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Research and development activities in military medicine in Finland

General presentation on the Finnish Defence Forces

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Finland's defence is based on general conscription and territorial defence. Men, aged 18–60 are liable for military service, women's military service is voluntary. Over 80% of each male age-group carries out their military service, which lasts 180, 270 or 362 days depending on the type of training given.

The peacetime strength of the Defence Forces is 16,500 men and women. About 8,500 of these are professional soldiers. Annually around 27,000 conscripts are trained (just under 500 of these are women). The number of reservists trained annually is about 30,000.

The wartime strength of the Finnish Defence Forces is approximately 490 000 men and women. The Army strength is 345,000, Air Force 35,000 and Navy 39,000. The strength of the frontier guard troops set up by the Frontier Guard is 22,000 men. According to the Security and Defence Policy White Paper of 2001, the total strength of wartime forces will decrease to 350,000 men by the year 2009.

Central Principles of Research in Military Medicine in Finland

The central principle in Finland's research activity in military medicine is that research results must be made available quickly in order to be implemented to serve the purposes of military activity. A second principle is that only such research work, which cannot be purchased from the universities or other civilian research institutes, is carried out using the Defence Forces' own research resources. A third central principle is that existing laboratory resources and technological know-how are put to good use through partnership, so that it is not necessary for the Defence Forces to invest large quantities of its own research resources in research facilities and equipment.



Figure 1.: Active participants in research and development activities within Finnish military medicine

The rapid application of research results in practical military activity is best achieved when, from the start of the planning phase, researchers work in direct cooperation with those who will benefit from the research results. This principle is realised especially well in the Air Force and Navy, where the relevant Chief Surgeon leads research activity in military medicine carried out within his service.

Organization

Surgeon General leads all activities within the whole field of medicine in Finnish Defence Forces (Figure 1.). The Scientific Director in the Medical Services Division, Defence Staff, is responsible for leading and coordinating all research and development activities in military medicine.

The Institute of Military Medicine,

Central Military Hospital, and Medical School conduct the research and development activity of the Defence Forces within the field of military medicine (Figure 1.). Medical Depot participates these activities by giving technical support.

The Institute of Military Medicine (Figure 2.) is divided into three sections that are occupied with clinical work and one section is concerned with pure research and development work. Clinical work is carried out by the Air Force, Navy and Army Divisions, the emphasis of whose activity is on the periodical examination of pilots and divers and evaluation of fitness for military service of soldiers. In accordance with the European Joint Aviation Requirements (JAR), the Air Force Division of the Institute of Military Medicine also functions as

an Aero-Medical Centre, which is the highest institution carrying out aeromedical examinations for professional civilian pilots in each JAR country. The Institute of Military Medicine's Epidemiology Division is responsible for the health statistics of conscripts and the monitoring of communicable diseases. The B and C Defence Units are responsible for medical expertise in their own fields. The Development Unit of Field Medical Material is responsible for the instruments and equipment needed in field medicine as well as testing of transportation systems and development work. The Institute of Military Medicine has also research resources, which it can allocate to different projects in accordance with the amount of support needed.

The research work of the Central Military Hospital is focused on studying the diagnostics of diseases and injuries among conscripts and on their treatment and prevention. The Medical School, which is situated in connection with the Logistics Training Centre trains medical personnel for the reserve. The research and development projects of the Medical School are related to first aid, initial treatment and the working chain of field medical services. Due to the characteristics of Finnish nature, certain input into research has been aimed at field medicine especially in cold conditions during winter. Experts from the Central Military Hospital also take part in the research and development projects of the Medical School by providing expert knowledge in their own fields of med-

icine. The Medical Depot is responsible for the procurement and maintenance of medical equipment and takes part in technological development projects (*Figure 1.*).

