in special situations of military

service), using pharmacotherapy (e.g. with modafinil, melatonin) as an innovative means for prevention.

I am convinced that my research efforts have established a sound base for further investigations that shall foster the implementation of results in practice. Carrying on my quest, I am planning to conduct further studies and analyses related to the screening, diagnostics, and management of sleep disorders, in order to assist accomplishing these goals.

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Resume of professional and scientific achievements

- 1960 – I was born on 30 October, in Debrecen, Hungary.
- 1980 – I was admitted to the University of Medical Sciences at Debrecen, where I graduated in 1986 at „*summa cum laude*” level.
- 1987 – at the end of this year, I joined the staff of the Department of Neurology of the Central Military Hospital of the Army of the Hungarian Republic.
- 1990 – I earned board certification in neurology. In keeping with the profile of our department, I took up electrophysiology. In 1990, my interest turned to sleep diagnostics and electrophysiological sleep studies – I have been working in this field since then.
- 1995 – The Center for Sleep Diagnostics & Therapy was established within the Central Military Hospital. I have been in charge of this unit since its establishment.
I have attended every *National Forum of Young Neurologists* – until becoming over-age, i.e. at Esztergom, Szeged, Győr, and Szombathely.
- 1998 – I became member of the *American Academy of Sleep Medicine*. I have been a regular participant and lecturer at Academy congresses since 1995: Washington 1996, San Francisco 1997, New Orleans 1998, Las Vegas 2000, Chicago 2001, and 2003, Philadelphia 2004, Denver 2005.

I regularly attend congresses of the European Sleep Research Society and I have exhibited posters at the events held in Brussels, Reykjavik, and Prague.

I am original member, as well as member of the Board of Directors, of the *Hungarian Sleep Society*, which has held its first congress in the premises of the Central Military Hospital.

I have pursued the following activities in order to publicize sleep medicine and to enhance its professional appreciation:

- I am first and co-author of many papers; I have authored two book-chapters, and a monograph.
- I have read lectures – sponsored by pharmaceutical companies, primarily – in almost all larger cities of Hungary.
- I have participated actively in the establishment of university sleep centers in Debrecen and Pécs. I have contributed to finalizing the methodology of sleep medicine, as well as to developing relevant guidelines and professional protocols.