Elimination of Intestinal Parasites among Polish Soldiers Deployed to Afghanistan, 2010-2014.*

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RESUME

Elimination des parasites intestinaux chez les soldats polonais déployés en Afghanistan, 2010-2014.

Objectif : *Plus de 20000 soldats polonais ont servi en Afghanistan au sein de la force multinationale (ISAF) de 2010 à 2014. Les troupes polonaises ont accompli leur devoir dans un environnement rude, des conditions sanitaires précaires et en contact étroit d'une population dans laquelle le portage de parasites est élevé. Le but de cette étude était de présenter le programme de prévention des forces armées polonaises, visant à éliminer les parasites intestinaux pathogènes chez les soldats déployés en zone de combat en Afghanistan.*

Matériel et méthodes : *Les dossiers médicaux de 16164 soldats d contingent polonais ayant servi dans l'est de l'Afghanistan de 2010 à 2014 ont été analysés. Quatre semaines avant la fin de leur mission, chacun des soldats devait fournir trois échantillons de selles récoltés sur une période de deux à trois jours et fixés dans du formol à 10 %. Les échantillons ont été expédiés au département d'épidémiologie et de médecine tropicale en Pologne ou ils furent examinés en microscopie optique en utilisant trois techniques : étalement direct dans le Lugol, flottation de Fülleborn et décantation en eau distillée.*

Résultats : *Une infestation par des parasites intestinaux pathogènes a été découverte chez 665 soldats (prévalence de 4,1 %). Les parasites les plus souvent observés ont été Ascaris lombricoïdes (46.2 %), Gardia intestinalis (34.6 %), et Hymenolepis nana (8.0 %). Tous ces soldats ont reçu un traitement antiparasitaire (albendazole, metronidazole ou praziquantel) avant leur retour en Pologne.*

Conclusion : *Le programme de prévention des parasitoses intestinales qui a été appliqué chez les soldats polonais déployés en Afghanistan a contribué à éliminer les parasites du milieu militaire et limité leur dissémination en Pologne.*

KEYWORDS: Intestinal parasites, Polish soldiers, ISAF, Afghanistan.
MOTS-CLÉS : *Parasites intestinaux, Soldats polonais, ISAF, Afghanistan.*

INTRODUCTION

Despite significant progress in laboratory diagnosis and treatment of parasitoses, helminthic and protozoan infections are still one of the major health hazards in the contemporary world. More than 2 billion people worldwide are estimated to be infected, and approximately 5 billion people live in areas where intestinal parasitoses are endemic[1, 2]. Globally, the most common intestinal helminth is *Ascaris lumbricoides*. The number of people infected with ascariasis is estimated at even 1.2 billion. 20-30% of people living in developing countries might be infected with giardiasis. There are a number of factors which facilitate the spread of infections in the Third World countries as well as increase the risk of importing parasitic infections into developed countries. They include poor sanitation, lack of medical care, mass migration, and the presence of hosts in some ecosystems (reservoirs of parasites)[3-8].

Soldiers deployed to countries at war usually serve under difficult climatic and sanitary conditions and therefore are at a higher risk of developing contagious or parasitic infections; they may import food- and waterborne diseases into a home country[9, 10]. Medical services supporting military operations carried out overseas need to pay particular attention to gastrointestinal parasitoses since these are extremely widespread in operational areas, can be easily transmitted through the oral-fecal route, and are often asymptomatic and may become a chronic condition[11]. The examination of Polish military personnel deployed to Chad in the period 2008-2009 demonstrated a high rate of gastrointestinal parasitic illnesses. As a result of the screening tests carried out among members of the Polish Military Contingent in Africa, a prevention program against intestinal parasitic diseases aimed at participants of overseas military operations was introduced in the Polish Armed Forces[12].

In the period from 2010 to 2014, more than 20,000 Polish soldiers were serving in Afghanistan as members of multinational coalition forces (ISAF, International Security Assistance Force). Polish troops performed their tasks in close contact with the local population characterized by a high carrier rate. The aim of the study was to present the effects of the prevention program whose aim was to eliminate intestinal parasites in PAF soldiers deployed to a combat zone in Afghanistan.