Focusing the Defence Forces' own research activity in such areas where civilian research institutions are not available as partners in cooperation, requires the Defence Forces to be well aware of the capabilities and resources of universities and other civilian research institutions. This flow of information is effectively aided by the Scientific Committee for National Defence (MATINE), which has expert divisions in all areas of science that are of importance from the point of view of military activity (*Figure 1.*). Two of the divisions of the Scientific Committee for National Defence are related to military medicine: the Field Medicine Division and the Health and Behavioural Sciences Division. Through these divisions, the experts of the Defence Forces are in contact with a broad field of researchers and university teachers. Information on the research interests of the Defence Forces is conveyed to them and they, in return, provide information on new research projects, which is relayed to Defence Forces experts for evaluation. This cooperation also aids the recruitment of young researchers into the Defence Forces. Military psychology is closely related to military medicine. In Finland military psychologists work in the Behavioural Sciences Division of the Defence Forces Education Development Centre. Intense cooperation is carried out especially in order to develop per-

sonnel selection methods. The Behavioural Sciences Division is also responsible for research on man-machine-interface and psychological research on stress tolerance.

Focal Points of Research in Military Medicine

Since the beginning of the 1980s, the focal point of research work has been on ensuring the fitness for duty and safety during service of conscripts as well as the fitness for duty of special groups such as divers and pilots. Central research subjects have been conscripts' respiratory infections, protection of hearing, asthma, and cardiologic problems, in particular myocarditis. Central subjects of research are also the effects of physical training on the heart and the risk of sudden cardiac death among young people in relation to physical exertion. Another central subject related to physical exertion are overuse injuries, especially stress fractures in the lower extremities. The survival of soldiers in cold conditions has been studied both in cold laboratories and in the field. A series of studies carried out in the 1990s within the Air Force focused on neck injuries among fighter pilots. In diving medicine research has been focused on determining the factors that can predispose divers to pulmonary embolism and on the diagnostics of complications of decompression sickness, such as changes in bone structure.

Research reports published in English are listed according to subject field at the end of the article.

Special Features of Research in Military Medicine

When comparing research in military medicine to purely academic research, which is carried out at universities or civilian research institutes, certain distinct differences can be noted. Research in military medicine should be able to give clear answers to questions that are very concrete, but difficult to approach through experimental research. Such a central research problem is the study of the effects of weapons on man: how can war injuries be treated and prevented. Information on the effects of weapons on people is based on experiences from previous conflicts and to a limited extent from injuries caused by weapons in civilian life. It is difficult to create an extensive and reliable picture of the effects of new weapons in advance. A similar problem is establishing the actual capacity of the field medical care system in dealing with a situation involving massive number of injured subjects.

Another special feature of research in military medicine is that research results must be rapidly available for implementation. Furthermore, the publicity of the research results is not as self-evident as in the case of medical research carried out in a civilian institution.

These features of research in military medicine result in the fact that research in this field cannot be dependent only on the academic research community's own research activity, but the leadership and steering of research work must be carried out at the initiative of the Defence Forces.

