

review article

Health hazards against the background of the present-day epidemiological situation in Chad

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Humanitarian catastrophe in Darfur, mass migrations, high morbidity, mortality and death rates among the local people all influenced this fact that the Saharan Africa region became the centre of attention of the international public opinion. This study presents data on the epidemiological situation in Chad, one of the poorest countries in the world, which has sheltered hundreds of thousands of refugees fleeing from the neighboring Sudan. Apart from numerous contagious and parasitic diseases occurring among the local people and the population of immigrants, the situation in Chad is further reinforced by adverse environmental conditions, in particular shortages of drinking water as well as sand and dust storms from the Sahara desert. This year the European Union launched a military mission with participation of more than ten countries in Eastern Chad. Knowledge on the existing health hazards in the regions of soldiers' deployment is crucial as far as the aspect of 'importing' infectious and invasive diseases to the home countries is concerned. The first rotation of national units is planned to be home-bound at the end of 2008.

Keywords:

Saharan Africa, Chad, health hazards, public health

INTRODUCTION

Chad is a landlocked country located in Central Africa. Its the largest water reservoir is Lake Chad located on the borders with Nigeria, Niger and Cameroon. The lake shows fluctuations in size; its area has shrunk considerably, mostly due to the effects of the desert expansion. The major geographical regions in Chad are the Sahara desert zone in the north, Sahelian belt in the center, and a savanna zone, supplied with rainfall, in the south. Rainfall in the Sahara desert does not exceed 500 mm, and temperatures range from 49°C in May (the warmest month) to 36°C in December. Bothersome sand and dust storms occurring in the region frequently result in diseases of the sight organ, skin and the respiratory tract. The northern parts of Chad belong to the most dust-laden places in the world. Sand and dust storms occurring in the Sahara account for 2/3 of the world's dust emission. The cen-

tral part of the Sahelian belt demonstrates similar temperatures as those prevailing in the Sahara. The dry season lasts for 8 months (from October to May). The average annual rainfall amounts to approximately 700 mm. The southern part of the country, where the subtropical climate prevails, is characterized with temperatures ranging from 41°C in March to 14°C in December. The wet season lasts from May to October. The average annual rainfall totals 900-1200 mm.^{1,2,3} Three quarters of Chad's population relies on poorly developed agriculture. High hopes are placed in the extraction of uranium and crude oil deposits. However, being a landlocked country impedes considerably free import and export. Farmland in Chad comprises merely 2.8% of the country's territory. Regular crops only apply to 0.02% of Chad's farmland. Irrigated areas account for 300 square km while the whole territory of the country totals 1,284,000 square km.³ Chadian society is ethnically and culturally diversified. Chad has 200 ethnic groups which communicate in nearly 100 different languages. The northern parts of the country are mainly inhabited by Berber and Tuareg tribes. In the south Sara, Massa, Mundani and Hakka tribes predominate. Sudanese Arabs constitute approximately 25% of the Chadian population; they inhabit the eastern and central parts of the country. Religion in Chad is diverse. 50% of Chadians are Muslim (mainly in the northern and central regions), 23% are Christian and 27% animist (in the southern regions).⁴ According to the UNDP Human Development index Chad is placed as the 173rd country in the world (out of 177) in terms of the affluence level. Thus, Chad belongs to a group of the poorest countries in the world along with such countries as Sierra Leone or Afghanistan. The Chadian people were significantly impoverished owing to three decades of political instability. Since 2003 Chad has hosted thousands of refugees fleeing from the war-ridden Darfur, a province of the Southern Sudan, and from Central African Republic (the number of Sudanese refugees living in camps in the eastern Chad was estimated at 234,000 people in 2007, while the number of refugees from Central African Republic staying in the southern regions of the country at 45 000 people; the numbers are continually growing). The catastrophic situation is further deepened by the civil war in Chad, where the rebels supported by the Sudanese government aim at overthrowing the currently ruling government. The effect of the ongoing civil war is internal displacement estimated at 110 000 people just within the last

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year.⁵ The present-day situation may worsen as ethnic cleansing in the neighboring Darfur (where 400 thousand people died and another 2.5 million were forced to flee abroad) continues. Further groups of Sudanese refugees struggle to find shelter in camps located in the eastern regions of Chad. Chad was granted independence in 1960, thus putting an end to the colonial domination of France. However, in 1965 Muslims from the northern Chad, supported by Libya, began a civil war. The war finally ended in 1996. In 1990 Idriss Deby became the president of Chad. He has remained in the office until now largely due to the support of French officials. In 2005 Chad declared war with the neighboring Sudan, which continues to assist Chadian rebels aiming at overthrowing the corrupt president.³