MATERIAL AND METHODS

Study population. The medical records of 16,164 soldiers from the Polish Military Contingent serving in eastern Afghanistan between 2010 and 2014 were analyzed. On average, the tour of duty lasted six months. Four weeks before the termination of duty in the mission area each soldier delivered 3 stool samples, collected at intervals of 2 to 3 days, fixed in 10% formalin. The samples were then transported to the Department of Epidemiology and Tropical Medicine in Poland where they were examined by light microscopy using 3 different diagnostic methods (direct smear in Lugol's solution, Fülleborn's flotation, decantation with distilled water) for the presence of nematode, cestode, trematode and pathogenic protozoan (cysts) infections. All of the infected soldiers received recommended antiparasitic treatment in Afghanistan; following their return to Poland they were screened for parasitic infections once more (a follow-up test upon completion of the antiparasitic therapy realized abroad).

Laboratory procedures. Stool examination was performed by means of three different testing methods by light microscopy[13, 14]:

Direct smear in Lugol's solution. Approx. 2 mg of stool was collected with a glass rod and applied onto a slide, a drop of Lugol's solution was added and the material was smeared over a 4 cm2 surface. Next, a cover slide was placed on top of the preparation and the material was examined microscopically under correct magnification objective (x10, then x40).

Fülleborn's flotation. Approx. 2 g of stool was mixed with saturated NaCl solution in a test tube. Next, NaCl solution was added to the top of the tube. A cover slide was placed on the top of the tube and in contact with the suspension. After 30 minutes the cover slide was removed with tweezers and placed the wet side down on a slide. The preparation was ready for microscopic examination (objective x10 magnification).

Decantation with distilled water. Approx. 2 g of stool was mixed thoroughly with a small amount of water in a test tube. Next, water was added to the top of the tube. After 30 minutes the supernatant was decanted and another portion of water was added. This procedure had been repeated until clear supernatant was obtained, generally three to four times. The sediment was then placed on a slide and stained with Lugol's solution for microscopic examination (objective x40 magnification).

Statistical analysis. All statistical calculations have been performed using the statistical suite StatSoft Inc. (2011) STATISTICA version 10.0. www.statsoft.com (SN JGNP3087539302 AR-E) and Excel. The qualitative variables were presented with the use of count and percentage. P=0.05 was assumed statistically significant for all calculations.

RESULTS

Infections with pathogenic intestinal parasites were detected in 665 of the 16,164 tested soldiers (prevalence of 4.1%) (Table 1, Figure 1).

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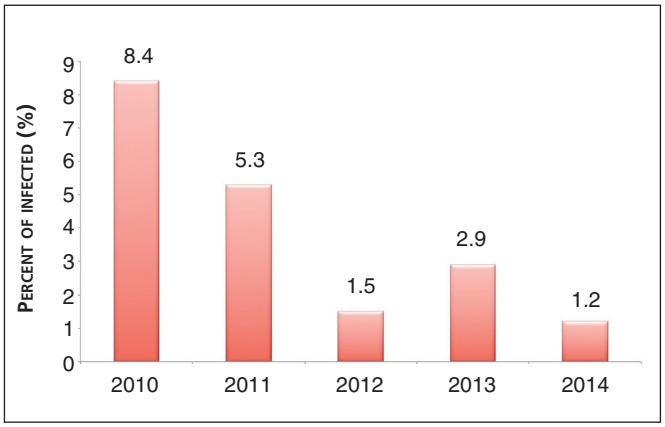
Table 1: Pathogenic intestinal parasitic infection in soldiers serving in PMC Afghanistan between 2010-2014 (n=16,164).

Year	Number of examined	Number of infected	Percent of infected
2010	2862	241	8.4%
2011	4761	252	5.3%
2012	4226	64	1.5%
2013	3154	91	2.9%
2014	1161	14	1.4%
Total	**16,164**	**662**	**4.1%** (arithmetical mean)

Figure 1: Percent distribution of pathogenic intestinal parasites in soldiers serving in PMC Afghanistan between 2010 and 2014 (n=16,164).



The highest prevalence of infections was observed in the beginning and the lowest at the end of the study period. A significant reduction in the prevalence of parasitic infections was possible owing to the implementation of appropriate preventive measures (avoiding food from the local market, drinking bottled water only, frequent hand washing).

