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SUPPLEMENT

Health hazards in areas of military operations conducted in different climatic and sanitary conditions

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ABSTRACT

This paper reviews the most common health hazards occurring among personnel of peacekeeping and stabilization missions functioning within armed conflicts in the contemporary world. Military operations have been executed in diverse climatic and sanitary conditions, which are frequently unfamiliar for their participants. Some of them, e.g. the UN peacekeeping missions in the Middle East (Lebanon, the Golan Heights), have been carried out in a relatively stable geopolitical environment; whereas, stabilization missions in Iraq and Afghanistan, which are actually combat activities, undoubtedly fall into the group of the most perilous military operations in the world. Hot or cold climate, poor sanitary and hygienic conditions along with warfare facilitate the occurrence of numerous diseases and body injuries not only among the local people but also among peacekeepers, who represent the population of immigrants. Health hazards which pose major epidemiological threats in combat zones are arthropod-borne, food and water-borne, respiratory tract diseases, sexually transmitted diseases, enzootic diseases, battle injuries, and non-battle injuries, e.g. traffic accidents. Another considerable health problem are psychiatric disorders, which can either appear directly after the occurrence of a traumatic event in a combat zone or indirectly, after some time had elapsed. In addition to the health hazards listed above, environmental factors such as changeable weather conditions and local fauna may also be life threatening.

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Key words: health hazards, soldiers, military operations

INTRODUCTION

Contemporary military operations constitute an epidemiological threat for participants who are not familiar with the diverse climate conditions and the combat zone. Arthropod-borne diseases, food and water-borne diseases, respiratory tract diseases, sexually transmitted diseases, zoonozes, skin diseases, battle injuries resulting from combat activities, mines and unexploded ordnance, and non-combat injuries make up the studied group of health problems. A wide range of psychiatric disorders related to the combat zone, including conditions like acute and post traumatic stress disorder as well as injuries caused by environmental factors (high and low temperature, local fauna, mountainous conditions) contribute to the overall morbidity and mortality.

INFECTIOUS DISEASES

Indisputably, battle injuries remain the major threat to lives and health of soldiers participating in operations conducted in any theatre of war. Nevertheless, the most commonly occurring health problems in the population of military personnel are diseases and non-battle injuries [1]. They remain the major source of sick absenteeism, hospitalizations, and temporary disability among peacekeepers of the

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U.S. Armed Forces within the last few decades [2]. Research conducted in the population of American soldiers home-bound for medical reasons from Iraq in 2003 indicated that patients suffering from diseases and non-battle injuries were subjected to evacuation from operational areas six times as often as patients who sustained battle injuries [3]. Infectious diseases in the population of soldiers participating in contemporary armed conflicts account for just 2.8% of all diagnoses. However, owing to the absence of complex laboratory diagnostics, some digestive, respiratory tract, and skin diseases diagnosed as non-infectious may in fact be of contagious or parasitic aetiology [3]. This fact is of great importance in terms of epidemic hazards, especially considering the fact that as much as 3/4 of the military personnel deployed in the *Iraqi Freedom* operation have reported episodes of diarrhoea and over 2/3 of the population have reported episodes of upper respiratory tract infections, with the rates of morbidity rising as hostilities intensified [4]. Owing to the fact that contract soldiers (who typically break their contracts after termination of service) constitute a substantial part of military contingents (in the U.S. Army 36% of the personnel deployed in Iraq and Afghanistan are reservists and members of the National Guard) it needs to be taken into account that if a health problem occurs after being home-bound they will seek medical advice from doctors working in the civil health service [5]. A similar situation occurs as far as Polish Military Contingents are concerned. Their participants (recruited by the Military Recruitment Offices) are members of various professions, mainly medical and technical. Therefore, it is crucial to have the right knowledge of health hazards prevailing in the territories of military missions, to monitor the health condition of military and civilian staff prior to their arrival into an operational zone, during their stay there, and after their homecoming, not only for medical but also for legal-judicial reasons. Major health hazards regarding infectious diseases are discussed below. They need be analysed in detail owing to the participation of the Polish Armed Forces in peacekeeping and stabilization missions abroad.

ARTHROPOD-BORNE DISEASES

The number of vector-borne diseases which have recently been observed among military mission personnel is insignificant. Nevertheless, a number of difficulties in implementing prophylactic action (lack of vaccines and desisting from applying drugs) result in the fact that they still pose a considerable threat as there exists the possibility of "importing" vector-borne infections to a home country. Whereas monitoring water and food as well as vaccinating military personnel may help to prevent the spread of food and water-borne diseases, not much can be done as far as vector-borne diseases are concerned. Thus, a limited number of prophylactic measures make vector-borne diseases the main interest of medical services [6].

Malaria. Approximately 3 billion people, half of the world's population, live in territories where malaria is endemic. Highly developed countries such as the U.S. or the U.K. are free from the endemic focus of malaria. Yet, numerous cases of imported infections have been observed in these countries [7, 8]. Approximately 1200 cases of the disease, including around a dozen deaths, are reported annually in the U.S. Over 50% of the cases are induced by *Plasmodium falciparum* and 25% by *P. vivax* [9]. In the U.K. 1722 cases of imported malaria were diagnosed in 2005 (including 1339 cases induced by *P. falciparum*) and 16 deaths were reported. Surveys have shown that merely 46% of the British were using full antimalarial chemoprophylaxis [7]. In Poland indigenous cases of malaria have not been reported since the late 1960s; however, 22 cases of imported malaria were diagnosed and 1 death was recorded in 2008 [10]. Such an insignificant number of infections does not prove our awareness of health hazards prevailing in tropical climate areas or proper application of prophylaxis, but rather it indicates that there have been numerous cases of fever of unknown origin which have not been reported, diagnosed, or treated [11]. In the Middle East and Central Asia the aetiological factor in most cases of malaria is *Plasmodium vivax* [12]. The incidence of malaria rises significantly within combat areas where local infrastructure has been destroyed and where sanitary-hygienic standards are highly unsatisfactory. In the territory of Iraq, despite the occurrence of factors facilitating the incidence of malaria, there is a low risk of infection. Within the years 2003–2005 not a single case of malaria was observed among hundreds of thousands of American soldiers deployed in Iraq [13]. In contrast, over 40,000 soldiers of the U.S. Forces were infected with malaria during the conflict in Vietnam in the 1960s and 1970s [14]. Merely 48 cases of malaria were diagnosed during warfare in Somalia in 1993; those were mainly due to inappropriate chemoprophylaxis [15]. According to the recommendations of the United States Central Command Air Forces (USCENTAF), American soldiers pre-

sently deployed in the territory of Iraq are not obliged to use antimalarial chemoprophylaxis. In cases of an increased risk of infection with malaria, chloroquine is chosen as the means of prophylaxis [16]. Polish soldiers fulfilling mandatory tasks in Iraq have taken chloroquine (Arechin), which had no medical justification since, as mentioned previously, there is low risk of becoming infected. Not a single case of malaria was recorded in the population of the Polish Military Contingent serving in Iraq from 2003 to 2008.

In Afghanistan, a country where the prevalence of malaria among the local people has been estimated at approximately 2–3 million annually by non-governmental organizations [17, 18], incidences of the disease are also recorded among the population of immigrants. During military operations in Afghanistan conducted by the Soviet Armed Forces from 1981 to 1989 the number of clinically confirmed cases of malaria among Soviet soldiers amounted to 7683 cases (the aetiological factor *Plasmodium vivax*) [19, 20], of which a great number of infections occurred after being home-bound. From 2002 to 2006 merely 85 cases of the disease, induced by *P. vivax,* had been diagnosed among American, British, and German soldiers participating in the *Enduring Freedom* and ISAF stabilization missions [21–23]. Representatives of 28 national contingents out of 36 countries being the members of the ISAF Coalition Forces apply different drugs as far as antimalarial chemoprophylaxis is concerned. Soldiers from 15 countries use mefloquine, from 5 countries — atovaquone/ /proguanil or doxycyclinum, from 2 countries — chloroquine and proguanil, and from 6 countries — chloroquine [24]. Soldiers of the Polish Military Contingents carrying out mandatory tasks in Afghanistan since 2005 have taken chloroquine, which demonstrates incorrect epidemiological recognition of this territory, as plasmodia of malaria occurring in the territory of Afghanistan are resistant to the above-mentioned drug. In 2005, Polish soldiers started taking mefloquine (Lariam). In the beginning of 2009 doxycyclinum was used (the same drug was taken by soldiers deployed in Chad). Currently, the medicament which is to be used as antimalarial chemoprophylaxis by soldiers of Polish Military Contingents is atovaquone/proguanil (Malarone), which, in comparison to mefloquine and doxycyclinum, has the fewest side-effects. Also, it is the best solution in short-term chemoprophylaxis intended for personnel sent into a mission's operational area for a period of several days/months (air-crew, reconnaissance, and visiting groups, transport of people and equipment) [25]. Until now, similarly to the situation in Iraq, not a single case of malaria has been reported among soldiers of the Polish Military Contingent deployed in Afghanistan and Chad. Nevertheless, due to a real danger of importing the disease into Poland or the occurrence of pathologic symptoms in the future, attention should be paid to each case of fever of unknown origin occurring among soldiers returning from areas where malaria appears endemically.

The exact number of malaria incidences in the population of American soldiers stationed in a given territory is difficult to establish due to the high rotation of US military personnel deployed in different regions of the world where malaria occurs endemically. From 2000 to 2005 423 cases of malaria were diagnosed in the population of U.S. Forces soldiers participating in military operations overseas (mainly in Afghanistan — 78 cases). From 2003 to 2005, 34% of American soldiers suffering from malaria became infected with the disease in more than one endemic region of the disease [26]. This issue needs to be considered in the aspect of the participation of Polish soldiers in more than one military operation abroad within the last 12–48 months.

Recommendations of preventive medicine within the U.S. Forces clearly define the necessity to apply means of personal protection against vector-borne diseases (mosquito nets, DEET, Permethrin) and, in the case of malaria, the necessity to use chemoprophylaxis [27, 28]. Regrettably, research on discovering a vaccine against malaria has been unsuccessful [29]. According to USCENTAF recommendations, anyone staying in the territory where malaria occurs endemically for a period of three or more days should use antimalarial chemoprophylaxis. Transmission of the disease in Afghanistan typically occurs between the end of March and the beginning of November. However, incidences of the disease were reported late in November within recent years in the Kandahar province. In 2003 one person became infected with the disease in December during an 11-day stay in the Bagram province (the disease developed following departure from the endemic region) [16]. Antimalarial chemoprophylaxis among U.S. Forces personnel in Afghanistan is based on the application of two types of drugs: doxycyclinum or mefloquine. In the case of the latter there are contraindications to its use by aircrew due to the occurrence of side effects. Mefloquine is a medicament the application of which may lead to some serious neuropsychiatric symptoms, a tendency to violence, and suicidal thoughts. This problem was given some consideration

following cases of homicide and suicide among five American soldiers home-bound in the summer of 2002 from Afghanistan, where they had used mefloquine as antimalarial chemoprophylaxis [30]. The most frequently occurring side effects of mefloquine are as follows: anxiety and depressive mood, psychomotor hyper excitability, paranoia, fear, mood changes, aggression, panic attacks, amnesia, sleep disorders, hallucinations. All of the above-mentioned side effects may persist long after termination of treatment with mefloquine [31, 32]. Nevertheless, despite such serious side effects, their percentage in the population taking the drug is low. In addition to this, it has been observed that mefloquine is better tolerated than doxycyclinum, which statistically has more side effects [33].

