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# Zoonoses and vector diseases in the Brazilian Army military personnel (2017/2018) and the role of the military veterinarian in disease prevention

*Zoonosis y enfermedades vectoriales en militares del Ejército Brasileño (2017/2018) y el papel del veterinario militar en la prevención de enfermedades*

**Abstract:** Several studies worldwide indicate high morbidity and mortality associated with infectious diseases in military personnel. This study aimed to learn the biological risks in activities of the Brazilian Army military personnel and to discuss the role of the military veterinarian in actions of Health Protection of the Force. An ecological study focused on the twelve Military Regions of the Force was carried out, analyzing data on notifiable diseases in military personnel, referring to 2017 and 2018. Notifications and the relative risk for diseases in military personnel were compared to the general population. The results showed that arboviruses transmitted by the *Aedes* spp. had the highest notifications among the military personnel and that the relative risk for various diseases was higher in the military personnel. The main hypothesis is the greater exposure to zoonoses during military activities. The veterinarian is qualified to play the role of health officer in the prevention and control of biological risks.

**Keywords:** Armed Forces; biological risks; military health.

**Resumen:** A nivel mundial, varios estudios indican una alta morbilidad y mortalidad asociada a enfermedades infecciosas en el personal militar. El objetivo de este estudio fue conocer los riesgos biológicos en las actividades de los soldados del Ejército Brasileño y discutir el papel del médico veterinario militar en las acciones de Protección de la Salud de la Fuerza. Se realizó un estudio ecológico destacando las 12 Regiones Militares de la Fuerza, analizando datos de enfermedades de declaración obligatoria en el personal militar, referentes a los años 2017 y 2018. Se compararon las notificaciones y el riesgo relativo de afecciones en el personal militar con la población general. Los resultados mostraron que los arbovirus transmitidos por el mosquito Aedes spp. tuvieron las mayores notificaciones entre los militares y se verificó que el riesgo relativo fue mayor en esta categoría en diversas situaciones de afecciones. La principal hipótesis para esto es una mayor exposición a las zoonosis durante las actividades militares. El veterinario, por tanto, está capacitado para desempeñar el papel de funcionario sanitario, actuando en la prevención y control de los riesgos biológicos.

**Palabras clave:** Fuerzas Armadas; riesgos biológicos; sanidad militar.

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## 1 INTRODUCTION

Biological health risk is the probability of exposure to biological agents such as bacteria, viruses, fungi, parasites, protozoa, in addition to vectors (arthropods) and animal bites. Here, this concept can be understood as a risk factor, which is a condition or set of circumstances with potential adverse effect, such as diseases (BRASIL, 2001; BRASIL, 2008). It is worth noting that many of these diseases are vector-borne or zoonotic.

The occurrence of infectious and parasitic diseases depends on the conditions or circumstances in which the work is performed and on the occupational exposure, which favors contact, contagion or transmission. Etiological agents are widespread in the environment, depending on environmental and sanitation conditions, as well as on the prevalence of diseases in the general population. As exposure to biological agents also happens in situations outside the workplace, establishing a causal link is difficult (BRASIL, 2001). Infectious diseases cause many problems for deployed military forces around the world. Historically, those transmitted by vectors were responsible for more casualties than combat (MACEDO; PETERSON; DAVIS, 2007). In low- and middle-income countries, infectious diseases are of great concerning in terms of morbidity and mortality for troops, especially due to the current emergence or re-emergence of vector-borne diseases (PAGES *et al*., 2010).

In the 62 United Nations' peacekeeping missions (UN), between 1947 and 2015, 30% of deaths occurred due to diseases, mostly infectious diseases associated with the environment where the missions were caried out. In the UN peacekeeping missions that Brazil participated in between 1957 and 2015, several diseases affecting the troops were identified, including yellow fever, malaria, leishmaniasis, dengue, chikungunya and rabies. Then, 38 deaths from various causes were confirmed, three of them due to malaria (ANDRADE LIMA, 2016).

In Brazil, there are several reports of military personnel affected by infectious diseases due to their work. Cases of leishmaniasis have already been confirmed in the states of Amazon (GUERRA *et al*., 2003; LORENZI, 2014) and in Pernambuco (ANDRADE, 2004; ANDRADE *et al*., 2009; BRANDÃO-FILHO *et al*., 1998); leptospirosis in Paraná (MARASCHIN; ESTRELA; FERREIRA, 2005), Ceará (BRAZ, 2014) and Rio de Janeiro (DE LORENZI, 2014;); severe acute respiratory syndrome in Rio de Janeiro (DE LORENZI, 2014), in addition to cases of chikungunya in military personnel who returned from the UN peacekeeping mission in Haiti in 2014 (LORENZI, 2014).