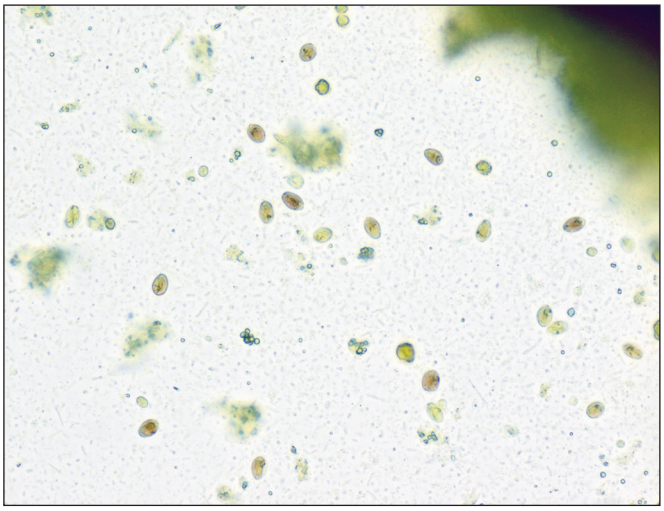
The most common intestinal parasites in the examined group were nematodes, protozoa, cestodes, and less frequently trematodes. The most common pathogens were *Ascaris lumbricoides* (46.2% of infections), *Gardia intestinalis* (34.6%), *Hymenolepis nana* (8.0%), and *Strongyloides stercoralis* (7.8%) (Picture 1-4, Table 2, Figure 2).

All of the infected soldiers received recommended antiparasitic treatment (albendazole, metronidazole or praziquantel) before returning to Poland (Table 3). In the home-country they were screened for parasitic infections once again as a follow-up test upon completion of the antiparasitic therapy realized in Afghanistan.

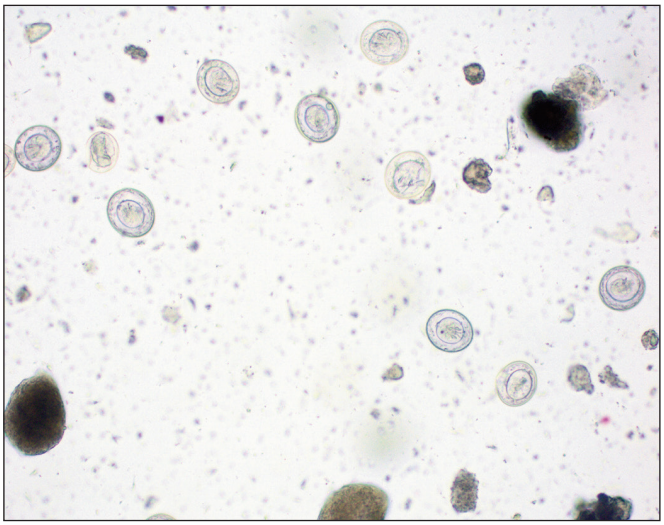
Because of high prevalence of intestinal parasitic infections among Polish soldiers serving in ISAF operation in Afghanistan, medical services supporting the Polish Military Contingent tried to determine risk factors affecting the incidence of parasitoses in the military environment. The examination of water used by soldiers for sanitation revealed contamination with fecal

Picture 1: Ascaris lumbricoides.
Source: Department of Epidemiology and Tropical Medicine, Military Institute of Medicine, Poland.

Picture 2: Giardia intestinalis.
Source: Department of Epidemiology and Tropical Medicine, Military Institute of Medicine, Poland.



Picture 3: Hymenolepis nana.
Source: Department of Epidemiology and Tropical Medicine, Military Institute of Medicine, Poland.