DEMOGRAPHIC RATES

In January 2008 Chad's population was estimated at 10.4 million people while in the year 2000 it totaled 8.5 million. In 2050 Chad's population is predicted to reach 15.6 million. The country's population is extremely young. An estimated 47.3% of Chadians are under 14, whereas 2.9% are over 65. The average age of a typical Chadian citizen is 16.3. The birth rate amounts to 2.32%; the life expectancy – 43.7; the fertility rate – 5.56 per woman; the mortality of newborns – 102 per 1000 live births; the mortality of infants (under 1 year old) – 124 per 1000 live births, the mortality of children under 5 years old – 208 per 1000 live births.⁴ 24.8% of Chad's population live in urban areas. 25.7% of Chadians are literate (40.8% of men and 12.8% of women). 42% of the country's citizens have access to uncontaminated drinking water while 9 % have access to sanitary fittings which comply with basic hygienic requirements.^{4,5} Health care in Chad rests upon 1 central and 4 regional as well as 64 district hospitals and 911 medical centers. However, the standard of medical services provided there leaves a lot to be desired. The number of hospital beds per 1000 citizens is estimated at 0.09 in the Massakor district, up to 1.61 in the Benoye district. There is 1 doctor per 27 680 people, 1 nurse per 6453 people, 1 midwife per 9074 women at the childbearing age. Births delivered with the assistance from professional medical personnel are estimated at merely 16% of all cases. There is a serious shortage of specialists, especially of anesthesiologists and radiologists. There are barely 15 dentists and 37 pharmacists in the whole country. The full range of medicines in national health care centers is unavailable. Private trade and distribution of medication is flourishing. The promotion of health or prophylactic actions carried out by representatives of the health services is practically non-existent. 26.7% of children under 5 are malnourished of whom 11.7% suffer from height and body weight disorders. The rate of children vaccinated against contagious diseases is at a particularly low level.^{5,6}

INFECTIOUS DISEASES IN CHAD

Chad is regarded as a country of a high risk in terms of the occurrence and spread of infectious diseases. This situation is mainly influenced by the following factors: contamination of water and soil (sewage and excrement), limited access to uncontaminated drinking water, disastrous condition of sewage and plumbing systems and of water purification plants, limited access to health care cen-

ters, shortages of basic medication and medical equipment, a substantial number of asymptomatic carriers of contagious and parasitic diseases among the local people, mass migrations, overpopulation at refugee camps, large areas of endemic regions and a high prevalence of infection vectors of arthropod-borne diseases. In the eastern parts of the country, which are heavily overpopulated due to the inflow of refugees, acute infections of the upper respiratory tract, diarrheas, malaria and battle injuries constitute over 60% of all diseases and injuries. No differences regarding the structure of the traumatic profile between the local people and the population located at refugee camps have been observed.⁵

Arthropod-borne diseases

Malaria. The disease accounts for 25% of all hospitalizations and effects in 23% of all hospital deaths.⁷ *Plasmodium falciparum* remains the etiological factor in more than 85% of all cases. Mosquitoes of the *Anopheles* species (e.g. *A. arabiensis*, *A. funestus*, *A. pharoensis*, *A. gambiae*) constitute the major infection vectors. Immunity to chloroquine in the treatment and prophylaxis is commonplace. Malaria occurs in the whole territory of the country all year long. 386 197 cases of the disease and 1001 deaths from malaria have been reported in 2001.⁶

Leishmaniasis. The incidence of cutaneous leishmaniasis is estimated at 15 cases per 1000 citizens. The infection vector are flies of the *Phlebotomus* genus while the etiological factor is *Leishmania* protozoan. The highest incidence has been observed in the eastern parts of the country, similarly to the incidence of visceral leishmaniasis.⁶

Filariases. 72.3% of Chad's population runs the risk of infection with wuchereriosis.⁶ Medical examination of patients with pathological changes in the Moyen Chari province revealed 167 cases of lymphatic filariases of which 164 cases were induced by *Mansonella perstans* (the other 3 by *Loa loa* and *Wuchereria bancrofti*).⁸ Among the population living in the vicinity of Mayo Kebbi, Logone and Chari rivers onchocerciasis is widespread. In the 1990s 870 000 cases of the disease, including 20 000 cases of blindness were registered there.⁶

Dracunculiasis. A mass scale campaign aimed at eradicating the disease was launched in Africa. The infection vector are Cyclops, the etiological factor is the *Dracunculus medinensis* nematode. The last 3 cases of the disease were registered in the year 2000 in the Guera region.⁹