U.S. military personnel deployed abroad have been routinely monitored in two directions. The first is the risk of transferring the infection via blood transfusion, thus each honorary blood donor should be routinely tested for infection with malaria *Plasmodium* [34]. The second is the test for glucose-6-phosphate dehydrogenase deficiency [35]. Following termination of service in regions where malaria is endemic, American soldiers are subjected to terminal chemoprophylaxis in the form of a 14-day treatment of primaquine, a drug which is a complement to chloroquine, mefloquine, atovaquone/proguanil, or doxycyclinum. Such treatment is justifiable in cases of infections with *Plasmodium vivax* and *P. ovale*, when, in spite of implemented chemoprophylaxis in an endemic region, *Plasmodium* can survive in liver cells and induce the disease several years after returning from malarial regions [36].

Owing to the fact that 100% of indigenous cases of malaria in Iraq and 80% of cases of malaria in Afghanistan are induced by *P. vivax*, implementation of terminal chemoprophylaxis seems fully justifiable. However, the use of primaquine in patients with glucose-6-phosphate dehydrogenase deficiency (mainly in the form of haemolytic anaemia) may have disastrous consequences. Cases of haemolysis occurred in two American soldiers homebound from Iraq. In both cases deficiency of the enzyme was confirmed [35]. Presently, soldiers of the U.S. Forces have been routinely tested for glucose-6-phosphate dehydrogenase deficiency. From October 2004 to January 2005 over 63,000 American soldiers were tested. The test was positive in 2.5% of males and 1.6% of females. The highest percentage of patients with glucose-6-phosphate dehydrogenase deficiency was observed in the population of Afro-Americans (12.2% of males and 4.1% of females) and Asian males (4.3%) [37]. As far as the Polish health service is concerned, in relation to soldiers of Polish Military Contingents, neither terminal prophylaxis of malaria (the use of primaquine) to prevent infections with *P. vivax* and *P. ovale* nor tests for enzymatic deficiencies are implemented.

Interestingly, a high percentage of military personnel seem to ignore health hazards regarding vector-borne diseases despite the wide availability of means of personal protection as well as chemoprophylaxis against malaria. Anonymous surveys conducted among soldiers of the U.S. Forces participants of the military operation in Afghanistan revealed that merely 52% used chemoprophylaxis in the operational zone, 41% — terminal prophylaxis following their home-coming, 31% — prophylaxis both in the operational zone and after their return home, 82% applied permethrin to uniforms and mosquito nets, and 29% applied insect repellents to bare skin (DEET) [6]. In other national contingents participating in the ISAF stabilization mission in Afghanistan the percentage of people using prophylactic means remains at a very low level. Insect repellents are used by 46% and mosquito nets by 39% of those surveyed [24]. Clearly, apart from appropriate medical coverage, a lot depends on the attitude of the military personnel towards prophylaxis, which, regrettably, leaves a lot to be desired.

Leishmaniasis. This disease is endemic in 88 countries inhabited by 350 million people in all continents except for Australia and Oceania. Annually, 1.5 million cases of cutaneous leishmaniasis and 0.5 million cases of viscerotropic leishmaniasis are recorded. 90% of all registered cases of the disease occur in Afghanistan, Iraq, Iran, Algeria, Saudi Arabia, Peru, and Pakistan [38]. The disease is transmitted from a sick animal or a human to a healthy individual by infected *Phlebotomus* flies. Taking into account the fact that until now transmission of the infection via blood transfusion occurred only in the territories where leishmaniasis is endemic, and the course of its viscerotropic form is mild and asymptomatic in blood donors, blood transfusion cannot be unambiguously defined as a risk factor in transmitting the disease [39].

Leishmaniasis has been occurring among the population of soldiers participating in military operations in the Middle East for decades. During the Second World War, from 1943 to 1944 more than a thousand cases of cutaneous leishmaniasis were registered among the population of U.S. Forces sol-

diers deployed in Iraq and Iran [40, 41]. During the Soviet aggression in Afghanistan in the 1980s infections of the cutaneous form of the disease among Soviet soldiers occurred on a mass scale, generally following their return home, due to a long incubation period [42]. Within the years 1990–1991, during the *Desert Storm* operation, 20 cases of cutaneous leishmaniasis (induced by *Leishmania major*) and 12 cases of its viscerotropic form (*L. tropica*) were observed in the population of American soldiers deployed in Saudi Arabia, Kuwait, and Iraq [43–45]. Present-day military operations in Iraq and Afghanistan reveal high incidence of leishmaniasis among soldiers of the Stabilization Forces. The first report from Iraq, issued in October 2003, informed of 22 incidences of the disease. A report issued in April 2004 reported 522 cases of leishmaniasis in the population of U.S. Forces soldiers (the predominant aetiological factor was *L. major*). In 2004 the U.S. Army epidemiological services employed in Iraq tested approximately 65,000 *Phlebotomus* flies and revealed that 1.4% were infected with *Leishmania* parasites [41]. From 2002 to 2005 827 cases of cutaneous leishmaniasis and 5 cases of its viscerotropic form were diagnosed and laboratory confirmed among American soldiers deployed in Iraq, Kuwait, and Afghanistan [13]. All the incidences of viscerotropic leishmaniasis occurred in Afghanistan (the aetiological factor was *L. donovani*) [46].

Retrospective surveys conducted among soldiers of U.S. Forces participating in operations *Iraqi* and *Enduring Freedom* from 2003 to 2004 revealed the occurrence of cutaneous leishmaniasis in 2.1% of respondents [4]. Within the given period the percentage of American soldiers evacuated from Iraq to the U.S. to undergo treatment of cutaneous leishmaniasis in a Walter Reed Army Medical Centre (WRAMC) reached 4.4% of all evacuations for medical reasons [47]. The author of this article witnessed criticism of the high costs of evacuation of hundreds of American soldiers to the U.S. (where they underwent a 20-day treatment of cutaneous leishmaniasis and after that were sent back into the mission's zone) in a meeting with the U.S. Army Hospital commanders in Bagdad (Level 3). Eventually, American health services realized that the cutaneous form of the disease is not life threatening and changed the therapeutic procedures. Thus, it was decided that soldiers should undergo treatment of leishmaniasis within the operational zone. The author of this article, while being deployed in Afghanistan in 2005, provided medical assistance for patients treated in the U.S. Army General Hospital in Bagram, where he treated cases of cutaneous leishmaniasis occurring among military and civilian personnel participating in the operation *Enduring Freedom* in an outpatient clinic. The incidence of leishmaniasis and other vector-borne diseases, which have already been mentioned in the context of malaria, constitute a serious health hazard largely due to the fact that basic principles of prophylaxis are neglected [48]. In prophylaxis of leishmaniasis, owing to the absence of vaccine or chemoprophylaxis, mosquito nets and insect repellents remain the fundamental prophylactic means. Questionnaires completed by 310 soldiers treated for leishmaniasis in the Walter Reed Army Medical Centre in the U.S. demonstrated that merely 10% of the respondents used mosquito nets [49]. The most effective insect repellent is N,N-diethyl-*m*-toluamide (DEET) [50]. Although its application has been recommended by the U.S. Armed Forces, not many soldiers use it. Only 68.5% of the surveyed soldiers homebound from Iraq and Afghanistan had known about its availability, 14.6% applied it regularly, and as much as 51.2% had never used it. In addition to this, conducted surveys revealed that only 41.1% of soldiers believed that DEET was effective, and 21.6% that it was safe, although it has been widely used for decades and both toxicologists and epidemiologists consider it to be safe and effective. So far not a single case of leishmaniasis has been diagnosed among soldiers of the Polish Military Contingent deployed in Afghanistan [51]. Similarly, leishmaniasis has not occurred in the population of Polish soldiers deployed in Iraq [52] even though the disease is endemic within the operational zone of the Multinational Division Central-South, especially in the Wasit Governorate, where cases of cutaneous leishmaniasis have occurred in soldiers of the Ukrainian [53] and American contingents [54].

Owing to an exceptionally long incubation period (months, years) and the likelihood of importing the disease from the territory of its endemic occurrence, particular attention needs to be paid to each case of a wound which is not healing (cutaneous leishmaniasis) and fever of unknown origin (viscerotropic form) among soldiers participating in operations *Iraqi* or *Enduring Freedom*, after their return home.

Other diseases. Further arthropod-borne diseases which may be life threatening for soldiers participating in military missions in Iraq and Afghanistan are sand fly fever, epidemic and endemic typhus, and Crimean-Congo haemorrhagic fever. Cases of the diseases mentioned above occur among the local

population inhabiting territories of both countries [55]. Sand fly fever — a viral infection, which, similarly to leishmaniasis, is transmitted by *Phlebotomus* flies, is particularly widespread. The disease occurred on a mass scale among Soviet soldiers occupying Afghanistan in the 1980s [56, 57]. In 2004, while being employed in the Polish Field Hospital in Iraq, the author of this article treated soldiers of the Coalition Forces for status past insect bites showing a similar clinical picture as seen in sand fly fever.

FOOD AND WATER-BORNE DISEASES

This group of diseases constitutes the most frequently occurring health problem among soldiers participating in military missions, which is primarily due to unsatisfactory sanitary standards in the regions of force deployment, contamination of soil and water, and incorrect system of purifying drinking water, as well as a disastrous condition of plumbing and sewage systems [58, 59]. The occurrence of diseases is further facilitated by neglect of military personnel to comply with recommendations regarding the rules of personal hygiene as well as food and feeding hygiene [60]. A good example of such disregard arose during the UN mission in Lebanon (UNIFIL), where, in 1998, an epidemic of staphylococcal food poisoning occurred among soldiers of the Polish Military Contingent owing to the fact that a cook with pyodermas (induced by *Staphylococcus aureus*) was working in the food-processing section [61]. Proper sanitary, hygienic, and anti-epidemic safety regulations significantly diminish the risk of the occurrence of contagious and parasitic diseases of the digestive system. A perfect example of such action is the prophylactic measures taken by the Croatian sanitary services during the Balkan war within the years 1991–1992. Regular sanitary inspections, mass vaccinations, and registration of the sick and carriers of infectious diseases resulted in the occurrence of merely one focus of a contagious disease of the digestive system in the whole country (21 cases of typhoid fever) [62].

Typically, military personnel deployed in combat zones constitute a population of immigrants recruited from countries of high hygienic standards. Thus, a sudden change of environmental conditions results in their increased sensitivity to local pathogens. This gives rise to gastrointestinal disorders, which typically occur among soldiers within the first few weeks of their arrival at a new post [63]. The individual research conducted in the population of American soldiers serving in the Multinational Division Central-South in Iraq from 2003 to 2004 revealed the highest incidence of digestive system diseases (36.8%), among which acute gastroenteritis, with its typical symptoms (nausea, vomiting, diarrhoea) lasting on average 1–3 days, was predominant. The incidence rate was the highest in the course of the first month after being relocated to a combat zone in the Middle East [54]. The most frequently occurring pathogen of contagious diseases of the digestive system among the population of the military personnel undergoing medical treatment in the MND SC Field Hospital in Iraq from October 2003 till March 2004 was enterotoxic *Escherichia coli* (bacteriologically confirmed in over 50% of all cases) [63]. Other pathogenic factors included *Shigella*, *Salmonella*, *Campylobacter*, *Cryptosporidium*, *Giardia intestinalis*, *Entamoeba histolytica*, and *Rotaviridae*. In 20–30% of cases the aetiological factor remained unspecified (negative microbiological test) [63, 64].