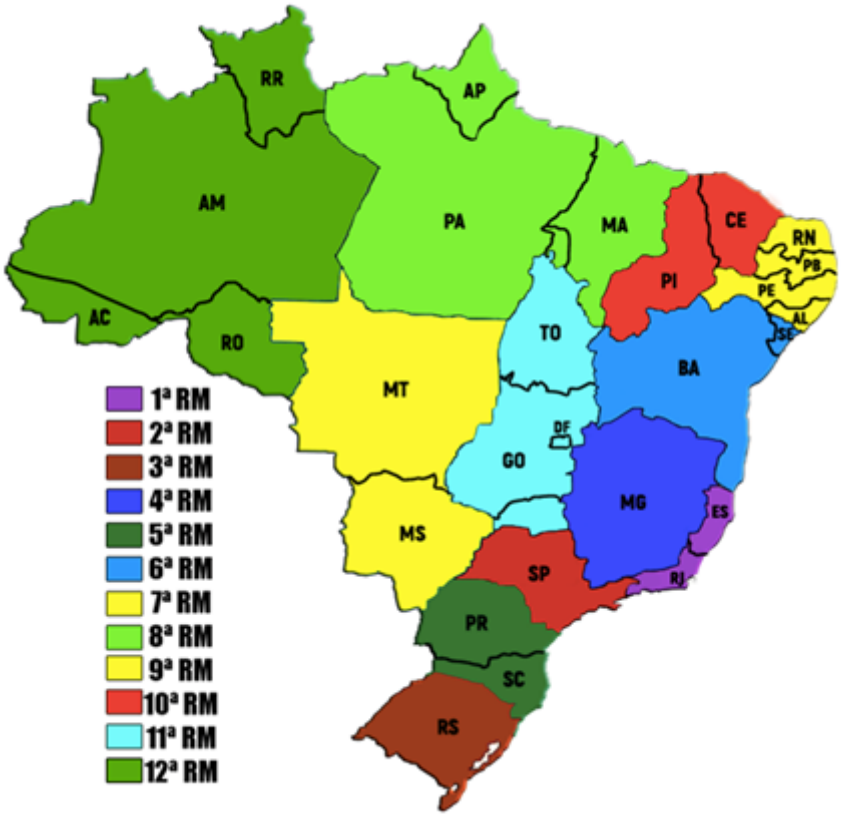
This article aimed to know the biological risks in the activities of military personnel of the Brazilian Army and discuss the role of the military veterinarian in actions of Health Protection of the Force.

## 2 MATERIALS AND METHODS

An ecological study was carried out adopting the 12 Military Regions (MR) of the Brazilian Army as area analysis units, with their respective federal units of coverage: 1st MR (Rio de Janeiro and Espírito Santo), 2nd MR (São Paulo), 3rd MR (Rio Grande do Sul), 4th MR (Minas Gerais), 5th MR (Paraná and Santa Catarina), 6th MR (Bahia and Sergipe), 7th MR

(Rio Grande do Norte, Paraíba, Pernambuco and Alagoas), 8th MR (Pará, Amapá and Maranhão), 9th MR (Mato Grosso do Sul and Mato Grosso), 10th MR (Ceará and Piauí), 11th MR (Federal District Goiás and Tocantins), and 12th MR (Amazonas, Acre, Rima and Rondônia) (Figure 1). The data considered in the study are comprised in the biennium 2017 and 2018.

**Figure 1 – Map of jurisdiction of the Military Regions (MR) of the Brazilian Army**




Source: CENTRO ROSA DA FONSECA, 2023

Data on diseases in military personnel were obtained from endemic disease control maps (compulsory notification diseases included) requested from the Army Health Directorate, so to identify the most frequent diseases the military personnel are exposed to in their activities. These maps are sent monthly by all Military Organizations (OM) that have a health section in the MR to which they are subordinated. Finally, the MR send the cartographies to the Army Health Directorate. Some OM, such as military hospitals, also serve reserve military personnel and dependents of military personnel, thus, the number of cases does not necessarily correspond only to occurrences in active-duty military personnel. Only data on diseases that are related to zoonoses and/or those transmitted by vectors were used. The incidences of reported diseases in military organizations were also calculated, using the number of cases divided by the estimate of the number of military personnel of each MR, according to the Army Statistical Yearbook (BRASIL, 2019a), and expressed per 100,000 individuals.