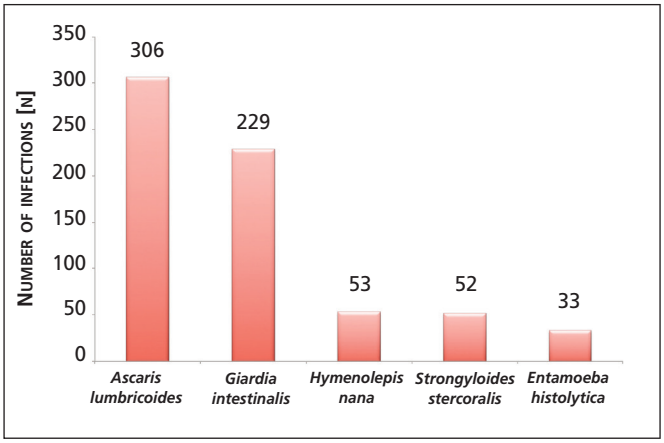


bacteria. Apart from screening Polish soldiers, the medical services conducted parasitological tests in a group of Afghan residents from the Ghazni province (eastern Afghanistan, the area of deployment of the Polish Military Contingent) under humanitarian aid. In 2011,

Picture 4: Strongyloides stercoralis.
Source: Department of Epidemiology and Tropical Medicine, Military Institute of Medicine, Poland.

the same Polish medical services tested 110 soldiers from the Afghan National Army (ANA) who were trained and accommodated in the same military base as the Polish soldiers. The results left no doubt as to who was the potential source of infection for the European population; 40% of the ANA soldiers were infected, mostly with the same species of intestinal parasites which had been found in Polish soldie rs (Table 4).

Figure 2: The most common intestinal parasites detected in soldiers serving in PMC Afghanistan between 2010-2014 (n=16,164).



Between 2012 and 2014, in cooperation with the Head of the Health Service Department in Ghazni Province Dr. Zia Ghul and the Head of the Ghazni Provincial Hospital Dr. Baz Mohammad Hemmat, parasitology tests were performed among 3,036 local residents (patients in Ghazni Provincial Hospital and students of Jahan Malika, Share Kona, and Khujia Ali High Schools in Ghazni). The parasitological examination revealed ascariasis, giardiasis, hymenolepiasis, and many other parasitoses in 38.9% of the tested patients (Table 5).

Table 2: Pathogenic intestinal parasitic infections in soldiers serving in PMC Afghanistan between 2010-2014 (n=16,164).

Intestinal parasites	2010	2011	2012	2013	2014	Total
Nematodes	**191**	**87**	**40**	**43**	**7**	**368**
Ascaris lumbricoides	141	83	38	40	4	306
Strongyloides stercoralis	48	3	1	-	-	**52**
Enterobius vermicularis	2	-	1	2	3	8
Trichostrongylus spp.	-	-	-	1	-	1
Trichuris trichiura	-	1	-	-	-	1
Cestodes	**19**	**28**	**3**	**7**	**3**	**60**
Hymenolepis nana	15	25	3	7	3	53
Hymenolepis diminuta	1	1	-	-	-	2
Taenia spp.	2	2	-	-	-	4
Diphyllobothrium latum	1	-	-	-	-	1
Trematodes	**-**	**-**	**3**	**2**	**-**	**5**
Dicrocoelium dendriticum	-	-	3	2	-	5
Protozoa	**31**	**137**	**18**	**39**	**4**	**229**
Giardia intestinalis	12	121	15	36	2	186
Entamoeba sensu lato	19	7	3	3	1	33
Cryptosporidium parvum	-	9	-	-	1	10
Total	**241**	**252**	**64**	**91**	**14**	**662**

Table 3: Treatment of intestinal parasitic infections in soldiers serving in PMC Afghanistan between 2010-2014 (n=16,164).

Intestinal parasites	Treatment
Nematodes	
Ascaris lumbricoides	albendazole tabl. 400 mg in a single dose
Strongyloides stercoralis	ivermectin tabl. 200 µg/kg/24 h for 2 days; alternative treatment: albendazole tabl. 2 x 400 mg for 5-7 days
Enterobius vermicularis	albendazole tabl. 400 mg in a single dose, treatment repeated after 2 weeks
Trichostrongylus spp.	albendazole tabl. 400 mg in a single dose
Trichuris trichiura	albendazole tabl. 400 mg in a single dose
Cestodes	
Hymenolepis nana	praziquantel tabl. 25 mg/kg in a single dose
Hymenolepis diminuta	praziquantel tabl. 25 mg/kg in a single dose
Taenia spp.	praziquantel tabl. 5-10 mg/kg in a single dose
Diphyllobothrium latum	praziquantel tabl. 5-10 mg/kg in a single dose
Trematodes	
Dicrocoelium dendriticum	praziquantel tabl. 3 x 25 mg/kg in a daily dose
Protozoa	
Giardia intestinalis	metronidazole tabl. 2 x 500 mg or 3 x 250 mg for 5 days
Entamoeba histolytica	metronidazole tabl. 3 x 750 mg for 10 days (amoebic colitis or amoebic liver abscess); paromomycin tabl. 3 x 500 mg for 7 days (asymptomatic intestinal colonization)
Cryptosporidium parvum	no treatment; self-limited infection