The occurrence of acute gastroenteritis, especially diarrhoea, is widespread among military personnel deployed within an operational zone. A surge in incidence of diarrhoea among American and British soldiers was observed during the initial stage of military operations in Afghanistan (2001) and Iraq (2003). The main aetiological factors were *Norwalk* viruses and bacteria of the *Shigella* genus [65–67]. The majority of military personnel deployed within a combat zone reported at least one episode of diarrhoea during their service in Iraq (77% of respondents) and Afghanistan (54%). Soldiers positioned in Iraq complained of a much longer and more severe course of the disease and went through more episodes of diarrhoea than soldiers deployed in Afghanistan did. Typically, symptoms of the disease lasted several days, in 10% of all cases symptoms persisted for over two weeks [68].

Questionnaires completed by American soldiers stationed in Iraq in the summer of 2004 revealed the occurrence of diarrhoea in 66% of the examined population, out of whom 50% complained of repeated episodes of the disease. The aetiological factor of the disease which was most frequently detected in laboratory tests was *Escherichia coli* (35.5% of all cases). Other pathogens included *Norwalk* virus (2.5%) and parasites (7%), of which *Entamoeba histolytica* and *Giardia intestinalis* posed the most serious epidemiological hazard [69].

Research conducted among American soldiers deployed in Iraq in 2005 demonstrated a relatively high percentage of diarrhoea induced by *Cryptosporidium*. In all cases of chronic diarrhoea occurring

in soldiers serving in overseas tours irritable colon syndrome or persistent parasitic infections induced by *Cryptosporidium sp*., *Entoamoeba sp*., or *Giardia sp*. should be taken into account [70]. On the basis of surveys conducted in American units among peacekeepers participating in the operations *Iraqi* and *Enduring Freedom* in 2004 the incidence rate of diarrhoea was estimated at 4.9 cases per 100 patients treated each month. The main aetiological factor was *Escherichia coli* (44%, including enterotoxic *E. coli* — 32%) and *Salmonella sp*. (6%) [71]. Subsequent research, conducted among 15,459 military personnel of the U.S. Army deployed in Iraq and Afghanistan from 2003 to 2004, demonstrated that the most commonly occurring diseases of the digestive system were diarrhoea of a relatively serious course (more than 6 loose stools) going together with fever (26%) and vomiting (18%). Over 80% of patients showing symptoms of the disease were provided with medical help at Level 1 [68].

A total of 1340 cases of diarrhoea of semi-serious and serious course were noted in the population of British soldiers participating in operation *Iraqi Freedom* within the first few weeks of their deployment in the operational zone; 73% of patients required hospitalization. The main aetiological factor was *Caliciviridae* (*Norwalk*) [72]. Research on morbidity rates conducted in the population of American peacekeepers as well as soldiers of other nationalities serving abroad for an extended period of time from 1990 to 2005 showed that episodes of diarrhoea concerned 38% of the population deployed in the Near East and 29% of the population deployed in South-East Asia. The most commonly occurring aetiological factors were enterotoxic *Escherichia coli*, *Campylobacter*, and *Shigella* [73]. Acute gastroenteritis, also called "traveller's diarrhoea", is one of the most serious health problems occurring among people travelling abroad, observed in 60% of all travellers [74]. Military personnel sent into combat zones constitute a distinctive group of travellers among which the occurrence of gastroenteritis is particularly widespread [75–77]. Despite the application of specific sanitary regulations in the areas of military operations conducted in Iraq and Afghanistan as well as constant supervision by sanitary services of military contingents, episodes of diarrhoea occur in the majority of soldiers deployed in the territory of both countries, and in more than 50% of patients symptoms of the disease occur repeatedly [78].

A significant problem connected with the occurrence of food- and water-borne diseases is the fact that a large number of the diseases were not diagnosed in terms of the aetiology of their pathogens. For this reason, data regarding the causes of sickness prevalence may not be fully credible [79]. The occurrence of acute gastroenteritis among military personnel is typically associated with the consumption of food from the local market and drinking water from unknown sources [68]. A survey conducted among American soldiers stationed in Iraq revealed that as much as 26.6% of them admitted the consumption of local food, and in Afghanistan — 5.3%. When asked for the reasons for their decision to eat local food which had not been attested in terms of sanitary standards, surveyed soldiers gave the following answers: they wanted to add variety to the military menu (25%), to satisfy their curiosity as to the local cuisine (20%), and they received food and drinks as a gift and did not want to offend their benefactors with refusal (15%) [68]. Implementing proper prophylactic measures which prevent the occurrence and spread of infectious and invasive diseases of the digestive system constitute a key factor in maintaining health in a given population, especially in a combat zone [80]. Simple sanitary procedures may considerably reduce the risk of the occurrence of pathological symptoms — washing hands by 42–47% [81], disinfection and correct disposal of excrement by 30–35%, and disinfection of drinking water by 15–20% [82, 83]. Should the prophylaxis regarding contagious and parasitic diseases transmitted through food and water be neglected, the risk of the disease incidence may become particularly high [84].

The group of food- and water-borne diseases occurring among the population inhabiting the territory of Iraq and Afghanistan, the incidence of which is strictly connected to unsatisfactory sanitary and hygienic standards, include typhoid fever, hepatitis A, and cholera. All military personnel participating in both of the mentioned stabilization missions are subjected to vaccination against typhoid fever and hepatitis A before being relocated to new posts. Also, while serving in a combat zone, preventive medicine services pay particular attention to personal hygiene and purity of drinking water as well as food and feeding hygiene [85]. Thus, the executed sanitary regime considerably reduces the risk of sickness prevalence (until now, cases of typhoid fever, hepatitis A, or cholera have not been registered in the population of American military personnel participating in operations *Iraqi Freedom* and *Enduring Freedom*). The situation regarding the application of proper prophylactic measures (or rather the absence of them) used

to be completely different among the 620,000 Soviet soldiers occupying Afghanistan in the 1980s. Within the given period 31,000 soldiers were hospitalized due to typhoid fever and a further 115,000 were hospitalized due to viral hepatitis (hepatitis A constituted 95% of all cases), which considerably reduced the combat potential of the Soviet Forces [86, 87]. Sanitary losses suffered by the Russians in Afghanistan caused by nothing else but contagious and parasitic diseases ranged from 53.2% (1980) to 68.7% (1983) of the population. The occurrence of complex infections, i.e. typhoid fever + + hepatitis A, typhoid fever + amebiasis, hepatitis A + + shigellosis, etc., was widespread. The majority of contagious and parasitic diseases contributed to the evacuation of the sick from the combat zone back to their home country [88].

RESPIRATORY TRACT DISEASES

Respiratory tract diseases belong to a group of health problems which are particularly widespread in combat zones. This is undoubtedly influenced by mass migrations, overpopulation, and a breakdown in prophylactic vaccination systems and changeable weather conditions. High morbidity occurs not only among civilians but also among soldiers participating in military operations [89, 90]. The aetiological factors of the respiratory tract diseases occurring in the population of military personnel are primarily *Streptococcus pneumoniae*, *Mycoplasma pneumoniae*, and *Haemophilus influenzae* [91, 92].

During the Gulf War in 1991 diseases of the respiratory tract were the most frequently reported illnesses among soldiers of the Coalition Forces taking part in the *Desert Storm* and *Desert Shield* operations [93]. Acute respiratory infections resulted in increased sick absenteeism among the population of Soviet soldiers deployed in Afghanistan in the 1980s. Within their first year of service in Afghanistan as much as 43% of Soviet soldiers suffered from acute bronchitis and/or pneumonia, mainly in the autumn/winter season, which was unquestionably caused by unfavourable weather conditions [94]. In areas where contemporary military operations are conducted medical services put special emphasis on prophylaxis of airborne diseases, which is primarily based on preventive vaccination against influenza and pneumococcal infections as well as treatment by means of guided pharmacotherapy [90, 95].

Research conducted on the population of American soldiers taking part in the *Iraqi Freedom* and *Enduring Freedom* operations revealed that respiratory tract diseases still remain one of the biggest health problem diagnosed in participants of military operations deployed in territories where different climatic and sanitary conditions prevail. In total, 69% of respondents complained of at least 1 episode of respiratory tract infection and 14% complained of more than 3 episodes [4]. The incidence of respiratory tract diseases was particularly high during direct combat activities [46]. Approximately 40% of patients reporting respiratory tract diseases admitted to smoking at least 10 cigarettes daily, which, in conjunction with environmental conditions, may notably increase the prevalence of the diseases [4]. In 3% of American soldiers complaining of respiratory tract diseases, pneumonia was diagnosed. Patients with pneumonia were generally treated on an outpatient basis [46]. Apart from cases of bacterial or viral aetiology, which occurred in the population of American soldiers from March 2003 to March 2004, 18 patients were diagnosed with idiopathic, eosinophilic pneumonia (2 patients died) [96]. Research conducted during the initial stage of operation *Iraqi Freedom* revealed fewer than 100 cases of pneumonia among American soldiers; 15% of patients suffered from acute respiratory failure and required treatment in an intensive care unit [97]. *Streptococcus pneumoniae* is the main pathogenic factor that induces pneumonia in the population of soldiers serving in the U.S. Forces in Iraq and Afghanistan [98].

Tuberculosis. The disease is widespread among the local people inhabiting the territory of ongoing military operations, and it poses a serious threat to the health of military mission personnel. It must be kept in mind that tuberculosis is not only transmitted through the respiratory tract but also through the digestive tract. Thus, avoiding the consumption of non-pasteurized dairy products from the local market is essential [99]. Tuberculin PPD tests (purified protein derivative of tuberculin) are carried out in the population of American soldiers prior to their arrival into a mission area as well as following their return home. The conversion index among American military personnel has been estimated at the level of 2.5%. During the Vietnam War at the turn of the 1960s and 1970s 3–5% of American soldiers deployed in the Indochina Peninsula for a period of one year demonstrated positive TB tests. In the same period, positive TB tests did not exceed 1% in the population of soldiers stationed solely in the territory of the U.S. [100].