General population data on chikungunya, dengue and Zika were obtained from the epidemiological bulletins about arboviruses of the Brazilian Ministry of Health (MH) (BRAZIL, 2019c; BRAZIL, 2019d); data on Chagas disease, cutaneous leishmaniasis, visceral leishmaniasis were obtained from the website of the National Notifiable Diseases System (Sinan), in which there were no data available for 2018 (BRAZIL, 2019g); data on yellow fever were obtained from the epidemiological bulletin and from the MH reports (BRAZIL, 2017b; BRAZIL, 2018b; BRAZIL, 2019b); data on spotted fever, hantavirosis, leospirosis, plague, and rabies were obtained from the website of the MH (BRAZIL, 2019f), and data on malaria were obtained from the Strategic Management Room of the Ministry of Health (BRAZIL, 2019b). Data on the size of the Brazilian population were obtained from the website of the Brazilian Institute of Geography and Statistics (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2019). Data on yellow fever were made available by seasonal period, which runs from July of one year to June of the following year and, therefore, it was not possible to separate the number of cases for each year; hence, the sum of the cases of 2017 and 2018 was considered. Data used refer to the reported cases confirmed and under investigation, excluding those discarded. The incidence of reported diseases was calculated using the number of cases divided by the estimated population of a given geographical area, according to the Brazilian Institute of Geography and Statistics (IBGE), and expressed per 100,000 inhabitants.

The relative risk for diseases in the military was estimated in relation to the general population, based on the ratio between the incidence of injury in the military and the incidence of injury in the population, to identify if the risk of illness was higher among the military.

## 3 RESULTS

Table 1 shows data on zoonotic and vector diseases recorded in military personnel.
Table 2 shows data on zoonotic and vector diseases recorded in the general population.

**Table 1 – Number of cases notified to the Army Health Directorate of zoonoses and vector diseases of compulsory notification registered in military personnel, by MR, in 2017 and 2018.**

| MR/Disease | | Chikungunya | Dengue | Zika | Chagas Disease | Yellow Fever | Cutaneous Leishmaniasis | Visceral Leishmaniasis | Leptospirosis | Malaria | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st MR (RJ, ES) | 2017 | 3 | 128 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 135 |
| | 2018 | 39 | 46 | 10 | 0 | 0 | 0 | 0 | 0 | 2 | 97 |
| 2nd MR (SP) | 2017 | 0 | 29 | 0 | 0 | 5 | 0 | 0 | 1 | 1 | 36 |
| | 2018 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 3rd MR (RS) | 2017 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 2 | 0 | 5 |
| | 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 4th MR (MG) | 2017 | 2 | 44 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 47 |
| | 2018 | 1 | 20 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 24 |
| 5th MR (PR, SC) | 2017 | 1 | 2 | 0 | 3 | 0 | 15 | 0 | 0 | 0 | 21 |
| | 2018 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 7 |
| 6th MR (BA, SE) | 2017 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 |
| | 2018 | 11 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 13 |
| 7th MR (RN, PB, PE, AL) | 2017 | 11 | 77 | 0 | 0 | 0 | 10 | 6 | 0 | 2 | 106 |
| | 2018 | 22 | 168 | 2 | 1 | 0 | 16 | 3 | 0 | 6 | 218 |
| 8th MR (PA, AP, MA) | 2017 | 15 | 120 | 25 | 0 | 10 | 11 | 0 | 1 | 5 | 187 |
| | 2018 | 0 | 15 | 0 | 0 | 0 | 110 | 2 | 0 | 0 | 127 |
| 9th MR (MS, MT) | 2017 | 1 | 54 | 0 | 0 | 0 | 1 | 3 | 0 | 3 | 62 |
| | 2018 | 52 | 16 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 73 |
| 10th MR (CE, PI) | 2017 | 96 | 40 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 141 |
| | 2018 | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 7 |
| 11th MR (DF, GO, TO) | 2017 | 3 | 72 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 76 |
| | 2018 | 0 | 85 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 88 |
| 12th MR (AM, AC, RR, RO) | 2017 | 85 | 363 | 43 | 0 | 0 | 34 | 2 | 0 | 335 | 862 |
| | 2018 | 6 | 157 | 8 | 0 | 0 | 28 | 1 | 24 | 425 | 649 |
| Total | 2017 | 217 | 951 | 75 | 5 | 15 | 72 | 15 | 4 | 346 | 1,700 |
| | 2018 | 132 | 518 | 28 | 2 | 1 | 157 | 9 | 27 | 433 | 1,307 |

Source: Prepared by the authors, based on data from the Army Health Directorate (2019).

**Table 2 – Number of cases notified to Sinan of zoonoses and vector diseases of compulsory notification recorded in the general population, by MR, in 2017 and 2018.**