Table 4: Pathogenic intestinal parasitic infections in Afghan soldiers in 2011 (n=110).

Nematodes		Cestodes		Trematodes		Protozoa	
Species	**No.**	**Species**	**No.**	**Species**	**No.**	**Species**	**No.**
Ascaris lumbricoides	17	*Hymenolepis nana*	1	*Dicrocoelium dendriticum*	4	*Giardia intestinalis*	15
Enterobius vermicularis	1	*Hymenolepis diminuta*	1	*Fasciola hepatica*	1	*Entamoeba histolytica*	4
Strongyloides stercoralis	1	*Taenia spp.*	3				
Trichuris trichiura	1	*Diphyllobothrium latum*	1				
Total	**20**	**Total**	**6**	**Total**	**5**	**Total**	**19**

Table 5: Pathogenic intestinal parasitic infections in Afghan civilians between 2012-2014 (n=3036).

Nematodes		Cestodes		Trematodes		Protozoa	
Species	**No.**	**Species**	**No.**	**Species**	**No.**	**Species**	**No.**
Ascaris lumbricoides	600	*Hymenolepis nana*	208	*Dicrocoelium dendriticum*	38	*Giardia intestinalis*	465
Enterobius vermicularis	56	*Hymenolepis diminuta*	36	*Fasciola hepatica*	18	*Entamoeba histolytica*	18
Ancylostoma duodenale / Necator americanus	14	*Taenia spp.*	42				
Strongyloides stercoralis	6						
Trichuris trichiura	1						
Trichostrongylus spp.	1						
Total	**678**	**Total**	**286**	**Total**	**56**	**Total**	**483**

As was the case with the Afghan soldiers, Afghan civilians were found to be infected with the same parasitoses as the ones detected in Polish soldiers. The identification of the sensitive population (Polish soldiers), the pathogens (intestinal parasites), and the environment (carriers of parasitic diseases in the Afghan population, contaminated water), representing a classic epidemiological triad, made it possible to introduce an effective epidemiological surveillance in the military environment lasting several years. The epidemiological surveillance included a set of carefully planned and conscious efforts, which combined with the enforcement of appropriate measures for disease prevention, gave an example of adequate sanitary and epidemiological support of the PMC deployed on overseas operations[15].

DISCUSSION

Poland is the only NATO member who has introduced obligatory parasitological tests for all its soldiers deployed on overseas military operations. In other armies, only those soldiers who report to a health care facility with pathological signs need to undergo parasitological tests. The tests performed in 286,305 U.S. Forces soldiers in the period from 2002 to 2012 revealed 8,381 cases of intestinal parasitic infections (2.9% of infected; 4.1% of infected in our study). This is, however, only an approximation, as just a part of infections only were laboratory-confirmed. Additionally, infection rates may be underreported because not all soldiers experiencing gastrointestinal symptoms consult a physician but rather tend to self-treat. The most common intestinal parasites detected in American soldiers in the analyzed period were nematodes (n=3,818), cestodes (n=2,358), trematodes (n=346) and protozoa (n=1,859)[16]. In our study, we observed among Polish soldiers serving in Afghanistan some clinical symptoms of intestinal parasitic infections (mainly diarrhea, pain of stomach, loss of weight), but our decision concerning the antiparasitic treatment was based on a laboratory (parasitological) examination rather than clinical picture, which was often non-specific.