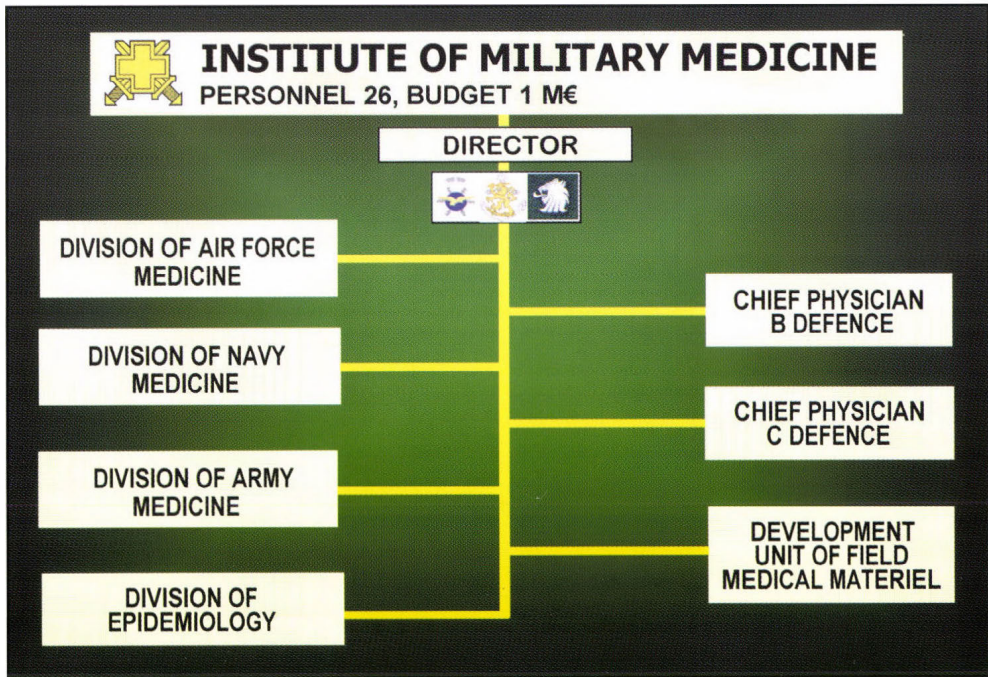


Figure 2.: *Organisation of Institute of Military Medicine*

The researchers of the Defence Forces must be capable of indicating the central subjects of research in military medicine and evaluate the importance of results reached. In other words, the steering of research in military medicine must remain in the hands of the Defence Forces' experts. On the other hand, according to the principles of partnership, it is reasonable to put to good use the expertise and material resources available from civilian institutions.

Organization in future

During this decade specialist medical care will be outsourced in Finnish Defence Forces.

However, research and development activities as well as the determination of fitness for service both in military personnel and in conscripts are re-

garded as key functions in military medicine that are not outsourced. The remaining activities within military medicine are planned to be centralized and closely controlled by Surgeon General in order to guarantee effective use of the resources.

The centralized unit of military medicine will be responsible for training the medical corps, development of field medical services, assessment of fitness for service, research within aviation and naval medicine as well as military exercise and environmental physiology. Also epidemiological and clinical research in military medicine regarding peace-time service is one of the main research areas. B- and C-defence activities are planned to be integrated with the civilian research institutes.

The key to success in Finnish military medicine is the cooperation with the civilian health care system in Finland and in the field of research and development close co-operation is needed both with domestic partners and with the military research establishments of other nations.

Publications in English language

Field medicine

- [1] Böstman O, Marttinen E, Mäkitie I, Tikka S.: Firearm injuries in Finland 1985-1989. *Annales Chirurgiae et Gynaecologiae*, 1993, 82(1): 47-9.
- [2] Kuusela T, Kurri J, Tikka S, Cederberg A, Rokkanen P.: Estimation of the extent of high velocity missile wounds in soft tissue with ultrasonography – an experimental study with special reference to the detection of x-ray negative foreign bodies. *Acta Chir Scand*, 1982, 508: 251-5.
- [3] Leppäniemi A, Cederberg A, Tikka S.: Truncal gunshot wounds in Finland, 1985 to 1989. *J. Trauma*, 1996, 40(3): 217-22.
- [4] Mäkitie I, Pihlajamäki H.: Fatal firearms injuries in Finland: a nationwide survey. *Scand J. Surg*, 2002, 91(4): 328-31.
- [5] Mäkitie I, Paloneva H, Tikka S.: Explosion injuries in Finland 1991-1995. *Annales Chirurgiae et Gynaecologiae*, 1997, 86 (3): 209-13.
- [6] Streng M, Tikka S, Leppäniemi A.: Assessing the severity of truncal gunshot wounds: a nation-wide analysis from Finland. *Annales Chirurgiae et Gynaecologiae*, 2001, 90 (4): 246-51.
- [7] Tikka S, Böstman O, Marttinen E, Mäkitie I.: A retrospective analysis of 36 civilian gunshot fractures. *J. Trauma*, 1996, 40 (3): 212-6.
- [8] Tikka S, Lötjönen V, Cederberg A, Rokkanen P.: The behaviour of three standard small calibre projectiles in soap blocks. *Acta Chir Scand – Supplementum*, 1982, 508: 89-104.
- [9] Tikka S, Cederberg A, Levänen J, Lötjönen V, Rokkanen P.: Local effects of three standard assault rifle projectiles in live tissue. *Acta Chir Scand – Supplementum*, 1982, 508: 61-77.
- [10] Tikka S.: The contamination of missile wounds with special reference to early antimicrobial therapy. *Acta Chir Scand – Supplementum*, 1982, 508: 281-7.
- [11] Tikka S, Cederberg A, Rokkanen P.: Remote effects of pressure waves in missile trauma. The intra-abdominal pressure changes in anesthetized pigs wounded in one thigh. *Acta Chir. Scand. – Supplementum*, 1982, 508: 167-73.