African trypanosomiasis. It occurs endemically in the Moissala¹⁰, Moyen-Chari¹¹, Tapol and Ranga¹² regions. The infection vector are tsetse flies (*Glossina tachinoides*, *G. fuscipes*) while the etiological factor is *Trypanosoma brucei gambiense*. The number of people inhabiting the endemic areas is estimated at 50 000. 222 cases of the disease were registered in 2003 and further 483 cases in 2004.⁶

Rift Valley fever. The first cases of the disease transmitted by mosquitoes and induced by viruses of the *Bunyaviridae* (*Phlebovirus*) family have been registered in Chad in 1967.¹³ Two cases of the disease were diagnosed among soldiers of the French contingent deployed in the country's capital, N'Djamena in 2001.¹⁴ Every year during the wet season numerous cases of fever of the unknown origin are reported in Chad. Once malaria has been excluded they

should be diagnosed towards the Rift Valley fever.⁶

O'nyong-nyong. In November 2004 pathological changes in the course of the infection with the O'nyong-nyong virus were diagnosed in a French soldier stationing in the Southern Chad. Until that time the virus has not been registered in the territory of Chad. The infection vectors are mosquitoes of the Anopheles (*A. funestus*, *A. gambiae*) genus. The occurrence of the disease is reinforced during the wet season and nearby the waterlogged areas, which remain the breeding ground of mosquitoes.⁷

Yellow fever. Indigenous cases of the disease have not been registered in the country for the past 50 years. Nevertheless, according to Centers for Disease Control and Prevention, Chad remains a country located within the boundaries of its endemic occurrence.¹⁵ Prophylactic actions include vaccinations against the disease in the population over 9 months old. 74% of Chadians were vaccinated against yellow fever in 2006.⁶

Food and water-borne diseases

Diarrheas. High risk of the disease incidence occurs in the territory of the whole country regardless of the season. Seemingly, diarrheas do not constitute a serious health hazard among the local people in connection with a large number of asymptomatic carriers. However, the occurrence of diarrheas is common owing to the fact of widespread contamination of food and water with human and animal excrement.¹⁶ Inspected and disinfected sources of drinking water account for merely 42% of all exploited sources. Only 9% of toilets, functioning in Chad, meet the basic sanitary and hygienic requirements.^{4,5} The major contagious and parasitic etiological factors of diarrheas are enterotoxigenic *Escherichia coli*, *Campylobacter*, *Salmonella*, *Shigella*, adeno- and rotaviruses, and protozoans (*Entamoeba histolytica*, *Giardia intestinalis*).¹⁶

Typhoid fever. The disease is widespread in the territory of the whole country. High risk of the incidence, regardless of the season, is strictly related to the contamination of food and water with pathogenic micro-organisms.⁶

Cholera. 3910 cases of the disease, including 164 deaths, were registered in the Southern Chad (including the country's capital, N'Djamena) from June to September 2004. 90 cases of the disease, including 14 deaths, were diagnosed in the territory of the whole country in 2005. 1668 cases, including 71 deaths, were reported in 2006.⁶

Helminthiases. Medical examination of 1024 randomly selected students aged from 6 to 15 conducted in Chadian schools in 2002 revealed that 32.7% of the given population were infected with helminthiases of the digestive system.⁸ The most frequently diagnosed parasites were *Ancylostoma duodenale* and *Necator americanus*. Scientists conducting the research have not observed any cases of ascariasis (*Ascaris lumbricoides*) or trichuriasis (*Trichuris trichiura*) invasion among the local population, thus suggesting the absence of the above mentioned parasites in the territory of the country.¹⁷

Hepatitis E. 1442 cases of hepatitis E infection, including 46 deaths, were registered in the refugee camps in Goz Amer and Goz Beida in the East Chad from June to September 2004. Within the same period (May-September 2004) 6861 cases of hepatitis E, including 87 deaths, were registered in Sudanese Darfur. Further mass inci-

dences of the disease, including 50 deaths, were observed in the refugee camps in Goz Beida in 2005. The course of the disease among Chadians, a malnourished population with compromised immune system, is particularly severe. Fulminant hepatitis diagnosed in Chad accounted for 66% of all registered cases of the disease in the world in the 1990s.¹⁸ In the 1980s numerous cases of hepatitis E were registered among French soldiers deployed in Chad.⁶

Respiratory diseases

Respiratory diseases frequently result in high morbidity rate among Chadians and high mortality rate among children under 5 years old. It is mainly influenced by mass migrations and overpopulation in refugee camps, which are typically characterized by poor sanitary conditions and a limited access to medical services.⁶