SEXUALLY TRANSMITTED DISEASES

This group of diseases does not pose a serious epidemiological risk among soldiers of Stabilization Forces serving in the Middle East and in the Central Asia under the conditions of regular clinical and laboratory supervision of mission participants. The risk of infection rises drastically in cases of incidental intercourse without the application of basic preventive means (condoms). However, the risk of infection has increased recently since military service has ceased to be an all-male profession. In national contingents participating in military missions women account for a substantial part of the contingents' population. In some of the U.S. Forces units women represent up to 20% of the population, which certainly influences the fact that sexual intercourse among military mission personnel is becoming increasingly commonplace. Gynaecological examination of 1737 women soldiers serving in the U.S. Army deployed in the Near and Middle East from August 2003 to April 2004 demonstrated 77 cases of positive pregnancy test. 23% of women became pregnant during their deployment in the military mission territory [101]. Further research conducted among female personnel of the U.S. Army stationed in dislocation camps in Kuwait before relocating them to Iraq or Afghanistan revealed clinical symptoms and/or positive results of laboratory tests in the direction of sexually transmitted diseases. Genital herpes (30%), genital warts (25%), and chlamydiasis (21%) prevailed among the diagnosed cases of STD. The results clearly indicate that detailed venereal tests need to be carried out before relocating soldiers to service abroad [102]. As regards sexually transmitted diseases chlamydiasis, gonorrhoea, and viral infections (HSV, HPV, HIV) prevail in the population of military mission personnel. Chlamydiasis remains the most frequently diagnosed bacterial venereal infection in the United States. Over 929,000 cases of infections with *Chlamydia trachomatis* were registered in 2004. However, considering the fact that in 75% of females and 50% of males the disease is asymptomatic, it has been estimated that approximately 2.8 million Americans might have become infected with chlamydiasis [103]. Also, chlamydiasis belongs to a group of the most commonly occurring STDs in the population of American soldiers [104]. Screening tests carried out in the U.S. Navy and Marines units demonstrated that 4.1% of the examined males and 4.5% of the examined females were positive [105]. Further research carried out among women about to begin their military service in the U.S. Army revealed that as much as 9.2% of the examined females were infected with *Chlamydia trachomatis* [106]. The epidemiological services of the U.S. Army recommend conducting screening tests in the direction of chlamydiasis in all candidates willing to enlist in the U.S. Forces [107]. Other STDs also constitute a considerable epidemiological hazard in the American population. Each year 600,000 cases of gonorrhoea are diagnosed in the U.S., more and more often with increasing refractoriness to pharmacotherapy. The incidence rate of gonorrhoea is estimated at 2.5 per 100,000 persons [108]. HIV infections, estimated at 1.2 million cases in the United States at the end of 2005 [109], have been registered and monitored in the U.S. Forces. Diagnostic tests (anti-HIV antibodies) have been routinely carried out in the U.S. Forces since 1985 [110, 111]. Until the end of the 1990s the number of HIV infections among the personnel of the U.S. Forces remained at a relatively low and constant level [112]. The rate of HIV seroconversion amounted to 1275 cases in all of the U.S. Forces [113]. In recent years, however, the number of infections has increased. A total of 1373 cases of HIV infections were registered by January 2004 only among the U.S. Air Force personnel, 155 persons remain in active service, 561 persons died of AIDS [108]. The risk of infection via sexual intercourse also relates to cases of hepatitis B and C; yet the number of infectees is relatively small [114]. An examination of 21,000 randomly selected American soldiers revealed infection with the HCV virus in 0.5% of the examined population, whereas the number of infectees in the population of adult Americans has been estimated at 2.6% [115, 116].

The incidence rate of sexually transmitted diseases among military personnel surges drastically in times of warfare and is several times greater in comparison to the incidence rate during times of peace. Military contingents generally consist of young, sexually active men susceptible to taking up sexual activities with incidental prostitutes as a means of working off stress [117]. In terms of venereal diseases the incidence rate is hugely influenced by the region of the deployment of forces. In Muslim countries of the Middle East and Central Asia, burdened with a number of moral restrictions, access to sexual services is extremely limited. Therefore, an insignificant number of infections have been reported. In contrast to other diseases prevalent in hot climate areas or combat zones, STDs do not pose an epidemiological hazard for military mission participants [118]. However, some consideration should be given to more and more commonly occurring HIV infections among

inhabitants of Muslim countries. Muslims seem to ignore the risk, thinking that extramarital sex, prostitution, homosexuality, or drug abuse do not concern followers of their religion [119]. Such hypocrisy facilitates the spread of the infection, especially as becoming infected with HIV still remains a taboo subject and cases of the disease are purposely kept secret for fear of public condemnation [120]. During operation *Desert Storm* in 1991 the incidence of STDs among soldiers of the Coalition Forces did not exceed 1% of all diseases treated within the given period. The individual research carried out in the population of the U.S. Forces soldiers (n = 7000) deployed in Bagram, Afghanistan from March to August 2005 demonstrated that 17 out of 2870 admissions to the U.S. Army General Hospital (on an outpatient basis) were due to STDs (8 cases of chlamydiasis, 4 of gonorrhoea, 2 of genital warts, 2 of genital herpes, 1 of trichomoniasis). Ten cases of STDs, including 9 cases of gonorrhoea were diagnosed in the population of the UN peacekeepers serving in the Golan Heights (UNDOF) from 1996 to 2000 (not a single case of STD was registered among soldiers of the Polish Military Contingent). Whereas, 24 soldiers were hospitalized due to STDs (2 cases of HIV/AIDS, 12 cases of gonorrhoea, 5 of lues, 5 of genital warts) during the following UN peacekeeping mission conducted in the Middle East (UNIFIL in Lebanon) from 1993 to 2000. One case of a venereal disease (gonorrhoea) was diagnosed in the population of Polish peacekeepers deployed in Lebanon within the given period, which was treated on an outpatient basis [121].

In contrast to the above-mentioned countries, the epidemiological situation in other parts of the world, e.g. in Southeast Asia, is completely different [118]. Unlimited access to sexual services provided by prostitutes, of whom the vast majority are infected with STDs, results in the fact that the incidence rate in this part of the world is particularly high. This may be illustrated on the example of the Polish Military Contingent's population participating in the UN peacekeeping mission in Cambodia (UNTAC) from 1992 to 1993. Ninety-two cases of venereal diseases were diagnosed (gonorrhoea was predominant) among 789 Polish patients subjected to medical examination, which amounted to 6.5% of all diseases treated within the given period [122]. A similar incidence rate occurred among American soldiers taking part in the Vietnamese conflict in the 1960s and 1970s [123, 124].

ZOONOZES

Zoonozes pose a considerable epidemiological threat to soldiers participating in military missions in endemic regions as they typically occur among local populations, especially those inhabiting rural areas. The group of enzootic diseases which are of epidemiological importance includes rabies, brucellosis, and Q fever [125, 126]. Although the incidence rate among the population of soldiers participating in military operations is insignificant compared to other contagious diseases, after-effects of such infections are so serious that each suspicious case should be analysed in detail, especially in cases of diseases proceeding with fever of unknown origin [127]. The main source of rabies infection for people is dogs (95% of all cases and deaths in the world). Over 99% of deaths among people occur in Asia and Africa. Each year approximately 55,000 people, mainly children, die of rabies. Over 7 million people run the risk of becoming infected with rabies. The risk of an infection is particularly high in Afghanistan, where bites of stray, infected dogs cause several hundred fatalities among the local people every year [128]. Until now not a single case of the disease was registered in the population of soldiers deployed in Iraq, Afghanistan, or Chad.

Brucellosis occurs endemically in the territory of the Middle East; it is transmitted to people through contact with infected animals or consumption of non-pasteurized dairy products. The routes of infection for humans are food, air, and contact with a carrier of the disease. Three cases of brucellosis were diagnosed among American soldiers deployed in the Middle East from 2003 to 2005. A helicopter pilot serving in Iraq became infected while he was witnessing the slaughter of sheep even though he refused to eat meat or dairy products of an infected animal [129]. The cause of the Q fever in humans may be a droplet infection in the case of the direct contact with infected animals (sheep, goats), contact with their infected excrement, or even clouds of dust produced by cars. Other routs of transmission are tick bites and consumption of non-pasteurized milk. Q fever proceeds in the form of an acute flu-like infection together with pneumonia or hepatitis. It may also take the form of a chronic infection, often as endocarditis [130]. Cases of Q fever were diagnosed in American soldiers participating in operation *Iraqi Freedom*, who had initially been treated for pneumonia or hepatitis. Antibodies against *Coxiella sp*. were found in 8 patients suffering from pneumonia and 2 patients

suffering from hepatitis [131]. Medical history of infected patients revealed that 3 of them had contact with animals, 2 of them were bitten by ticks, and 1 was drinking non-pasteurized milk. A further 22 cases of the disease were diagnosed among U.S. Marines serving in Southern Iraq. In these cases the disease took the form of a respiratory tract infection with high fever [132]. Q fever is a disease which poses a significant epidemiological risk on a global scale. This is not merely the matter of the risk of becoming infected in the regions where military forces are deployed, but more importantly the possibility of exploiting its aetiological factor (*Coxiella burnetii*) as a biological weapon in bioterrorist attacks [13].

Another animal-borne disease, the aetiological factor of which may be applied as biological weapon, is anthrax. Vaccination against anthrax is included in the vaccination schedule of soldiers serving in the U.S. Forces. Until now the disease has not occurred among participants of the *Iraqi Freedom* and *Enduring Freedom* operations. However, single cases of other rarely occurring zoonozes have been registered in the population of military personnel. Several cases of *ophtalmomyasis*, myiasis of severe course, occurred among American soldiers deployed in Iraq. A gadfly, *Oestrus ovis*, parasitizing in sheep's nostrils lays larva on a human eyeball, which in consequence may lead to some serious ophthalmological complications, including loss of sight [133].

SKIN DISEASES

The majority of stabilization missions in the world have been executed in hot climate areas, which in connection with poor sanitary and living standards facilitate the occurrence of various dermatoses, which in turn result in the growth of morbidity among soldiers, mainly treated on an outpatient basis [134, 135]. Allergic, bacterial, and viral diseases as well as mycoses prevail among dermatoses [136, 137]. There is a close correlation between maintaining personal hygiene and the occurrence of dermatological problems, which is clearly evident among participants of military operations who are all equally provided with sanitary fittings and cleaning products (soap, washing powder, toothpaste). However, the broadly understood concept of hygiene is interpreted in a number of different ways and it frequently leaves a lot to be desired [138]. Appropriate uniforms and underwear are also essential and need to be adapted to prevalent climatic conditions. The point is not only that the dress code needs to be observed by the soldiers themselves, but more importantly that appropriate clothing and footwear, ordered by the military administration, need to be supplied [138]. The fact that the first rotation of the Polish Military Contingent were sent to Iraq equipped with footwear with cracking soles, polyester T-shirts, and uniforms tailored to climatic conditions prevailing in Poland rather than in the Middle East attracted widespread attention.

A large number of cosmopolitan dermatoses, which in moderate climate areas do not represent a serious health hazard, in tropical areas, due to intensification of changes, frequently result in sick absenteeism [139]. Also, it must be taken into account that the health condition of soldiers suffering from allergic dermatoses gets worse in hot climate areas. Clinical observation indicates that persons with a positive history of allergies, e.g. patients with photodermatoses, complain of allergic diseases in sunlit areas more frequently [136]. Phototoxic and photoallergic reactions resulting from associated effects of sunshine and products such as medications and cosmetics are particularly widespread in tropical and subtropical areas [140]. In addition to this, contact dermatitis caused by exposure to chemical products (oil and lubricants) belongs to a group of frequently occurring dermatological diseases in regions of ongoing military operations in hot climate areas [141]. The individual research conducted in the population of the Polish Military Contingents deployed in Iraq and Afghanistan indicated that skin diseases, with allergic dermatoses as the prevailing ones, belonged to a group of the most frequently occurring health problems among patients treated on an outpatient basis [142].

ENVIRONMENTAL FACTORS

Military service in peacekeeping and stabilization missions is burdened with a number of adverse environmental factors such as high or low temperatures, wind, sand, dust, and local fauna. During the summer heat, injuries pose a serious health hazard. Also, sand and dust storms become extremely bothering. In the winter, exposure to low temperatures becomes a serious health problem. In countries such as Afghanistan, mountainous conditions are an additional threat, especially during the winter when there is much snowfall.