Infections

- [12] Savolainen, S., Ylikoski, J., Jousimies-Somer, H.: The bacterial flora of the nasal cavity in healthy young men. *Rhinology*, 1986, 24: 249-255.
- [13] Julkunen, I., Lehtomäki, K., Hovi, T.: Immunoglobulin class-specific serological responses to adenovirus in respiratory infections in young adult men. *J. Clin. Microbiol*, 1986, 24: 112-115.
- [14] Lehtomäki, K., Julkunen, I., Sandelin, K., Salonen, J., Virtanen, M., Ranki, M., Hovi, T.: Rapid diagnosis of respiratory adenovirus infections in young adult men. *J. Clin. Microbiol*, 1986, 24: 108-111.
- [15] Ylikoski J, Karjalainen J.: Acute tonsillitis in young men: Etiological agents and their differentiation. *Scand. J. Infect. Dis*, 1989, 21: 169-74.
- [16] Ylikoski J., Karjalainen, J.: Acute tonsillitis in young men: etiological agents and their differentiation. *Scand. J. Infect. Dis*, 1989, 21: 169-174.
- [17] Karjalainen J.: Streptococcal tonsillitis and acute nonrheumatic myopericarditis. *Chest*, 1989, 95: 359-63.

- [18] Kleemola M, Karjalainen J, Rätty R.: Rapid diagnosis of *Mycoplasma pneumoniae* infection. Clinical evaluation of a probe test. *J. Infect. Dis.* 1990, 162: 70–5.
- [19] Karjalainen J.: Exercise response in 404 young men with asthma: no evidence for late asthmatic reaction. *Thorax*, 1991, 46: 100–4.
- [20] Laitinen, L.A., Miettinen, A.K., Kuosma, E., Huhtala, L., Lehtomäki, K.: Lung function impairment following mycoplasmal and other acute pneumonias. *Eur. Respir. J.*, 1992, 5: 670–674.
- [21] Jousimies-Somer, H., Savolainen, S., Mäkitie, A., Ylikoski, J.: Bacteriological findings of peritonsillar abscesses in young adults. *Clin. Infect. Dis.* 1993, 16 (4): 292–298.
- [22] Kleemola M, Rätty R, Karjalainen J, Schuy W, Gerstenecker B, Jacobs E.: Evaluation of an antigen-capture enzyme immunoassay for rapid diagnosis of *Mycoplasma pneumoniae* infection. *Eur. J. Clin. Microbiol Infect. Dis.* 1993, 12: 872–875.
- [23] von Hertzen L, Leinonen M, Surcel H-M, Karjalainen J, Saikku P.: Measurement of sputum antibodies in the diagnosis of acute and chronic respiratory infections associated with *Chlamydia pneumoniae*. *Clin. Diagn. Lab. Immunol.* 1995, 2: 454–457.
- Cardiovascular system*
- [24] Koskenvuo, K.: Sudden deaths among Finnish conscripts. *BMJ.* 1976, 2: 1413–1415.
- [25] Koskenvuo, K., Karvonen, M.J., Rissanen, V.: Death from ischemic heart disease in young Finns aged 15 to 24 years. *Am. J. Cardiol.* 1978, 42: 114–118.
- [26] Karjalainen, J., Nieminen, M.S., Heikkilä, J.: Influenza A1 myocarditis in conscripts. *Acta Med. Scand.* 1980, 207: 27–30.
- [27] Heikkilä, J., Karjalainen, J.: Evaluation of mild acute infectious myocarditis. *Br. Heart J.* 1982, 47: 381–91.
- [28] Karjalainen, J., Heikkilä, J., Nieminen, M.S., Jalanko, H., Kleemola, M., Lapinleimu, K., Sahi, T.: Etiology of mild acute infectious myocarditis. Relation to clinical features. *Acta Med. Scand.*, 1983, 213: 65–73.
- [29] Karjalainen J.: Functional and myocarditis induced T-wave abnormalities: Effect of orthostasis, beta blockade and, epinephrine. *Chest*, 1983, 83: 868–74.
- [30] Nieminen, M.S., Heikkilä, J., Karjalainen, J.: Echocardiography in acute infectious myocarditis. Relation to clinical and electrocardiographic findings. *Am. J. Cardiol.* 1984, 53: 13–31-7.
- [31] Karjalainen, J.: Clinical diagnosis of myocarditis and dilated cardiomyopathy. *Scand. J. Infect. Dis. Suppl.* 1993, 88: 33–43.
- [32] Nieminen, M.S., Rämö, P., Viitasalo, M., Heikkilä, P., Karjalainen, J., Mäntysaari, M., Heikkilä, J.: Serious cardiovascular side effects of large doses of anabolic steroids in weight lifters. *Eur. Heart. J.*, 1996, 17: 15–76–1583.
- [33] Karjalainen, J., Mäntysaari, M., Viitasalo, M., Kujala, U.: Left ventricular mass, geometry and filling in endurance athletes: association with exercise blood pressure. *J. Appl. Physiol.*, 1997, 82: 531–537.
- [34] Stolt A., Kujala, U., Karjalainen, J., Viitasalo, M.: Electrocardiographic findings in female endurance athletes. *Clin. J. Sports Med.*, 1997, 7: 85–89.
- [35] Karjalainen, J., Heikkilä, J.: Incidence of three presentations of acute myocarditis in young men in military service: a 20-year experience. *Eur. Heart. J.*, 1999, 20: 1120–1125.
- [36] Stolt A., Karila, T., Viitasalo, M., Mäntysaari, M., Kujala, U., Karjalainen, J.: QT interval and QT dispersion in endurance athletes and in power athletes using large doses of anabolic steroids. *Am. J. Cardiol.* 1999, 84: 364–366.