| MR/Disease | | Chikungunya | Dengue | Zika | Chagas Disease | Yellow fever* | Spotted Fever | Hantivirus disease | Cutaneous Leishmaniasis | Visceral Leishmaniasis | Leptospirosis | Malaria | Rabies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st MR (RJ, ES) | 2017 | 5,476 | 17,514 | 2,905 | 0 | 864 | 22 | 0 | 185 | 34 | 236 | 109 | 0 |
| | 2018 | 35,342 | 20,351 | 2,286 | ... | | 7 | 0 | ... | ... | 315 | 215 | 0 |
| 2nd MR (SP) | 2017 | 934 | 9,204 | 309 | 2 | 1.000 | 64 | 8 | 254 | 159 | 564 | 127 | 0 |
| | 2018 | 400 | 11,465 | 209 | ... | | 104 | 2 | ... | ... | 530 | 141 | 1 |
| 3rd MR (RS) | 2017 | 63 | 176 | 14 | 0 | 9 | 2 | 6 | 10 | 6 | 494 | 13 | 0 |
| | 2018 | 45 | 93 | 6 | ... | | 3 | 2 | ... | ... | 449 | 19 | 0 |
| 4th MR (MG) | 2017 | 16,320 | 25,949 | 723 | 0 | 1.228 | 33 | 5 | 1,520 | 770 | 129 | 69 | 0 |
| | 2018 | 11,438 | 23,290 | 123 | ... | | 72 | 8 | ... | ... | 179 | 46 | 0 |
| 5th MR (PR, SC) | 2017 | 210 | 2,343 | 73 | 0 | 12 | 37 | 21 | 261 | 8 | 575 | 47 | 0 |
| | 2018 | 137 | 1,210 | 14 | ... | | 46 | 14 | ... | ... | 579 | 79 | 0 |
| 6th MR (BA, SE) | 2017 | 9,412 | 10,287 | 2,326 | 0 | 27 | 0 | 0 | 2,845 | 340 | 109 | 11 | 1 |
| | 2018 | 3,412 | 7,824 | 679 | ... | | 0 | 0 | ... | ... | 93 | 94 | 0 |
| 7th MR (RN, PB, PE, AL) | 2017 | 5,991 | 21,838 | 850 | 0 | 13 | 1 | 0 | 399 | 330 | 305 | 26 | 1 |
| | 2018 | 3,638 | 40,945 | 936 | ... | | 0 | 0 | ... | ... | 311 | 22 | 0 |
| 8th MR (PA, AP, MA) | 2017 | 15,251 | 15,799 | 1,207 | 306 | 28 | 0 | 2 | 4,988 | 1,182 | 223 | 53,354 | 0 |
| | 2018 | 6,526 | 5,809 | 297 | ... | | 1 | 10 | ... | ... | 239 | 62,009 | 10 |
| 9th MR (MS, MT) | 2017 | 3,606 | 11,523 | 2,252 | 2 | 4 | 0 | 10 | 2,335 | 148 | 21 | 604 | 0 |
| | 2018 | 13,338 | 8,273 | 629 | ... | | 1 | 5 | ... | ... | 28 | 898 | 0 |
| 10th MR (CE, PI) | 2017 | 120,423 | 44,345 | 1,527 | 0 | 2 | 1 | 0 | 441 | 642 | 28 | 35 | 0 |
| | 2018 | 1,868 | 5,286 | 106 | ... | | 2 | 0 | ... | ... | 58 | 41 | 0 |
| 11th MR (DF, GO, TO) | 2017 | 3,361 | 72,307 | 4,614 | 0 | 39 | 5 | 2 | 588 | 333 | 36 | 133 | 1 |
| | 2018 | 354 | 76,371 | 1,005 | ... | | 1 | 2 | ... | ... | 52 | 95 | 0 |
| 12th MR (AM, AC, RR, RO) | 2017 | 4,546 | 8,104 | 793 | 10 | 9 | 0 | 0 | 4,359 | 35 | 320 | 139,900 | 3 |
| | 2018 | 244 | 4,874 | 379 | ... | | 0 | 1 | ... | ... | 260 | 130,854 | 0 |
| Total | 2017 | 185,593 | 239,839 | 17,593 | 320 | | 165 | 54 | 18,185 | 3,987 | 3,041 | 194,428 | 6 |
| | 2018 | 76,742 | 205,791 | 6,669 | ... | 3.235 | 237 | 44 | ... | ... | 3,093 | 194,513 | 11 |

Source: Prepared by the authors, based on Sinan data. Note: No data available; * aggregate data 2017/18

Table 3 shows data on the incidence of zoonoses and vector diseases recorded in the military personnel and in the general population, as well as relative risk data for zoonoses and vector diseases in the military personnel in relation to the general population.

In 2017, the relative risk was higher in military personnel in the following diseases: chikungunya in the 5th MR (5.61), 7th MR (2.64), 8th MR (1.66), 10th MR (1.82) and 12th MR (7.11); dengue in the 1st MR (3.80), 2nd MR (8.24), 4th MR (4.07), 6th MR (7.50), 7th MR (5.07), 8th MR (12.81), 9th MR (2.05), 10th MR (2.06) and 12th MR (17.03); Zika in the 8th MR (34.93), 10th MR (4.49) and 12th MR (20.62); yellow fever in the 2nd MR (13.12) and 8th MR (613.94); Chagas disease in the 3rd MR and 5th MR (the relative risk value could not be determined since the incidence in the general population was zero); cutaneous leishmaniasis in the 1st MR (2.82), 5th MR (68.22), 7th MR (36.00), 8th MR (3.72) and 12th MR (2.96); visceral leishmaniasis in the 3rd MR (65), 4th MR (3.12), 7th MR (26.13), 9th MR (8.89), 10th MR (7.13) and 12th MR (21.94); leptospirosis in the 2nd MR (4.64), 3rd MR (1.49) and 8th MR (7.56); and malaria in the 2nd MR (20.71), 7th MR (108.54) and 9th MR (2.18). The relative risk in military personnel for dengue in the 5th MR (1.01) presented a value very close to 1, showing no association between exposure to the risk factor and the occurrence of the disease.