Tuberculosis. In the 1990s the incidence of tuberculosis in Chad ranged from 60 to 120 cases per 100 000 people¹⁹, in the year 2000 it reached 370 cases, thus making the country one of the regions characterized by the highest incidence rate in the world.²⁰ In 2005 the number of cases dropped to 272 000 per 100 000 people.⁴ At the beginning of the 21st century African countries accepted the strategy of tuberculosis treatment recommended by WHO, which involved 25% of the infected population in Chad.^{21,22} The rate of vaccinations increased from 38% in 2004 and 71% in 2005 to 85% in 2006. The incidence of the disease among Chadians amounted to 4946 cases in 2004 and 6311 cases in 2005. Whereas the mortality rate due to tuberculosis totaled 7767 in 2004 and 6786 in 2005.¹⁶ Also, it needs to be emphasized that tuberculosis frequently coexists with other diseases which negatively affect the body's immune system. 33.2% of Chadians infected with tuberculosis are also carriers of HIV.²³

Contagious pediatric diseases

Due to the implementation of a mass vaccination schedule the rates of morbidity and mortality from contagious pediatric diseases among African children diminished significantly.

Measles. The rate of mortality from measles in Africa dropped from 519 000 in 1999 to 216 000 in 2004.²⁴ Nevertheless, measles remains one of the major causes of death among children under 5 in sub-Saharan countries.²⁵ The rate of vaccinated Chadian children increased from 56% in 2004, 70% in 2005, to 83% in 2006. The number of registered cases of the disease was estimated at 15,801 in 2003, 10,324 in 2004. In 2005 more than 6000 cases were diagnosed, including 115 deaths. As much as 3400 cases of measles were registered in the country's capital, N'Djamena.²³

Poliomyelitis. Despite an ongoing campaign, which is conducted on a global scale, aiming at eradicating the disease, Chad remains one of the few countries where cases of poliomyelitis are still being registered.²⁶ The priority in fighting the disease is the implementation of the vaccination schedule among all population of children under 5, which accounts for as much as 2.5 million of the total 10.4 million Chadians. In 2004 the rate of vaccinated children was estimated at 47%, in 2005 – at 57%, in 2006 – at 73%. 24 cases of the disease were diagnosed in 2004, 2 cases in 2005, 1 case in 2006, 2 cases in 2007. The incidence rate of acute flaccid paralysis in the population of children under 15 was estimated at 2.20 per

100 000 in 2004, 3.50 in 2005, 2.80 in 2006.⁶

Meningococcal meningitis. In the period from January to March 2005 387 cases of the disease were diagnosed in the territory of the whole country (serotype A), including 53 deaths. The highest incidence occurred in Bangor (124 cases, including 6 deaths) and Moissal (64 cases, including 16 deaths) provinces.²⁷ In 2006 1352 cases were diagnosed, including 150 deaths.⁶

Diphtheria. The rate of vaccinated children: 50% in 2004, 58% in 2005, 77% in 2006. Registered cases of the disease: 10 in 1985, 4 in 1986.⁶

Tetanus. The rate of vaccinated children: 50% in 2004, 58% in 2005, 77% in 2006. Registered cases of the disease in the population of infants: 232 in 2004, 191 in 2005, 161 in 2006.⁶

Sexually transmitted diseases

HIV/AIDS. The first cases of the disease were diagnosed in Chad in 1986. In 2005 the number of HIV carriers was estimated at 180 000, including 16 000 of children under 14. The number of deaths induced by AIDS was estimated at 11 000 (range from 5.3 to 20 thousand) in 2005.²⁸ At present, 200 000 of the country's inhabitants, including children, are considered to be HIV carriers. The number of infections has surged considerably in the country's capital N'Djamena, where the number of carriers is estimated at 8% of the city's total population at the reproductive age (in the territory of the whole country the rate is estimated at 3.5% for people aged 15-49). HIV infection is observed to coexist with tuberculosis in 1/3 of all cases.²⁹ The 89% of AIDS cases occur in the population aged from 15 to 49. The portal of infection in 94% of all cases is sexual intercourse, in 6% of the cases it is vertical route (from mother onto fetus).⁶

Enzootic diseases

Anthrax. In the territory of Chad the disease is endemic in the population of cattle. 1354 cases of anthrax were diagnosed in the stock of cows in 2002, in 2003 – 133 cases.²⁹ The incidence of anthrax, both its cutaneous and visceral form, has also been observed in humans.³⁰ The last cases of the disease occurred in 1998 (716 cases, including 88 deaths). Within the same year anthrax was diagnosed in 2050 sheep and goats as well as 820 camels.³¹