- [37] Karjalainen, J., Kujala, U., Stolt A., Mäntysaari, M., Viitasalo, M., Kainulainen, K., Kontula, K.: Angiotensinogen gene M235T polymorphism predicts left ventricular hypertrophy in endurance athletes. *J. Am. Coll. Cardiol.*, 1999, 34: 494–499.
- [38] Stolt A., Karjalainen, J., Heinonen, O.J., Kujala, U.M.: Left ventricular mass, geometry and filling in elite female and male endurance athletes. *Scand. J. Med. Sci. Sports*, 2000, 10: 28–32.
- [39] Raatikka, M., Pelkonen, P.M., Karjalainen, J., Jokinen, E.V.: Recurrent pericarditis in children and adolescents. Report of 15 cases. *J. Am. Coll. Cardiol.*, 2003, 42: 759–764.
- [40] Karila, T., Karjalainen, J., Mäntysaari, M., Viitasalo, M., Seppälä, T.: Anabolic androgenic steroids produce dose-dependent increase in left ventricular mass in power athletes, and this effect is potentiated by concomitant use of growth hormone. *Int. J. Sports. Med.*, 2003, 24: 1–7.

Asthma

- [41] Kava, T., Lindqvist, A., Karjalainen, J., Laitinen, L.A.: Unchanged bronchial reactivity after killed influenza virus vaccine in adult asthmatics. *Respiration*, 1987, 51: 98–104.
- [42] Heino, M., Karjalainen, J., Ylikoski, J., Laitinen, A., Laitinen, L.A.: Bronchial ciliogenesis and oral steroid treatment in patients with asthma. *Br. J. Dis. Chest.*, 1988, 82: 175–8.
- [43] Karjalainen, J., Lindqvist, A., Laitinen, L.A.: Seasonal variability in exercise-induced asthma. Effect of birch pollen allergy. *Clin. Exper. Allergy.*, 1989, 19: 273–8.
- [44] Karjalainen, J.: Exercise response in 404 young men with asthma: no evidence for late asthmatic reaction. *Thorax*, 1991, 46: 100–104.
- [45] Ekroos, H., Karjalainen, J., Sarna, S., Laitinen, L.A., Sovijärvi, A.: Shortterm variability of exhaled nitric oxide in young male pa-

tients with mild asthma and in healthy subjects. *Resp. Med.*, 2002, 96: 895–900.