In 2018, the relative risk was higher in military personnel for the following diseases: chikungunya in the 6th MR (10.82), 7th MR (8.54), 9th MR (1.64), 10th MR (1.22) and 12th MR (9.03); dengue in the 1st MR (1.17), 4th MR (2.02), 5th MR (2.73), 7th MR (5.80), 8th MR (4.12), 10th MR (2.15) and 12th MR (11.61); Zika in the 1st MR (2.27), 6th MR (4.94), 7th MR (3.02), 9th MR (2.67), 11th MR (1.35) and 12th MR (7.76); yellow fever in the 4th MR (1.92); leptospirosis in the 5th MR (5.72) and 12th (33.90); and malaria in the 1st MR (4.82), 7th MR (379.82) and 12th MR (1.19). The relative risk for Chagas disease, cutaneous leishmaniasis and visceral leishmaniasis in the military personnel could not be estimated in relation to the general population due to the unavailability of data on the incidence in the general population (Table 3).

**Table 3 – Incidence of zoonoses and vector diseases of compulsory notification registered in the military personnel (/100 thousand) notified to the Army Health Directorate, incidence of zoonoses and vector diseases of compulsory notification registered in the general population (/100 thousand) notified to Sinan and relative risk (RR) in the military personnel, by MR, in 2017 and 2018. (continued)**

| MR/Disease Military | | Chikungunya | | | Dengue | | | Zika | | | Yellow Fever | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Military | Population | RR | Military | Population | Military | Military | Population | RR | Population | Population | RR |
| 1st MR (RJ, ES) | 2017 | 7.52 | 26.41 | 0.28 | 320.94 | 84.46 | 3.80 | 7.52 | 14.01 | 0.54 | 0 | 4.13 | 0 |
| | 2018 | 95.90 | 160.24 | 0.60 | 113.11 | 96.30 | 1.17 | 24.59 | 10.82 | 2.27 | 0 | | 0 |
| 2nd MR (SP) | 2017 | 0 | 2.07 | 0 | 168.19 | 20.41 | 8.24 | 0 | 0.68 | 0 | 29.00 | 2.21 | 13.12 |
| | 2018 | 0 | 0.88 | 0 | 16.77 | 25.18 | 0.67 | 0 | 0.46 | 0 | 0 | | 0 |
| 3rd MR (RS) | 2017 | 0 | 0.56 | 0 | 0 | 1.55 | 0 | 0 | 0.12 | 0 | 0 | 0.008 | 0 |
| | 2018 | 0 | 0.40 | 0 | 0 | 0.82 | 0 | 0 | 0.05 | 0 | 0 | | 0 |
| 4th MR (MG) | 2017 | 22.75 | 77.27 | 0.29 | 500.51 | 122.87 | 4.07 | 0 | 3.42 | 0 | 0 | 5.82 | 0 |
| | 2018 | 11.16 | 54.36 | 0.20 | 223.11 | 110.69 | 2.02 | 0 | 0.58 | 0 | 11.16 | | 1.92 |
| 5th MR (PR, SC) | 2017 | 6.46 | 1.15 | 5.61 | 12.92 | 12.79 | 1.01 | 0 | 0.40 | 0 | 0 | 0.06 | 0 |
| | 2018 | 0 | 0.74 | 0 | 17.95 | 6.57 | 2.73 | 0 | 0.08 | 0 | 0 | | 0 |
| 6th MR (BA, SE) | 2017 | 0 | 53.38 | 0 | 437.55 | 58.34 | 7.50 | 0 | 13.19 | 0 | 0 | 0.16 | 0 |
| | 2018 | 215.90 | 19.96 | 10.82 | 0 | 45.78 | 0 | 19.63 | 3.97 | 4.94 | 0 | | 0 |
| 7th MR (RN, PB, PE, AL) | 2017 | 77.61 | 29.39 | 2.64 | 543.25 | 107.14 | 5.07 | 0 | 4.17 | 0 | 0 | 0.06 | 0 |
| | 2018 | 153.18 | 17.93 | 8.54 | 1,169.75 | 201.75 | 5.80 | 13.93 | 4.61 | 3.02 | 0 | | 0 |
| 8th MR (PA, AP, MA) | 2017 | 156.56 | 94.35 | 1.66 | 1,252.48 | 97.74 | 12.81 | 260.93 | 7.47 | 34.93 | 104.37 | 0.17 | 613.94 |
| | 2018 | 0 | 39.85 | 0 | 146.07 | 35.47 | 4.12 | 0 | 1.81 | 0 | 0 | | 0 |
| 9th MR (MS, MT) | 2017 | 7.23 | 59.53 | 0.12 | 390.51 | 190.22 | 2.05 | 0 | 37.18 | 0 | 0 | 0.06 | 0 |
| | 2018 | 352.30 | 215.48 | 1.64 | 108.40 | 133.65 | 0.81 | 27.10 | 10.16 | 2.67 | 0 | | 0 |
| 10th MR (CE, PI) | 2017 | 1,794.39 | 983.87 | 1.82 | 747.66 | 362.30 | 2.06 | 56.08 | 12.48 | 4.49 | 0 | 0.02 | 0 |
| | 2018 | 18.45 | 15.14 | 1.22 | 92.25 | 42.84 | 2.15 | 0 | 0.86 | 0 | 0 | | 0 |
| 11th MR (DF, GO, TO) | 2017 | 12.11 | 29.56 | 0.41 | 290.54 | 636.02 | 0.46 | 4.04 | 40.59 | 0.10 | 0 | 0.34 | 0 |
| | 2018 | 0 | 3.09 | 0 | 335.32 | 666.93 | 0.50 | 11.84 | 8.78 | 1.35 | 0 | | 0 |
| 12th MR (AM, AC, RR, RO) | 2017 | 447.51 | 62.95 | 7.11 | 1,911.13 | 112.22 | 17.03 | 226.39 | 10.98 | 20.62 | 0 | 0.12 | 0 |
| | 2018 | 30.26 | 3.35 | 9.03 | 776.56 | 66.91 | 11.61 | 40.34 | 5.20 | 7.76 | 0 | | 0 |