Soldiers deployed on military operations serve under difficult environmental conditions; therefore they run a high risk of developing a food or water-borne parasitic disease. This is all the more important because medical services supporting coalition forces in the theaters of operations rarely perform comprehensive parasitological tests, which results in the fact that some gastrointestinal diseases are diagnosed as non-infectious although they may be of parasitic etiology. Infectious and invasive diseases represent merely 2.8% of all diagnoses in the population of soldiers participating in contemporary military operations[17]. Assuming that 75% of soldiers deployed overseas experience episodes of diarrhea, and that the patients are treated on an out-patient basis with no parasitological tests being performed, the infection rates may be significantly higher than those cited in the official statistics[18]. Therefore, it is extremely important to supervise the implementation of basic disease prevention measures in all operational areas as it can prevent an outbreak and spread of food and water-borne diseases. The study carried out by military preventive medicine services showed that the basic sanitary practices may considerably lower the risk of developing infections: hand washing by 42-47%[19], disinfection and safe disposal of excreta by 30-35%, disinfection of drinking water by 15-20%[20, 21].

Limitations of the study

Stool examination was made two weeks after collection and transfer of biological material (fixed in 10% formalin) to Poland. This prolonged time of examination and fixation might lead to underestimation of some intestinal

parasitic infections. For protozoa only cysts were taken into account.

CONCLUSIONS

Prevention program against intestinal parasitic diseases which has been implemented among Polish soldiers deployed to Afghanistan helped to eliminate parasitoses in the military environment and limited the spread of intestinal parasites into Poland.

Parasitological examination of stool samples collected from Afghan residents showed high infection rates in the local population, which is an important risk factor for the transmission of parasitic infections to immigrant populations, e.g. members of military operations.

ABSTRACT

Objective. More than 20,000 Polish soldiers were serving in Afghanistan as members of multinational coalition forces (ISAF) between 2010 and 2014. Polish troops performed their tasks under harsh environmental conditions, poor sanitation and in close contact with the local population characterized by a high carrier rate of parasitic infections. The aim of the study was to present the effects of a prevention program introduced in the Polish Armed Forces aiming at the elimination of pathogenic intestinal parasites among soldiers deployed into a combat zone in Afghanistan.

Material and Methods. The medical records of 16,164 soldiers of the Polish Military Contingent serving in eastern Afghanistan between 2010 and 2014 were analyzed. Four weeks prior to the termination of their service in the mission area each soldier delivered 3 stool samples, collected at the intervals of 2 to 3 days, fixed in 10% formalin. The samples were then transported to the Department of Epidemiology and Tropical Medicine in Poland where they were examined in light microscopy using 3 different diagnostic methods (direct smear in Lugol's solution, Fülleborn's flotation, decantation in distilled water).

Results. Pathogenic intestinal parasitic infections were detected in 665 of the tested soldiers (prevalence of 4.1%). The most common pathogens in the examined group were *Ascaris lumbricoides* (46.2%), *Gardia intestinalis* (34.6%), and *Hymenolepis nana* (8.0%). All of the infected soldiers received recommended antiparasitic treatment (albendazole, metronidazole or praziquantel) before returning to Poland.

Conclusions. Prevention program against intestinal parasitic diseases which was implemented among Polish soldiers deployed to Afghanistan helped to eliminate parasitoses in the military environment and limited the spread of intestinal parasites into Poland.