HEAT INJURIES

A commonly occurring type of health hazard among soldiers executing mandatory tasks in hot climate areas are heat injuries. They represent a wide spectrum of symptoms of moderately serious intensi-

fication in the course of diseases, such as heat exhaustion and heat cramps, to life-threatening condition such as heat stroke or rhabdomyolysis [143]. Initial symptoms of a heat stroke are typically abrupt. In cases of extensive dehydration, continuation of extreme exertion, or delayed medical intervention it may turn out to be life-threatening [144]. Heat injuries typically concern physically fit young people [145, 146]. According to Porter, soldiers are more likely to suffer from heat injuries than marathon runners [147]. Manual labour, heat accumulation, thermoregulation (sweating, metabolic processes, and action of the cardiovascular system) may cause dehydration, dyselectrolytaemia, and dysfunction of a number of body systems and organs. Soldiers who have not undergone the acclimatization process run the highest risk of suffering from heat injuries among all military personnel executing tasks in hot climate areas [148]. In the summer of 2003, 6000 soldiers of the Coalition Forces underwent the acclimatization process in northern Kuwait before having been relocated to Iraq (operation *Iraqi Freedom*). With average temperatures reaching +46°C heat injuries occurred in 50 out of 1000 soldiers within 10–14 days [149].

The number of heat injuries among soldiers decreases significantly if accurate prophylactic action is implemented. The preventive measures should include consumption of a specific amount of water and electrolytes, and defining specific duration and intensification of physical effort depending on the type of work performed. Also, it is essential to define the risk factors which facilitate the occurrence of health problems mentioned above such as old age, taking medicines (especially anticholinergic and psychotropic), obesity, skin diseases, or former episodes of heat injuries in the past [150, 151]. Normally, it takes at least 10–14 days for a representative of a moderate climate to fully adjust to weather conditions prevailing in hot climate areas. The rise of internal temperature in a human body above the rest level is observed in areas where climatic conditions facilitate such an increase (high temperatures and humidity, a lot of sunlight). Heat is eliminated from a human body by means of a physical thermoregulation mechanism (haemangiectasia, growth in cutaneous blood flow, increased activity of sweat glands, sweat evaporation). The human body uses the mechanism of thermoregulation to adapt to a wide range of external temperatures. However, it remains sensitive to internal temperatures. A body temperature of ± 2–3°C may result in serious pathological conditions, including death [152, 153]. The most commonly occurring heat injuries are: heat stroke, sunstroke, heat exhaustion, and heat convulsions. Heat stroke is an acute disorder which occurs as a result of hyperthermia caused by prolonged exposure to high temperatures proceeding with disorders of the cardiovascular and the central nervous systems. Apart from high temperatures the occurrence of a heat stroke is facilitated by high humidity. The direct reason for the incidence of a heat stroke is exhaustion of the mechanism regulating heat and sweating processes. The occurrence of a heat stroke is further determined by exertion, badly chosen clothing, and inadequate demand for water and salt, as well as internal factors which impair thermal equilibrium. A heat stroke results from direct exposure to sunlight, especially to infrared rays onto the skull cap. This type of radiation causes congestion of cerebrospinal meninges and brain, which in turn leads to meningeal signs. Therefore, in areas where insolation is particularly high it is crucial to wear headgear. Heat exhaustion is a disease which occurs when the heat-regulating mechanisms of the body become unable to effectively deal with the heat. It is characterized by dehydration and loss of electrolytes (mainly sodium and chlorine) as well as failure of peripheral circulation, which may eventually lead to a collapse. Heat convulsions are associated with painful contraction of the skeletal muscles resulting from excessive loss of electrolytes while sweating.

Heat injuries pose a significant problem in NATO armies executing mandatory tasks all over the world. Among U.S. Army personnel, 5246 persons were hospitalized due to heat injuries (37 of whom died) in the course of a training process or while conducting military operations from 1980 to 2002. Within the given period the morbidity rate of heat exhaustion decreased, whereas the rate of heat stroke rose [154]. The incidence of heat injuries was significantly lower in the population of Afro-Americans and Latin Americans than in the population of white Americans (0.76), and it was much higher in the population of white Americans coming from northern states than in those living in southern states (1.69). Females were hospitalized more often (1.18). Retrospective studies conducted in a British Field Hospital in southern Iraq from 2003 to 2004 revealed that heat injuries accounted for 15.7% of all hospitalizations (n = 4870) within the first 12 months of operation *Iraqi Freedom*. Pathological changes typically occurred within the first few days after their deployment into an operational zone, largely due to hastily conducted acclimatization processes [155]. Until now heat

injuries have resulted in five fatalities among soldiers of the Stabilization Forces deployed in Iraq [156]. Furthermore, military service in hot climate areas is not only a matter of increased incidence of heat injuries but also the exacerbation of chronic diseases such as arterial hypertension, coronary heart disease, ulcer disease, or nephrolithiasis. Commonly, deployment in hot climate areas results in the occurrence of diseases the earlier process of which had been asymptomatic.

WIND, SAND, AND DUST

A distinctive feature of a hot and dry climate, which prevails in Iraq, Afghanistan, and Chad, is the high number of distressing sand and dust storms which predominate in the summer. The effects of wind, sand, and dust are often eye, skin, and respiratory tract diseases. Dry air and wind desiccate oral and nasal mucosa leading to nosebleeds, dry cough, and lip inflammation. Parts of the body where sand and dust accumulate (ears, armpits, and groin) are prone to irritation or inflammation [41, 157].

LOCAL FAUNA

The occurrence of venomous arthropods and reptiles is widespread in hot climate areas. Among the former, scorpions, spiders, solpugids, and centipedes prevail. The latter are represented by three snake families: *Elapidae*, *Viperidae*, and *Crotalidae* [80, 158]. Normally, the venom of the existing arthropods is not deadly for humans. Solpugid bites happen fairly often (camel spider), and although their venom is not deadly it may result in some serious body injury. However, a snake bite might be life-threatening. Its venom is typically a compound of two types of protein (neurotoxin and haemotoxin), which induce characteristic clinical symptoms. If haemotoxin predominates, the venom is said to have a haemotoxic effect, in which case it attacks blood cells and damages vessels, muscular tissue, and skin, which in turn leads to necrosis at the spot of the bite, shock, and in serious cases death. The venom of some snakes, e.g. Indian cobra occurring in eastern Afghanistan, exhibit markedly neurotoxic effects. It strongly affects the nervous system and results in disorders of the heart muscle action and the respiratory tract, which eventually leads to death [159].

Surveys conducted among 3265 American soldiers serving in Iraq and Afghanistan from January 2005 until May 2006 demonstrated that 9 persons were bitten by snakes (4.9 cases out of 10,000 patients treated on a monthly basis), whereas 85 persons were bitten by either scorpions or spiders (46.1 cases out of 10,000 patients/monthly) [160]. The individual research revealed that 4 soldiers of the U.S. Forces were hospitalized in the U.S. Army General Hospital in Bagram, Afghanistan due to arthropod bites (spiders, scorpions) from July 2002 to September 2005. Cases of snake bites were not registered. Within the same period four Afghans were hospitalized due to bites of venomous snakes. No fatalities were registered.

LOW TEMPERATURE INJURIES

Health problems connected to the effects of low temperatures rarely occur in the majority of countries where a hot climate prevails. However, in countries such as Afghanistan (during the winter) they may lead to health- or life-threatening conditions such as hypothermia, frostbite, chilblains, trench foot, or dehydration [161, 162]. Factors which facilitate the occurrence of the above-mentioned diseases are first of all climatic conditions (ambient temperature, speed of wind, humidity, altitude), body injuries related to the effects of low temperatures, wrong diet, drinking alcohol or coffee (dehydrating effect), increased sweating, too much exposure to the cold, poor fitness, and inappropriate clothing and equipment.

Hypothermia occurs when the body temperature drops below 35°C. Symptoms of the disease are typically shivers, drowsiness, stupefaction, hyper excitability, confusion, slow and unclear speech, and visual disturbances. If the person is entering critical condition, pulse and respiration rates decrease and the patient loses consciousness. If the person is not provided with medical help, death occurs. Frostbite occurs at temperatures below 0°C, in mild conditions it only affects the skin, but if the disease proceeds to more severe stages, damage occurs in subcutaneous, muscular, and bone tissue. The constriction of blood vessels leading to circulatory disturbances typically result in frostbite of peripheral parts of the body such as fingers, toes, ears, nose, or cheeks. Chilblains is a superficial dermatitis, with no damage to body tissue, which generally occurs at temperatures 0–15°C, in high humidity and long, repeated exposure to severe weather conditions. Chilblains may develop in just a few hours, and the damage usually involves peripheral parts of the body. Trench foot is a medical condition caused by prolonged exposure to low temperatures (0–10°C) in connection with damp or wet conditions (more than 12 hours). Pathological changes typically occur during floods. Damage may also occur if a person sweats

a lot but has no chance to dry out the skin (feet in boots, hands in gloves). Dehydration is an excessive loss of water and electrolytes, which disturbs the natural processes of a human body. During the Second World War 91,000 cases of injuries being the effect of low temperatures occurred among American soldiers fighting on all continents [163]. During the Korean conflict 6300 cases of body injuries caused by the effects of low temperatures were diagnosed among soldiers of the U.S. Army and the U.S. Marines. The prevailing injury was frostbitten feet [163]. In contemporary armed conflicts the risk of the occurrence of such injuries has decreased considerably due to advanced technology of footwear and uniforms. However, expertise in the field of existing risks is essential as far as the implementation of appropriate preventive measures is concerned.

MOUNTAIN CONDITIONS

The UN designated the year 2002 as the year of mountains, thus emphasizing the fact that 23 out of 27 military conflicts conducted nowadays take place in high-mountain areas [164]. An example of such a hot spot is undeniably Afghanistan. Mandatory tasks of the military operation conducted in the territory of Afghanistan are usually carried out at altitudes of 2000–3000 metres. Therefore, inhabitants of lowland countries, such as Poland, need to undergo a well-planned acclimatization process. Also, they need to acquire basic knowledge of existing hazards which occur in high-mountain areas. Health problems of persons staying at high altitudes can be divided as follows: low temperature injuries (which have already been mentioned), diseases caused by hypobarism, hypoxia, and injuries induced by prolonged exposure to the sun [165]. At high altitudes, especially in the winter, the occurrence of such injuries is the result of environmental factors in relation to the physiology of a person positioned in a given environment. Normally, temperatures drop at higher altitudes, on average, by 2°C every 300 meters. Apart from this, cloudless skies as well as dry and diluted air causes fluctuations in temperature due to intense solar radiation during the day and rapid loss of heat during the night. Hypobarism and hypoxia result in a wide range of diseases — from pathological changes of moderate intensification to life-threatening conditions. The degree of intensification depends on the altitude (at higher altitudes the pressure drops and there is less oxygen in the air), time of exposure (hours, days, months), and the speed of climb and descent. Intensity of effort, psychomotor condition, age, and co-existing health problems may also induce pathological changes in high-mountain areas. Acute mountain sickness (AMS) is likely to occur in anybody who has climbed to a high altitude (more than 1800 metres) within a short period of time (fewer than 24 hours) and has stayed there for several or more hours. AMS relates both to people who have climbed from lowland areas to higher altitudes within a short period of time and those who being at high altitudes ascended to even higher ones. Thus, the cause of altitude sickness is not high altitude itself but rather covering long distances (ascending or descending) within a short period of time. The first signs of AMS may be cerebral or pulmonary oedema (HAPE, HACE); however, the majority of cases develop without clear symptoms suggesting the development of a full clinical picture. Other pathological changes which occur due to hypoxia or hypobarism include: peripheral oedema, retinopathy, thromboembolism, sub-acute mountain sickness, suppression of immune system, slow wound healing [165]. Additionally, owing to the increased emission of UV rays and reflection of sunlight from snow, ice, and rocks there exists a high probability of body injuries resulting from the effects of the sun's radiation. Increased UV radiation is caused by its decreased filtration through diluted air. The intensity of UV radiation increases, on average, by 4% every 300 metres. As a result, at an altitude of 4300 metres UV radiation is 55% higher than at a sea level. Snow and ice reflect 75% of the UV rays, which is especially dangerous on glaciers, where radiation is particularly high [166].