Stress fractures and overuse injuries

- [46] Kuusela, T.: Stress fracture. A radionuclide, roentgenological and clinical study of Finnish conscripts. *Ann. Med. Milit Fenn.*, 1980, 55: 33–94.
- [47] Friberg, O.: Leg length asymmetry in stress fractures. A clinical and radiological study. *J. Sports. Med. Phys. Fitness*, 1982, 22: 485–488.
- [48] Friberg, O.: Clinical symptoms and biomechanics of lumbar spine and hip joint in leg length inequality. *Spine*, 1983, 8: 643–651.
- [49] Sahi, T., Friberg, O., Riihimäki, M., Tikkinen, J.: Epidemiology, etiology and prevention of stress fractures in the Finnish Defence Forces and the Frontier Guard. In Mann, G. (ed.) *Sports Injuries. Proceedings of The Third Jerusalem Symposium.* Freund Publishing House, London, 1988, 112–126.
- [50] Visuri, T., Aho, J.: Injuries associated with the use of the ejection seats in Finnish pilots. *Aviat. Space Environ. Med.*, 1992, 63: 727–730.
- [51] Visuri, T., Koskenvuo, M., Dahlström, S.: Hemarthrosis of clinically stable knee due to sports and military training in young recruits: an arthroscopic analysis. *Mil. Med.*, 1993, 158: 378–381.
- [52] Väänänen, I., Mäntysaari, M., Huttunen, P., Komulainen, J., Vihko, V.: The effects of a 4-day march on the lower extremities and hormonal balance. *Milit. Med.*, 1997, 162: 118–122.
- [53] Eskelin, M., Lötjönen, J., Mäntysaari, M.: Chronic exertional compartment syndrome. 0.1 Tesla MRI compared with tissue pressure measurements. *Radiology*, 1998, 206: 333–337.
- [54] Kiuru, M., Pihlajamäki, H., Perkiö, J., Ahovuo, J.: Dynamic contrast-enhanced MR imag-

- ing in symptomatic bone stress of the pelvis and the lower extremity. *Acta Radiol.*, 2001, 42: 277–285.
- [55] Väinänen, I., Vasankari, T., Mäntysaari, M., Vihko, V.: Hormonal responses to daily strenuous walking during 4 successive days. *Eur. J. Appl. Physiol.*, 2002, 88: 122–127.
- [56] Kiuru, M., Pihlajamäki, H., Hietanen, H., Ahovuo, J.: MR imaging, bone scintigraphy, and radiography in bone stress injuries of the pelvis and the lower extremity. *Acta Radiol.*, 2002, 43: 207–212.
- [57] Kiuru, M., Pihlajamäki, H., Ahovuo, J.: Fatigue stress injuries of the pelvic bones and proximal femur: evaluation with MR imaging. *European Radiology*, 2003, 13: 605–611.
- [58] Ahovuo, J., Kiuru, M., Kimmunen, J., Haapamäki, V., Pihlajamäki, H.: MR imaging of fatigue stress injuries to bones: intra- and interobserver agreement. *Magn. Reson. Imag.*, 2002, 20: 401–406.
- [59] Kiuru, M., Mäntysaari, M., Pihlajamäki, H., Ahovuo, J.: Evaluation of stress-related anterior lower leg pain: evaluation with MRI and intracompartmental pressure measurement. *Military Medicine*, 2003, 168: 48–52.
- Health effects of cold environment*
- [60] Rintamäki, H., Hassi, J., Oksa, J., Mäkinen, T.: Rewarming of feet by lower and upper body exercise. *Eur. J. Appl. Physiol.*, 1992, 65: 427–432.
- [61] Rintamäki, H., Hassi, J., Smolander, J., Louhevaara, V., Rissanen, S., Oksa, J. et al: Response to whole body and finger cooling before and after an Antarctic expedition. *Eur. J. Appl. Physiol.*, 1993, 67: 380–384.
- [62] Lehmuskallio, E., Lindholm, H., Koskenvuo, K., Sarna, S., Friberg, O., Viljanen, A.: Frostbite of the face and ears: epidemiological study of risk factors in Finnish conscripts. *BMJ.*, 1995, 311(7021): 1661–3.
- [63] Lehmuskallio, E., Anttonen, H.: Thermo-physical effects of ointments in cold: an experimental study with a skin model. *Acta Derm Venereol.*, 1999, 79(1): 33–6.
- [64] Lehmuskallio, E.: Cold protecting ointments and frostbite. A questionnaire study of 830 conscripts in Finland. *Acta Derm Venereol.*, 1999, 79(1): 67–70.
- [65] Lehmuskallio, E.: Emollients in the prevention of frostbite. *Int. J. Circumpolar Health.*, 2000, 59(2): 122–130.
- [66] Lehmuskallio, E., Rintamäki, H., Anttonen, H.: Thermal effects of emollients on facial skin in the cold. *Acta Derm. Venereol.*, 2000, 80(3): 203–7.
- [67] Rissanen, S., Mäkinen, T., Rintamäki, H., Aatsalo, O., Kuronen, P.: Simulated parachute descent in the cold: thermal responses and manual performance. *Aviat Space Environ. Med.*, 2002, 73: 1100–1105.
- [68] Mäntysaari, M., Rintamäki, H., Mäkinen, T., Oksa, J., Rissanen, S., Korhonen, E.: Accumulation of sweat in clothing during interval exercise in cold environment. Meeting Proceedings NATO/RTO-MP-076, Blowing hot and cold: Protecting against climatic extremes, 2002.
- [69] Lehmuskallio, E., Hassi, J., Kettunen, P.: The skin in the cold. *Int. J. Circumpolar Health.*, 2002, 61(3): 277–86.
- Aviation, naval and hyperbaric medicine*
- [70] Hämäläinen, O., Vanharanta, H., Kuusela, T.: Degeneration of cervical intervertebral disks in fighter pilots frequently exposed to high +Gz forces. *Aviat. Space Environ. Med.*, 1993, 64: 692–696.
- [71] Hämäläinen, O., Visuri, T., Kuronen, P., Vanharanta, H.: Cervical disk bulges in fighter pilots. *Aviat. Space Environ. Med.*, 1994, 65: 144–146.
- [72] Skyttä J, Karjalainen J, Aho J, Laitinen L, Lindqvist A.: Heart rate and cardiac arrhythmia during high-Gz flight. *Military Medicine*, 1994, 159: 490–493.