REFERENCES

1. HOTEZ PJ, MOLYNEUX DH, FENWICK A, KUMARESAN J, SACHS SE, SACHS JD, *et al.* Control of neglected tropical diseases. *The New England Journal of Medicine* 2007; 357: 1018–1027.
2. HORTON J. Human gastrointestinal helminth infections: are they now neglected diseases? *Trends in Parasitology* 2003; 19: 527–531.
3. EL-SHERBINI GT, ABOSDERA MM. Risk factors associated with intestinal parasitic infections among children. *Journal of the Egyptian Society of Parasitology* 2013; 43: 287–294.
4. ZIEGELBAUER K, SPEICH B, MAUSEZAHL D, BOS R, KEISER J, UTZINGER J. Effect of Sanitation on Soil-Transmitted Infection: Systematic Review and Meta-Analysis. *PLoS Medicine* 2012; 9: e1001162.
5. BETHONY J, BROOKER S, ALBONICO M, GEIGER SM, LOUKAS A, DIEMERT D, HOTEZ PJ. Soil-transmitted helminth infections: ascariasis, and hookworm. *The Lancet* 2006; 367: 1521–1532.
6. DE SILVA NR, BROOKER S, HOTEZ PJ, MONTRESOR A, ENGELS D, SAVIOLI L. Soil-transmitted helminth infections: updating the global picture. *Trends in Parasitology* 2003; 19: 547–551.
7. PHAM-DUC P, NGUYEN-VIET H, HATTENDORF J, ZINSSTAG J, PHUNG-DAC C, ZURBRÜGG C, ODERMATT P. Ascaris lumbricoides and Trichuris trichiura infections associated with wastewater and human excreta use in agriculture in Vietnam. *Parasitology International* 2013; 62: 172–180.
8. SCHÄR F, INPAKAEW T, TRAUB RJ, KHIEU V, DALSGAARD A, CHIMNOI W, *et al.* The prevalence and diversity of intestinal parasitic infections in humans and domestic animals in a rural Cambodian village. *Parasitol Int* 2014; 63: 597–603.
9. ARONSON NE, SANDERS JW, MORAN KA. In Harm's Way: Infections in Deployed American Military Forces. *Clinical Infectious Diseases* 2006; 43: 1045–1051.
10. BUCZYŃSKI A, KORZENIEWSKI K, BZDĘGA I, JEROMINKO A. Epidemiology of parasitic diseases in persons treated in the Hospital of the United Nations Interim Force in Lebanon from 1993 to 2000. *Przegląd Epidemiologiczny* 2004; 58(2): 303–312 [in Polish].
11. FRICKMANN H, SCHWARZ NG, WIEMER DF, FISCHER M, TANNICH E, SCHEID PL, *et al.* Food and drinking water hygiene and intestinal protozoa in deployed German soldiers. *European Journal of Microbiology & Immunology* 2013; 3: 53–60.
12. KORZENIEWSKI K. Examination regarding the prevalence of intestinal parasitic diseases in Polish soldiers contingents assigned to missions abroad. *International Maritime Health* 2011; 62: 31–36.
13. Procedures for the Recovery and Identification of Parasites from the Intestinal Tract: Approved Guideline, M28-2A. Clinical and Laboratory Standards Institute, Villanova PA, 2005.
14. GARCIA LS, SMITH JW, FRITSCHE TR. Selection and use of laboratory procedures for diagnosis of parasitic infections of the gastrointestinal tract. Washington DC: ASM press, 2003.
15. KORZENIEWSKI K, SMOLEŃ A. Health problems of Polish Military Contingents soldiers – imported diseases. In: BOGDALSKI P, NOWAKOWSKI Z, PŁUSA T. (Eds).

Contemporary bioterroristic and cyberterroristic threats and national safety of Poland. *Warszawa-Dęblin* 2015, pp. 467-474 [in Polish].

16. Medical Surveillance Monthly Report. Gastrointestinal Infections, Active Component, U.S. Armed Forces, 2000–2012. *Medical Surveillance Monthly Report* 2013; 20(10): 7–11.

17. HARMAN D, HOOPER T, GACKSTETTER G. Aeromedical evacuations from Operation Iraqi Freedom: a descriptive study. *Military Medicine* 2005; 170: 521–527.

18. SANDERS JW, PUTNAM SD, FRANKART C, FRENCK RW, MONTEVILLE MR, RIDDLE MS, *et al.* Impact of illness and non-combat injury during Operations Iraqi Freedom and Enduring Freedom (Afghanistan). *American Journal of Tropical Medicine and Hygiene* 2005; 73: 713–719.

19. ROBINSON A. Community-led Total Sanitation. *Journal of British Travel Health Association* 2006; 7: 18–19.

20. CURTIS V, CAIRNCROSS S. Effect of washing hands with soap on diarrhoea risk in the community: a systemic review. *The Lancet Infectious Diseases* 2003; 3(5): 275–281.

21. ESREY S, POTASH JB, ROBERTS L, SHIFF C. Effects of improved water supply and sanitation on ascariasis, diarrhea, dracunculiasis, hookworm infection, schistosomiasis and trachoma. *Bulletin of the World Health Organization* 1991; 69(5): 609–621.