TRAUMATIC PROFILE

Contemporary military operations are at risk from criminal or terrorist attacks. Bombings or ambushes with the use of firearms occur virtually every day. As a result, a great number of shrapnel and gunshot wounds dominate the traumatic profile among soldiers deployed in both countries. Mines and unexploded ordnance — the remnants of bygone wars — pose an additional threat in Afghanistan. Yet, it needs to be remembered that the execution of mandatory tasks by the Coalition Forces is not only a question of battle injuries. Non-battle injuries, e.g. traffic accidents, misuse of arms, or sports injuries, are also widespread in the population of soldiers serving in military contingents. The incidence of non-battle injuries together with battle injuries negatively affects the combat efficiency of armed forces and dominates the traumatic profile in areas of military operation.

NON-BATTLE INJURIES

Non-battle injuries have always constituted one of the major health problems among soldiers in all military conflicts. During the Vietnamese conflict they represented the biggest cause of sanitary losses in the U.S. Forces [167]. During the *Desert Storm* operation they resulted in 81% of all fatalities (being the result of traffic and aircraft accidents) and 25% of all hospitalizations [168]. Injuries of the musculoskeletal system (fractures, sprains, and dislocations) represented the major cause of all hospitalizations among the 21,655 soldiers of the Coalition Forces participating in the operation *Desert Storm*, whereas battle-injuries constituted less than 5% of all hospitalizations within the same period [168]. An examination of American soldiers taking part in operations *Iraqi Freedom* and *Enduring Freedom* from 2003 to 2004 revealed the occurrence of non-battle injuries in 34.7% of peacekeepers (77% of patients required medical assistance) [4]. Despite the advanced technology employed by armed forces nowadays, non-battle injuries are widespread and frequently affect the combat capacities of units in a negative way. The percentage of non-battle injuries might be even higher than quoted in official statistics as the data is frequently based on records of medical evacuations and hospitalizations of patients, whereas a large number of non-battle traumas are taken care of at levels 1 and 2 of medical evacuation on an outpatient basis [169]. There are no major differences as to the occurrence of non-battle injuries among U.S. Forces deployed in Iraq and Afghanistan. The most common causes of such traumas are sports injuries (workout, sporting competitions, gym) and traffic accidents that take place while carrying out mandatory tasks [170]. The survey conducted among 13,861 soldiers of the U.S. Army hospitalized due to sports injuries demonstrated that sprains or dislocations of the musculoskeletal system accounted for 82% of all traumas. Injuries of the knee-joint and its sacral ligament occurred most frequently [171]. In males, sports injuries typically occurred while playing American football or basketball, whereas in females they occurred during workout or whilst playing basketball. Traffic accidents occurring in combat zones frequently result in injuries or fatalities, which is largely due to the poor condition of roads and drivers' ignorance of traffic regulations [172].

The research conducted from 2003 to 2005 determined factors which directly influence a large number of traffic fatalities in operations *Iraqi Freedom* and *Enduring Freedom* (having no connection to military operations). The main cause of accidents involving soldiers of the U.S. Forces included the poor condition of roads and bad weather conditions on the one hand, and drivers' or passengers' mistakes (unfastened seat belts, speeding in bad weather conditions) on the other [173]. As many as 315 British soldiers wounded in traffic accidents were registered in the British Field Hospital in southern Iraq from August 2003 to January 2004 (3 people died, 47 were hospitalized). Of the hospitalized soldiers, 32% rolled over in a collision, and 28% fell out of a vehicle. 34% of all the hospitalized were homebound for medical reasons [174].

The number of fatalities in the population of soldiers serving in the Stabilization Forces in Iraq and Afghanistan due to non-battle injuries is surprisingly high in relation to the total number of losses suffered in both military operations.

Non-battle fatalities accounted for 18% of the total number of victims among soldiers of the Coalition Forces in operation *Iraqi Freedom* registered until July 2007, but in operation *Enduring Freedom* the rate of such fatalities amounted to 41% [175]. In Iraq the main cause of fatalities with no connection to battle injuries were overland (255 — 36.3%) and aircraft (91 — 13.1%) accidents. Also, it is worth pointing out that as many as 61 fatal accidents were due to misuse of arms. In addition to this, 24 suicides, 8 homicides, and 16 incidents of drowning were registered [176]. In Afghanistan fatalities resulting from aircraft (112 — 43.8%) and overland (29 — 11.3%) accidents dominated [177].

BATTLE INJURIES

Contemporary stabilization missions in Iraq and Afghanistan represent a group of military operations in which the risk of health damage or death is particularly high. The areas of combat operations are at risk of criminal and terrorist attacks. Virtually every day there are bombings and ambushes with the use of improvised explosive devices, firearms (snipers), or artillery weapons (anti-tank launchers, mortars) [175]. As a result of all the risks mentioned above the occurrence of gunshot and shrapnel wounds as well as multi-organ wounds is widespread. Battle injuries resulted in 3188 fatalities among soldiers serving in Stabilization Forces participating in operation *Iraqi Freedom* until July 2007 — within just 4 years of the mission's duration. The major cause of death was an enemy attack with the use of improvised explosive devices (IEDs) (1530 fatalities), firearms, and grenades (405 fatalities) as well as artillery weapons

(180 fatalities). A total of 22 deaths occurred as a result of friendly fire (unintentional firing from one's own side) [176]. In Afghanistan, similarly to the situation in Iraq, the main cause of deaths due to battle injuries remains enemy attack with the use of IEDs (110 fatalities), firearms, and grenades (58 fatalities) and also anti-tank launchers and mortars (13 fatalities). Anti-personnel mines caused 9 fatalities. Out of 369 battle fatalities which occurred during operation *Enduring Freedom*, 10 deaths were the result of friendly fire [177]. So far, Americans have suffered the highest number of sanitary losses in both operations, which is definitely connected with the fact that their representation in multinational Stabilization Forces is the biggest. The number of military personnel participating in operation *Iraqi Freedom* in June 2007 totalled 151,000 soldiers from different countries, out of whom 141,000 were American [178]. From the beginning of the operation in March 2003 until November 2010 the number of fatalities among American soldiers amounted to 4427, and 31,902 US soldiers were injured in combat [179]. Within the same period 318 fatalities occurred among soldiers of different nationalities, including 179 British, 33 Italian, and 23 Polish soldiers. Fatalities which occurred in the Polish contingent resulted from battle injuries (14 incidents), non-battle injuries (8 incidents including 4 overland traffic accidents, 3 aircraft accidents, 1 case of arms misuse), and diseases (1 case). The 23rd soldier died in a military operation in Iraq on 2 November 2007 [180]. He was the last Polish victim of the war in Iraq (Polish soldiers finished their duty in this country in 2008).

The number of peacekeepers serving in the Stabilization Forces ISAF in Afghanistan at present totals 119,800. The soldiers come from 47 different countries. Americans contribute 78,430 soldiers in ISAF and further military personnel in operation *Enduring Freedom*. The UK contribute a contingent of 9500 soldiers, Germany — 4590, France — 3750, Italy — 3400, Canada — 2830, and Poland — 2630 [181]. The number of fatalities, from the beginning of the military operation in Afghanistan in October 2001 until November 2010, amounted to 2195 soldiers (1370 US soldiers and 825 peacekeepers of other nationalities). It should be mentioned that Canadians, contributing a 2830 contingent in one of the most dangerous provinces, Kandahar, have suffered serious sanitary losses. There were 152 fatalities among Canadian military personnel within the given period, most of them as a result of battle injuries. The first Polish soldier died in Afghanistan on 14 August 2007. In the years 2008–2010, 21 soldiers of the Polish Military Contingent died of battle injuries [182].

Unlimited access by local civilians to firearms and explosives constitutes a considerable problem as far as maintaining safety in Iraq and Afghanistan is concerned. Attacks on soldiers participating in military missions are widespread. There are a large number of volunteers willing to act as suicide-terrorists, and trap mines are planted along the routes of military convoys and patrols. So far Americans and their allies have failed to introduce law and order in this unstable and dangerous part of the world despite their crushing military superiority. The most serious threat seems to be improvised explosive devices, as Polish soldiers saw for themselves. Military experts suggested ironically that the *Honker*, a Polish military vehicle, should be used in agriculture rather than in combat operations in Iraq. A similar situation took place in Afghanistan where the *Rosomak*, another Polish vehicle, was pierced with firearm bullets and required extra strengthening [175]. Over 75% of combat injuries in soldiers participating in contemporary military conflicts relate to limbs [183, 184]. On the one hand, this results from the protection of the head and trunk (helmet, bulletproof or anti-shrapnel vest), and on the other hand it is connected with the type of weapons applied (shrapnel wounds resulting from trap mines, grenades, bombs, mortars, and gunshot wounds which are the effect of firearms use) [46]. The research I have conducted individually among soldiers hospitalized due to battle injuries in the Polish Field Hospital of the Multinational Division Central-South from October 2003 to June 2004 (n = = 116) demonstrated that injuries of lower limbs, resulting mainly from gunshot (46%) or shrapnel (42%) wounds prevailed [63].

It has been estimated that shrapnel wounds, which frequently coexist with bone fractures, soft tissue damage, and wound infections, amount to 2/3 of all body injuries sustained in the contemporary battlefield [185]. The risk of shrapnel wound occurrence is highest if improvised explosive devices (trap mines) are applied. Their explosion also results in acoustic traumas which are a consequence of the resulting shock wave [186]. In addition to this, the blast of bombs and explosives effect the occurrence of burns, which represent 5% of body injuries among soldiers evacuated from operations *Iraqi Freedom* and *Enduring Freedom* for medical reasons [187]. The total body surface area (TBSA) among soldiers who

had suffered burns in the battlefield is estimated at 15–21% on average [188]. Military personnel typically suffer from burns of unprotected body parts (face, arms) due to wearing personal protection clothing (helmet, flak jacket) [189, 190]. The incidence of multi-organ wounds is widespread in the contemporary battlefield. Such injuries occur as a result of damage to soft tissue (skin, subcutaneous tissue, muscles), vessels, nerves, and bones. An examination of Soviet soldiers wounded during the war in Afghanistan in the 1980s revealed that injuries of limbs (sustained in combat) coexisted with damage to great vessels (42% of cases), nerves (45.5% of cases), and bones (47.4%). The majority of the injured were in shock (83.7%). 13.9% of patients who sustained a battle injury required amputation of the limb [191].

In contemporary military operations a lot of attention is paid to efficient medical evacuation from the battlefield to the highest possible level. So far, over 1 million soldiers of the Coalition Forces have taken part in the *Enduring Freedom* and *Iraqi Freedom* operations. More than 20,000 of them have sustained battle injuries while executing military tasks; 46% of the injured required medical evacuation to a home country. Injuries resulting from the blast of explosives, anti-personnel mines, mortars, and grenade launchers prevailed [192–194].