Brucellosis. The incidence of the disease is generally observed among stock farmers in the north of the country. In the year 2000 the number of Fulani nomads infected with brucellosis was estimated at 3.8% of the total population, their cattle at 7% and their camels at 1.4%. The portal of infection in the population of nomads was typically the consumption of non-pasteurized milk (98%) or direct contact with an infected animal's placenta (62%).³²

Q fever. Three cases of the disease occurred in the population of immigrants (patients of French nationality) in the Chad's territory from 1999 to 2003.⁶ Q fever occurs endemically among cattle and camel farmers as well as their livestock. In the year 2000 11 cases of the disease were diagnosed in the population of Arab farmers of camels and 4 cases among stock farmers (1% of the examined population).²⁹ Whereas in the population of breeding camels the morbidity rate is at a particularly high level (73-80%).^{29,32}

Rabies. The last cases occurred among Chadians in the 1990s (10 in 1996, 3 in 1997). The source of infection in humans is typically

infected dogs.⁶ The population of the animals solely in the country's capital was estimated at 23 575 in 2001, of which merely 19% were vaccinated against rabies.³³ Medical examination conducted in the population of dogs suspected of rabies in N'Djamena confirmed the prior diagnosis in 34 of the examined animals. The morbidity rate is estimated at 1.4 per 1000 non-vaccinated dogs.³⁴

Other diseases

Trachoma. A contagious disease of the sight organ induced by *Chlamydia trachomatis*, strictly connected with poor sanitary standards, is widespread among Chad's inhabitants. Medical examination conducted in the population of children under 10 (n = 3952) and women over 14 (n = 2492) within the years 2000-2001 indicated that 31.5% of the given population were infected with trachoma, of which 16.7% of the cases represented acute form of trachoma which resulted in serious complications such as corneal opacity (1%) or blindness (0.5%).³⁵ In 2003 as much as 1 016 889 cases of acute form of the disease were diagnosed in the territory of the whole country.⁶

Treponematoses. Their occurrence is endemic in the northern regions of the country among nomadic tribes. The incidence rate is connected with poor sanitary standards and in contrast to lues, a sexually transmitted disease, the portal of infection in case of treponematoses is non-sexual; the infection is transmitted via personal contact or via objects of everyday use.³⁶ The last reports regarding the number of infections date from the 1980s. In 1984 600 cases of endemic syphilis (bejel) and 629 cases of framboesia (yaws) were registered.⁶

Leprosy. The number of infected Chadians was estimated at 591 people in 2005, 786 – in 2006, 822 – in 2007.⁶

Schistosomiasis. The majority of cases (caused by *Schistosoma haematobium* and *S. mansoni*) have been observed in the southern provinces of the country. The research conducted in 2000 among children and adolescents indicated that the number of carriers among the examined population was estimated at 2.6% in the country's capital, 39.1% in the Sahel areas, 23.2% in the territories bordering with Sudan, 6.1% in the south of the country. Further research conducted in 2002 among 1024 randomly selected students revealed *S. haematobium* infection in 13.2% and *S. mansoni* infection in 1% of the examined population.¹⁶

CONCLUSIONS

Travelers to Chad are recommended to vaccinate against yellow fever, hepatitis A and B, typhoid fever, tetanus, poliomyelitis, diphtheria, rabies and meningococcal meningitis. Antimalarial chemoprophylaxis is required. Resistance to chloroquine is observed in the territory of Chad, therefore, it should not be implemented in the treatment and prophylaxis of malaria. The following medicines are recommended instead: doxycycline (1 capsule/tablet daily, 1-2 days before the departure, continued in the course of the stay in malarial areas as well as 4 weeks after the return), mefloquine (1 tablet once a week, 1-2 weeks before the departure, continued in the course of the stay as well as 4 weeks after the return) or atovaquone/proguanil (1 tablet daily, 1-2 days before departure, in the course of the stay as well as 7 days after the return). In addition to this, application of personal protection measures, such as mos-

quito-nets and insect repellents (DEET, Permethrin) is strongly advised with relation to the occurrence of numerous infection vectors of arthropod-borne diseases. Due to the widespread occurrence of food and water-borne diseases food and water (bottled) intended for consumption must come exclusively from sources complying with hygienic requirements.³⁷ Also, it needs to be remembered that special precautionary measures should be taken while traveling into unfamiliar territory. A number of military and paramilitary units operate in the territory of Chad; they typically implement diverse devices aimed at eliminating the enemy. 32 people died in the explosion of anti-personnel mines in the territory of the country in 2004.⁴

Conflict of interest

None declared.

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