- [73] *Sipinen, S.A., Kulvik, M., Leinio, M., Viljanen, A., Lindholm, H.*: Neuropsychologic and cardiovascular effects of clemastine fumarate under pressure. *Undersea Hyperb. Med.*, 1995, 22: 401–6.
- [74] *Pääkkönen, R., Kuronen, P.*: Noise attenuation of helmets and headsets used by Finnish Air Force pilots. *Appl. Acoust.*, 1996, 49: 373–382.
- [75] *Pääkkönen, R., Kuronen, P.*: Noise exposure of fighter pilots and technicians during flight rounds. *Acta Acust.*, 1997, 84: 91–97.
- [76] *Leino, T.K., Leppäluoto, J., Ruokonen A., Kuronen, P.*: Neuroendocrine responses to psychological workload of instrument flying in student pilots. *Aviat Space Environ. Med.*, 1999, 70: 565–570.
- [77] *Kuronen, P., Pääkkönen, R., Savolainen, S.*: Low-altitude overflights of fighters and risk of hearing loss: A case study and experiments. *Aviat. Space Environ. Med.*, 1999, 70: 650–655.
- [78] *Leino, T.K., Leppäluoto, J., Ruokonen A., Kuronen, P.*: Neuroendocrine responses and psychomotor test results in subjects participating in military pilot selection. *Aviat. Space Environ. Med.*, 1999, 70: 571–576.
- [79] *Oksa, J., Hämäläinen, O., Rissanen, S., Salmiinen, M., Kuronen, P.*: Muscle fatigue caused by repeated aerial combat maneuvering exercises. *Aviat. Space Environ. Med.*, 1999, 70: 556–560.
- [80] *Hämäläinen, O., Toivakka-Hämäläinen S.K., Kuronen, P.*: +Gz associated stenosis of the cervical spinal canal among fighter pilots. *Aviat. Space Environ. Med.*, 1999, 70: 330–334.
- [81] *Sipinen, S.A., Ahovuuo, J., Halonen, J.P.*: Electroencephalography and magnetic resonance imaging after diving and decompression incidents: a controlled study. *Undersea Hyperb. Med.*, 1999, 26: 61–5.
- [82] *Kuronen, P., Sorri, M.J., Pääkkönen, R., Muhli, A.*: TTS in military pilots after one flight measured by conventional and extended high-frequency audiometry. *Int. J. Audiol.*, 2003, 42: 29–33.
- [83] *Siitonen S, Kauppinen T, Leino T, Vanninen E, Kuronen P, Länsimies E.*: Cerebral blood flow during acceleration in flight measured with SPECT. *Aviat. Space Environ. Med.*, 2003, 74: 201–206.