MINES AND UNEXPLODED ORDNANCE

The territory of Afghanistan remains one of the most heavily mined areas in the world. Therefore, bombings and ambushes set by the enemy are not the only danger for the Coalition Forces. Mines and unexploded ordnance pose an additional threat. 95% of the mines found in Afghanistan include antipersonnel mines, including blast mines, fragmentation mines, directional mines and scatterable mines, which actuate after a fall from height (an aircraft). Most of the soldiers hospitalized due to a mine explosion were injured by Soviet PMN mines planted in the territory of Afghanistan in the 1980s [195]. The individual research carried out in the U.S. Army General Hospital in Bagram demonstrated that 286 civilians (103 children and 174 adults), 78 members of the Coalition Forces (77 Americans, 1 German), and 7 Afghan soldiers underwent surgery due to injuries sustained in the explosion of mines, unexploded ordnance, or improvised explosive devices within the period from July 2002 to September 2005.

The first military conflict during which land mines were used on a mass scale was the American War for Independence (1775–1783). The use of land mines became widespread during the First World War. The military conflicts which followed propagated the implementation of land mines on a large scale as one of the basic means of fighting the enemy. However, it soon became evident that land mines are a double-edged weapon — both sides of the conflict suffer losses. And what is worse, the victims of landmines are first of all civilians — people who are not directly engaged in military operations. The majority of modern land mines are made of plastic or other synthetic materials, which makes them more difficult to detect by means of highly specialized equipment (detectors). A land mine can be triggered by direct pressure (pressure-operated). Tripwire-operated mines (triggered if a cord attached to a mine is pulled or broken) are also frequently employed. At present, electronically or radio-operated land mines have become more commonly employed in terrorist attacks. Whereas the placing and arming of landmines is relatively inexpensive ($3–10) and simple, the process of detecting and removing them is typically expensive ($300–1000), slow, and dangerous. Landmines are deadly weapons, which, from the point of view of their users, make them highly effective. According to one of the Khmer Rouge generals “a landmine is a perfect soldier, it is brave, it never sleeps, and it doesn’t long for anything”. Landmines have caused death or permanent disability in over 1 million people all over the world, and another 1000 people die and 800 people are injured as a result of landmine explosions each month. Every 20 minutes another landmine is detonated. It has been estimated that approximately 110 million landmines remain hidden in 64 countries. The process of demining is slow and dangerous. Combat engineers need to check every square centimetre of ground for landmines to safely return it to normal use. One combat engineer is capable of searching through an area of 20–50 square metres a day. Assuming that no more landmines were laid, it would take another 1000 years to demine all dangerous territories. The International Campaign to Ban Landmines achieved some success in December 1997, when the Mine Ban Treaty was signed by more than 130 countries and ratified by another 40. However, the treaty was only half successful. Some countries have refused to ratify the treaty and they continue to produce and lay landmines. The United States, who has not signed the ban, committed to do so in 2006.

BATTLE STRESS

Past experience gained from contemporary military operations points to the fact that a certain percentage of soldiers executing military tasks in extreme situations are incapable of adapting to existing conditions and therefore must be evacuated to their home country for medical reasons [196]. The reasons for being homebound before the termination of service are not only service in a combat zone, adverse climatic conditions, and the feeling of alienation, but also a superficially conducted medical qualification of candidates for military service before relocating them to a mission area [197]. This is both a matter of the physical health condition (occurrence of chronic illnesses) and mental health condition of candidates for overseas tours. The absence of a reliable psychological profile of a candidate results in the fact that extreme conditions of service may lead to the manifestation or intensification of disorders in the form of neuroses, depression, and anxiety [198]. The effects of an experienced mental trauma (a strong or dramatic event induced by either a brief incident or a long-lasting experience) may be temporary or long-term psychiatric disorders in the form of acute stress disorder (ASD) or posttraumatic stress disorder (PTSD) [199]. Symptoms of ASD persist for at least several days but no longer than a month (numbness, indifference, excitation, or depression). They differ from short-term non-pathological responses to stress, which typically occur in the middle of or directly after an experienced trauma and disappear spontaneously. The major difference between PTSD and ASD is the time of manifestation and the period of subsistence of mental disorders (from one month to many years after an experienced trauma). The most commonly occurring symptoms of PTSD are concentration disorders, recurrent memories and thoughts, nightmares, and insomnia [199]. The mental condition of soldiers is predominantly influenced by the view of a battlefield, the sight of the wounded and killed, especially of fellow-soldiers, and also the sight of complete material devastation. The factors mentioned above especially affect soldiers performing extremely difficult and dangerous tasks (landing-assault forces and Special Forces) or deployed in unusual conditions such as a siege [200].

The medical nomenclature of psychiatric disorders occurring in soldiers who suffered traumatic experiences while serving in a combat zone has changed within the last decades. After the First World War veterans suffered from *shell shock*, after the Second World War and the Korean conflict the same disorders were named *war neurosis*, whereas since the Vietnamese war the terms *acute stress disorder* and *posttraumatic stress disorder* have been employed in psychiatry. According to the Polish Ministry of Defence, over 200 soldiers of the Polish Military Contingent failed to cope with the difficulties of operation *Iraqi Freedom* within the first year of the mission's duration — until September 2004. The majority of them remained in the area for the whole 6 months — until a new rotation of soldiers arrived — even though they demonstrated symptoms of psychiatric disorders in the form of apathy, anxiety, concentration disorders, and nightmares. According to psychologists and medical officers participating in the Iraqi mission, each soldier reporting mental problems (because, for instance, he/she was scared by an explosion) is diagnosed with posttraumatic stress disorder. However, there is a serious disadvantage to such actions as there is a group of soldiers who take advantage of psychiatric consultations and entries in their health records confirming psychiatric disorders as a means of being granted an earlier pension [196].

One of the biggest problems as far as medical coverage of military operations carried out abroad is concerned is the fact that only a few clinical psychiatrists participate in such missions. Lack of experience in the field of military psychiatry and examining the mental condition of soldiers taking part in combat operations after their return home and not directly after they have experienced a trauma are the reasons why some of the opinions given by Polish psychiatrists are, at best, surprising. Describing the military operation in Iraq as a peacekeeping mission, trying to prove that units of the Polish Armed Forces have not taken part in an armed conflict (e.g. defence of a town hall during the Sadrist uprising in Karbala in 2004) is a huge misunderstanding. Since the beginning of the military missions executed in Iraq and Afghanistan Polish soldiers diagnosed with psychiatric disorders have been evacuated directly to military hospitals in Poland, mostly to the Clinic of Psychiatry and Battle Stress of the Central Clinical Hospital of the Ministry of Defence in Warsaw or to the Ward of Clinical Psychiatry of the Clinical Military Hospital in Bydgoszcz. Following the termination of hospital treatment patients are sent home, and further therapy is carried out either in outpatient clinics of mental health or at psychotherapists' offices in the military units where the soldiers are employed. Patients suffering from psychiatric disorders of low intensity, typically being the result of acute stress reaction, do not require medical evacuation to a home

country. They stay in the area of operations and remain under the supervision of Polish psychologists [201]. The current medical doctrine binding for the Polish Armed Forces assumes that sanitary losses due to psychiatric disorders occurring in operational zones relate merely to 0.1–1% of the personnel. Whereas doctrines of other NATO armies assume that battle stress accounts for up to 20% of their sanitary losses [202]. Psychiatric disorders, mostly in the form of depression or anxiety, have been commonly observed among soldiers homebound from Iraq or Afghanistan who have suffered a trauma while on service. Psychiatric disorders may occur both in soldiers who have suffered serious battle injuries and in those who have not sustained any wounds but were put at risk of death or serious health damage. Such complaints do not only occur among soldiers participating in combat actions but also among personnel securing such operations, e.g. medical services [203]. Presently, psychiatric disorders amount to 10% of all medical evacuations of American military personnel from combat zones in Iraq and Afghanistan [204]. According to representatives of the American health service, the most commonly occurring psychiatric disorder among soldiers homebound or evacuated from the territory of Iraq and Afghanistan is PTSD [205, 206]. The number of American soldiers homebound from operations *Iraqi Freedom* and *Enduring Freedom* complaining of PTSD has been estimated at 15% of the total population participating in both military missions [207]. PTSD is an ongoing emotional reaction to an extreme psychological trauma; its diagnostic symptoms include persistent and sudden re-experience, such as flashbacks and nightmares. If not properly treated, PTSD may lead to suicidal thoughts. Twenty-four incidents of suicide among American soldiers participating in operation *Iraqi Freedom* from April 2003 to January 2004 were officially reported by the U.S. Army officials. However, the number may be much greater as causes of some deaths in the population of American soldiers have not been unequivocally explained [208]. The Veterans' Health Administration, an organization providing medical assistance for American war veterans deployed outside the U.S., has estimated that each year approximately 1000 soldiers and reservists serving in the U.S. Forces commit suicide (the number of all suicides in the U.S. has been estimated at 30,000 a year) [209, 210]. The number of suicides registered in the population of soldiers serving in the Polish Armed Forces is about the same as in other professions. In comparison with the national rate of suicides committed by males, the number of suicides in the population of soldiers is distinctly smaller (the total number of suicides in Poland: 2003 — 5467, 2004 — 4893, 2005 — 4621; suicides among professional soldiers and recruits: 2003 — 20, 2004 — 31, 2005 — 21) [211]. The abuse of alcohol and psychotropic drugs is common among patients with PTSD who want to soothe depression, anxiety, and insomnia. Coexistence of somatic symptoms on the part of the cardiovascular and digestive systems is frequently noted [212]. War veterans are often reluctant to accept any medical help. 80% of American soldiers homebound from Iraq have not registered with the system controlling their health condition in the U.S. Department of Veterans' Affairs [213]. Diagnosis of PTSD is problematic as its diagnostic symptoms may manifest themselves even a year after experiencing a traumatic event [207].

Extensive studies of this group of psychiatric disorders were initiated in the U.S. in the mid 1970s. The results of the research demonstrated that war veterans have difficulties adapting into society, they also exhibit family, social, and health problems. The rates of unemployment, alcoholism, drug addiction, and crime are particularly high among military personnel participating in combat operations diagnosed with PTSD [214]. Among the 3.14 million American soldiers who took part in the Vietnamese conflict in the 1960s and 1970s fewer than 500,000 people have recently reported symptoms of PTSD and nearly 1 million have reported episodes of PTSD in the past [215]. A similar trend was observed in Russia among veterans of the war in Afghanistan [214]. The PTSD incidence rate among American soldiers participating in operation *Desert Storm* from 1900 to 1991 ranged from 7 to 22.6% [216, 217]. A growth in the incidence rate was observed after termination of service in an operational zone [218]. American soldiers returning from overseas service in Iraq and Afghanistan who had experienced a traumatic event are eligible for specialized medical assistance provided by military health centres supervised by the Department of Veterans' Affairs for two years after homecoming. They are diagnosed in terms of the occurrence of psychiatric disorders as well as psychosocial disorders. From 30 September 2001 until 30 September 2005 more than 103,000 American soldiers participating in operations *Iraqi Freedom* and *Enduring Freedom* underwent psychiatric and psychological examinations. Over 25% of the studied population demonstrated clinical symptoms of psychiatric disorders and 31% showed symptoms of psy-

chosocial disorders which required psychological intervention. Pathological changes were most commonly observed in soldiers aged 18–24 [219, 220]. Recent studies conducted among U.S. Forces veterans who have participated in military operations revealed that older soldiers, over 45 years old, are less likely to suffer from psychiatric disorders [221].

The most serious psychosocial disorder in the population of war veterans is alcoholism. Research conducted among American soldiers returning from overseas tours in Iraq and Afghanistan demonstrated that 33% of the respondents abuse alcohol [222]. Military personnel commonly use alcohol as a means of dealing with stress. Unfortunately, it significantly lowers morale and discipline.