(continua)

**Table 3 – Continuation**

| MR/Disease Military | | Chagas Disease | | | Cutaneous leishmaniasis | | | Visceral leishmaniasis | | | Leptospirosis | | | Malaria | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Military | Population | RR | Military | Population | RR | Military | Population | RR | Military | Population | RR | Military | Population | RR |
| 1st MR (RJ, ES) | 2017 | 0 | 0 | 0 | 2.51 | 0.89 | 2.82 | 0 | 0.16 | 0 | 0 | 1.14 | 0 | 0 | 0.53 | 0 |
| | 2018 | 0 | ... | ... | 0 | ... | ... | 0 | ... | ... | 0 | 1.49 | 0 | 4.92 | 1.02 | 4.82 |
| 2nd MR (SP) | 2017 | 0 | 0.004 | 0 | 0 | 0.56 | 0 | 0 | 0.35 | 0 | 5.80 | 1.25 | 4.64 | 5.80 | 0.28 | 20.71 |
| | 2018 | 0 | ... | ... | 0 | ... | ... | 0 | ... | ... | 0 | 1.16 | 0 | 0 | 0.31 | 0 |
| 3rd MR (RS) | 2017 | 6.51 | 0 | * | 0 | 0.09 | 0 | 3.25 | 0.05 | 65 | 6.51 | 4.36 | 1.49 | 0 | 0.12 | 0 |
| | 2018 | 0 | ... | ... | 0 | ... | ... | 3.01 | ... | ... | 0 | 3.96 | 0 | 0 | 0.17 | 0 |
| 4th MR (MG) | 2017 | 0 | 0 | 0 | 0 | 7.20 | 0 | 11.38 | 3.65 | 3.12 | 0 | 0.61 | 0 | 0 | 0.33 | 0 |
| | 2018 | 0 | ... | ... | 22.31 | ... | ... | 0 | ... | ... | 0 | 0.85 | 0 | 0 | 0.22 | 0 |
| 5th MR (PR, SC) | 2017 | 19.38 | 0 | * | 96.87 | 1.42 | 68.22 | 0 | 0.4 | 0 | 0 | 3.14 | 0 | 0 | 0.26 | 0 |
| | 2018 | 0 | ... | ... | 5.98 | ... | ... | 0 | ... | ... | 17.95 | 3.14 | 5.72 | 0 | 0.43 | 0 |
| 6th MR (BA, SE) | 2017 | 0 | 0 | 0 | 0 | 16.14 | 0 | 0 | 1.93 | 0 | 0 | 0.62 | 0 | 0 | 0.06 | 0 |
| | 2018 | 19.63 | ... | ... | 0 | ... | ... | 0 | ... | ... | 0 | 0.54 | 0 | 0 | 0.55 | 0 |
| 7th MR (RN, PB, PE, AL) | 2017 | 0 | 0 | 0 | 70.55 | 1.96 | 36.00 | 42.33 | 1.62 | 26.13 | 0 | 1.50 | 0 | 14.11 | 0.13 | 108.54 |
| | 2018 | 6.96 | ... | ... | 111.40 | ... | ... | 20.89 | ... | ... | 0 | 1.53 | 0 | 41.78 | 0.11 | 379.82 |
| 8th MR (PA, AP, MA) | 2017 | 0 | 1.89 | 0 | 114.81 | 30.86 | 3.72 | 0 | 7.31 | 0 | 10.44 | 1.38 | 7.56 | 52.19 | 330.07 | 0.16 |
| | 2018 | 0 | ... | ... | 1,071.18 | ... | ... | 19.48 | ... | ... | 0 | 1.46 | 0 | 0 | 378.61 | 0 |
| 9th MR (MS, MT) | 2017 | 0 | 0.03 | 0 | 7.23 | 38.55 | 0.19 | 21.70 | 2.44 | 8.89 | 0 | 0.35 | 0 | 21.70 | 9.97 | 2.18 |
| | 2018 | 0 | ... | ... | 0 | ... | ... | 6.78 | ... | ... | 0 | 0.45 | 0 | 0 | 14.51 | 0 |
| 10th MR (CE, PI) | 2017 | 0 | 0 | 0 | 0 | 3.60 | 0 | 37.38 | 5.24 | 7.13 | 0 | 0.23 | 0 | 0 | 0.29 | 0 |
| | 2018 | 0 | ... | ... | 0 | ... | ... | 18.45 | ... | ... | 0 | 0.47 | 0 | 0 | 0.33 | 0 |
| 11th MR (DF, GO, TO) | 2017 | 0 | 0 | 0 | 0 | 5.17 | 0 | 0 | 2.93 | 0 | 0 | 0.32 | 0 | 0 | 1.17 | 0 |
| | 2018 | 0 | ... | .. | 0 | ... | ... | 0 | ... | ... | 0 | 0.45 | 0 | 0 | 0.83 | 0 |
| 12th MR (AM, AC, RR, RO) | 2017 | 0 | 0.14 | 0 | 179.00 | 60.36 | 2.96 | 10.53 | 0.48 | 21.94 | 0 | 4.43 | 0 | 1,763.72 | 1,937.23 | 0.91 |
| | 2018 | 0 | ... | ... | 126.06 | ... | ... | 5.04 | ... | ... | 121.02 | 3.57 | 33.90 | 2,143.11 | 1,796.45 | 1.19 |