At the very beginning of the stabilization mission in Iraq seven Polish soldiers, members of the first rotation of the Polish Military Contingent, were sent back home because they were abusing alcohol. This incident revealed the scale of the problem of alcohol abuse in Polish military units [223]. Obviously, alcohol abuse does not only concern soldiers. As many as 800,000 Polish citizens are addicted to alcohol, over 2 million people abuse alcohol, and approximately 4 million live in families where acts of violence resulting from alcohol abuse are nothing out of the ordinary [224]. The relation between the occurrence of psychiatric disorders being the effect of traumatic experiences and alcohol abuse has been frequently mentioned in international medical literature. According to some British psychiatrists, PTSD typically coexists with alcohol abuse in more than 50% of patients [225].

Reports on the occurrence of psychiatric disorders among British soldiers participating in operation *Iraqi Freedom* issued by British medical services are worth mentioning. The total number of medical evacuations in the population of British soldiers deployed in Iraq in 2003 totalled 2009 people; as much as 10% of the evacuations were due to psychiatric disorders. What is interesting, 37% of the evacuated soldiers had reported psychiatric disorders before their relocation to the area of operations. 72.4% of the personnel evacuated due to psychiatric disorders were not directly engaged in combat (technical personnel, drivers), and just 27.6% of the evacuated were members of combat units. The main reasons for the occurrence of psychiatric disorders included: environmental factors — 38.5% (hot climate, armed conflict, alienation), isolation from friends and family — 35%, and pathological relations in the military community — 7.7%. Only 3.4% of the disorders were the result of a psychological trauma suffered in the theatre of operations. All of the British personnel evacuated from Iraq were diagnosed in clinical centres in the UK; adaptation disorders were diagnosed in 50.8% of the examined cases, acute stress response in 6.9% of the cases, and 30.2% of patients were not diagnosed with any psychiatric disorder as earlier symptoms had receded [220]. Undoubtedly, the major reason for the occurrence of psychiatric disorders within an operational area of stabilization missions remains the risk of death or serious health damage. Yet, there are also a number of other stress-related factors which facilitate the incidence of the above-mentioned diseases, e.g. adverse climatic and environmental conditions, but also a positive history of psychiatric disorders or usage of psychoactive drugs, which commonly affect the sense of self-esteem in a negative way and in consequence lead to anxiety, depression, or irritation [226]. The authority of commanders and their ability to effectively command absolutely units of armed forces is crucial when it comes to overseas service in areas where armed conflicts escalate. While serving in Iraq and Afghanistan as a medical officer, the author of this article treated a lot of soldiers who were on patrol or guard duty. They repeatedly complained of physical and mental exhaustion resulting from noncompliance of their superiors with regulations referring to the relation of working time to free time. Soldiers pointed out a lack of experience of their superiors in commanding military units in a theatre of war. They also complained about the impossibility of regular visits to a psychologist. Military missions in Iraq and Afghanistan have proven that a Polish soldier has to learn all about the military profession in combat conditions, this relates both to commanders and their subordinates. An experienced commander should be able to significantly reduce sanitary losses resulting from psychiatric disorders among his subordinates. A great number of soldiers who have suffered a psychological trauma can usually return to service quite quickly if only they are given expert psychological advice. Psychologists employed in a theatre of operation need to treat an existing disorder as a normal response to an abnormal situation rather than cowardice or avoiding military service [227]. If psychiatric disorders occurring in a combat zone are diagnosed and treated directly after an experienced trauma, their symptoms subside in at least 90% of all cases. Thus, prompt and effective treatment enables soldiers to return to active service with no health damage [228]. However, there is a group of soldiers who avoid visits to a psychologist or a psychiatrist.

Studies conducted among soldiers of the U.S. Forces deployed in Iraq or Afghanistan have demonstrated that merely 23–40% of the surveyed soldiers diagnosed with psychiatric disorders sought psychological or psychiatric advice within an operational zone. The main cause of such behaviour was fear of loss of trust among their fellow soldiers, and being labelled as a weak person [205]. The analysis of morbidity rates in the population of American soldiers has served as a model for the evaluation of health hazards prevailing in operational areas in Iraq and Afghanistan. The choice of the U.S. Army population was not made at random. The U.S. Forces military personnel accounts for just 1% of working Americans aged 18–45 (1.4 million soldiers), but it is the best diagnosed and medically consulted social group in the U.S. [229]. The number of American soldiers (of all military formations: Army, Air Force, Navy, and Marines) hospitalized from 1990 to 1999 totalled 1,529,323. 13% of all the hospitalizations (194,974) referred to psychiatric diseases and disorders (classified according to ICD-9 and then divided into 8 sub-categories: disorders resulting from addiction to alcohol and/or psychoactive drugs, adaptation disorders, mood changes, psychotic disorders, anxiety disorder, somatic/dissociative disorders, other). Out of the total number of hospitalizations due to psychiatric disorders 56% (109,451) included admission to a psychiatric ward, 16% (31,883) admission of alcohol or drug addicts to disaccustoming wards, and 28% (53,640) admission to other wards, e.g. internal medicine ward.

The most commonly diagnosed psychiatric diseases were alcoholism and drug addiction, adaptation disorders, and personality disorders [229]. The number of U.S. Forces personnel remaining in active service who underwent treatment for psychiatric disorders in the 1990s was estimated at 6% of all American soldiers. Probably the number of patients requiring psychological or psychiatric assistance will increase as a result of ongoing military operations conducted in Iraq and Afghanistan. American soldiers deployed in Iraq and Afghanistan suffering from mental disturbances are provided with medical advice at all levels of the military health care system.

Teams of psychotherapists ascribed to Combat Stress Control Units, Division Mental Health Sections, and Combat Support Hospitals have been functioning within organizational structures of the U.S. Forces [230]. There are three groups of patients among military personnel of the U.S. Forces which are particularly susceptible to combat stress: women (combat stress overlapping with sexual harassment or sexual assault), Afro-Americans and Latin-Americans (racism), and the sick or wounded (psychiatric disorders overlapping with physical ones) [231].

Extreme stress, being the part of military missions conducted in Iraq and Afghanistan, affects each and every peacekeeper [232]. All participants of stabilization missions experience helplessness and vulnerability, they realize they have no influence on the outside world or health/life-threatening situations taking place around them. Participation in combat actions, witnessing death, the sight of the wounded, killing an enemy (a fellow human-being), unexpected life-threatening attacks (ambushes, explosive devices), and the sight of mass sanitary losses among allied troops, troops of the enemy, or among civilians, especially massacred corpses of women and children, affect the human psyche in a very negative way [233]. Persistent or emerging stress factors facilitate the development of PTSD. The feeling of euphoria, being the effect of safe homecoming, quickly subsides and it soon turns out that soldiers need to face and deal with new problems such as family crises or a marriage breakdown caused by their prolonged absence, and thus they become a menace to society. They abuse alcohol, they have sexual intercourse with prostitutes (with the risk of an infection), and they avoid psychiatric treatment [234]. Another problematic issue is the fact that a large number of war veterans are commonly diagnosed and treated by family doctors, who typically cannot diagnose psychiatric disorders correctly or they trivialize them, rather than by psychiatrists. Studies conducted in the population of 746 American soldiers homebound from operation *Iraqi Freedom* demonstrated that 86 of the examined patients suffered from PTSD (according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition). Previously, all of the patients were diagnosed by their family doctors, but only 46.5% of the diagnoses were correct [235]. War veterans suffering from psychiatric disorders demonstrate a wide range of responses: from helplessness and anxiety to fits of aggression. However, one should remember that not everyone who has been exposed to an extreme psychological trauma is going to develop PTSD or other mental disturbances [236].

Psychiatric disorders being the result of battle stress are usually clearly defined (acute stress response, PTSD). Nonetheless, some psychiatric disorders, although they have not been precisely defined, were given names: *soldier's heart*, *effort syndrome*, *non-ulcer dyspepsia*, *effect of Agent Orange*, *Gulf War*

Syndrome. All of these accidental diagnoses include a wide range of aetiological factors such as the effects of a hot climate, side effects of vaccinations, taken medicaments, air contamination (caused by burning oil wells), and usage of shells with depleted uranium [237]. The explanation of some disorders is fairly straightforward. For instance, medical services of the Israeli Forces define ASD as a perfectly normal and temporary response to a traumatic event, which occurred in unfavourable environmental conditions such as shortages of food, sleep, or support of fellow soldiers or superiors [238].

Over 90% of soldiers sustaining serious battle injuries survive, due to modern equipment (helmets, flak jackets) as well as efficient medical evacuation and prompt stabilization of life functions from the very moment of sustaining an injury [239]. Nevertheless, post-traumatic amputation of limbs, loss of vision, or other forms of disability are widespread. Studies conducted in the population of American soldiers participating in the Vietnamese conflict demonstrated that the risk of developing psychiatric disorders was particularly high among seriously wounded patients. Therefore, it is extremely important to treat physical and mental disorders simultaneously [240].

The research conducted among American soldiers returning from overseas tours from 2003 to 2004 revealed the occurrence of psychiatric disorders (mainly in the form of PTSD and depression) in 19.1% of *Iraqi Freedom* participants (n = 222,620), 11.3% of *Enduring Freedom* participants (n = = 16,318), and 8.5% of soldiers taking part in other military operations abroad (n = 64,967) [241].

In recent years the percentage of military personnel exposed to a traumatic event while participating in combat actions has dropped considerably. Whereas during the First World War as much as 73.4% of soldiers were directly engaged in combat, during the Second World War this figure was 52%, and during operation *Desert Storm* it was only 19.8%. However, sanitary losses in the population of soldiers participating in military operations due to psychiatric disorders remain at a high level [242].

SUMMARY

Contemporary military operations — peacekeeping and stabilization missions — have been executed in territories characterized by difficult climatic and sanitary conditions, in areas where, in connection with ongoing hostilities, the risk of the occurrence of different diseases and injuries is particularly high. The main factors that determine the increase in morbidity and traumatism are as follows: escalation of an armed conflict, hot climate, unsatisfactory sanitary-hygienic standards in areas of deployment, and cultural differences of a given region. Military service goes hand in hand with an increased risk of sustaining battle injuries (gunshot and shrapnel wounds) or non-battle injuries (sports injuries, traffic accidents). Low sanitary and hygienic standards facilitate the occurrence of contagious and parasitic diseases of the digestive tract, vector-borne diseases, diseases of the respiratory tract, and sexually transmitted diseases. Cultural differences and alienation of a closed community in connection with traumatic experiences suffered in the area of an armed conflict are extremely stressful and induce the occurrence of psychiatric diseases and disorders.

Acquiring expertise in preventive medicine, which may prevent the occurrence of infectious and non-infectious diseases as well as battle injuries or non-battle injuries, remains one of the major tasks that the medical staff of military missions have to handle. Therefore, it is crucial to have the right knowledge of an up-to-date epidemiological situation and health hazards influencing the increase in the incidence of diseases and injuries in operational zones of peacekeeping and stabilization missions. A detailed analysis of data regarding diseases and injuries of soldiers deployed in areas of military operations is also necessary. Such analyses may be further exploited to create a health policy which could be implemented in armed forces of particular countries. In the era of military operations executed under the auspices of international organizations, expertise in the field of health hazards remains a fundamental issue which determines success in fulfilling the assigned tasks.

REFERENCES

242 items with the author.