**Source**: Prepared by the authors, based on data from the Army Health Directorate, Army Statistical Yearbook, Sinan and INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (2019). Note: [...]: no data available; (*) could not be estimated.

## 4 DISCUSSION

The results show that urban arboviruses transmitted by the mosquito *Aedes* spp. (chikungunya, dengue and Zika) are the diseases with the most notifications among the military personnel, considering the years 2017 and 2018. With the exception of the 3rd MR, all MRs had reported cases of at least one of them. In general, the cases in the military personnel presented the same pattern of increase or decrease in 2018 relative to 2017 as in the general population.

Studies show that arboviruses are an occupational risk for military personnel in several countries. Gibbons *et al*. (2012) pointed out that dengue is a threat to military troops in endemic areas and that, between 1960 and 1990, dengue occurred frequently in American troops deployed in Asia, Africa and Central America, with an attack rate of up to 80%.

Frickmann and Herchenröder (2019) reviewed the literature on Chikungunya virus infections in troops from several countries on missions abroad and concluded that this disease is a real threat to military personnel deployed in endemic areas due to the mode of vector transmission and in an outbreak scenario. On the other hand, the transmission frequency appears to be low outside the outbreak scenario.

Two cases of Chagas disease were reported in the 3rd MR and three in the 5th MR in 2017, while Sinan data show that there were no cases reported in the same areas and period. Military personnel is constantly transferred and can serve anywhere in Brazil; therefore, these cases can be of professionals who have been transferred from areas with notification to places without notification history. However, the notification of cases of acute Chagas disease must be immediate (within 24 hours of care, by the fastest possible means) to the Municipal Health Department/ State Health Department. The health authority that receives the immediate mandatory notification must notify the other management spheres of the Unified Health System within 24 hours (BRASIL, 2016b). Thus, the differences between the information from the Army Health Directorate and those from the Sinan may result from the failure in the chain of notifications. The cases reported in the military personnel could not be compared to those reported by the general population in 2018, since no data on this condition were available in Sinan.

Of the nine diseases with positive reports in military personnel in 2017 and 2018, yellow fever was the one with the lowest number of reports among MRs (three). This can be explained by the fact that vaccination against yellow fever is mandatory in the military personnel (BRASIL, 2014). However, in MRs that reported it, the incidence was higher than in the general population (although the comparison was impaired because the yellow fever data in the population were not annual but seasonal). Non-compliance with mandatory vaccination, vaccine failure, interference of cases occurring in military dependents may justify the higher incidence in military personnel.

According to researchers Leggat and Frean (2006), the military personnel compose the high-risk group for yellow fever if in endemic areas. However, since there is a vaccine against this disease, the risk will be reduced if the military is vaccinated.

Izurieta *et al*. (2009) published a study with the results of an investigation of an outbreak of hemorrhagic fever in military personnel on a mission in the interior of the Ecuadorian Amazon rainforest. In total, 44 cases of yellow fever and three deaths were identified among the 341 individuals who had not been immunized. The spread of the outbreak was quickly

controlled by vaccination of military personnel who had not been affected. Detachments and outposts within the Amazon rainforest were significantly associated with yellow fever infection due to increased exposure to the transmitting mosquito.

The 8th and the 12th MRs, which cover states in the northern region of the country, showed the highest number of diseases, with the highest incidence. When transferred to one of these MRs, every soldier mandatorily performs the Adaptation Stage to Life in the Jungle, whose objective is to provide adaptation and aggregate military knowledge of combat and survival techniques in the jungle. In these MR there are other internships and operational courses, of a voluntary nature, carried out by military personnel from all over the country. These courses and internships take place in the Amazon operating environment, where there are reservoirs and vectors of leishmaniasis, leptospirosis and malaria. These soldiers usually had no previous contact with these diseases and, therefore, have no immunological memory, which makes them vulnerable. Several military personnel serve in border outposts and patrol the jungle, increasing exposure to these diseases. A study by Dhiman *et al*. (2011) corroborates these claims and points out that the high incidence of malaria in the local population also increases the risk of infection, since it functions as a reservoir for the disease. The studies by Guerra *et al*. (2003) and Lorenzi (2014), which describe outbreaks of cutaneous leishmaniasis in military personnel who participated in operational courses in the Amazon, showed similar findings to those of this research.

The high incidence of cutaneous leishmaniasis in the two years of the study in the 7th MR, which was higher than in the general population in 2017, may be associated with the training that takes place at the Newton Cavalcanti Instruction Center in the state of Pernambuco. In this location, several outbreaks have been reported according to the studies by Brandão-Filho *et al*. (1998), Andrade (2004) and Andrade *et al*. (2009).

Approximately 75% of emerging or re-emerging diseases affecting humans at the beginning of the 21st century are zoonotic diseases (BROWN, 2013). Work environments with animals increase the risk of transmission of zoonotic infections (BIENZ; TOMASZEWSKI; MCDONALD, 2018).

The risk in epidemiological surveillance is shown by the incidence. Incidence measures the risk of becoming ill due to a given disease in a given population in a given period. A high incidence means a high collective risk of getting sick (BRASIL, 2005). The relative risk estimates the magnitude of the association between exposure to the risk factor and the onset of the disease, indicating how often the occurrence of the disease in those exposed is greater than that among those not exposed (WAGNER; CALLEGARI-JACQUES, 1998). The results showed that, in 2017, the risk of military personnel becoming ill due to chikungunya was higher in five MRs; dengue in nine MRs; Zika in three MRs; Chagas disease in two MRs; yellow fever in two MRs; cutaneous leishmaniasis in five MRs; visceral leishmaniasis in six MRs; leptospirosis in three MRs, and malaria in three MRs. In 2018, the risk of the military personnel becoming ill due to chikungunya was higher in five MRs; dengue in seven MRs; Zika in six MRs; yellow fever in one MR; leptospirosis in two MRs and malaria in three MRs; Chagas disease, cutaneous leishmaniasis and visceral leishmaniasis could not be estimated in the general population due to data unavailability.

A review article prepared by Leggat (2010) concluded that even with the advance of measures to prevent tropical diseases, these continue to represent a significant risk for military troops deployed in other countries and in terms of infectious diseases, those transmitted by

vectors, in particular, malaria and arboviruses and, more recently, leishmaniasis, stand out as a major risk for the military personnel.

The causes for the increased risk of these diseases in the military personnel must be investigated. One of the hypotheses is the greater exposure to vectors and reservoirs of diseases during operational activities. Davoust, Marié and Boni (2008) pointed out that the military personnel, by their profession, take risk and constitute a group particularly exposed to zoonotic diseases during operations or training in various environments. In addition, according to these authors, they appear to be more sensitive to exotic zoonoses when they enter a new ecosystem because they do not have immunological memory. Biselli *et al*. (2022) say that the military are exposed to the risk of infectious diseases for a number of reasons, including community life, often in poor environmental conditions regarding hygiene of water and food supply, sanitation, trauma with contaminated wounds and possibility of exposure to extreme temperatures and unknown diseases at their place of origin, for which no natural immunization has therefore been developed.

### 4.1 Health protection and the role of the military veterinarian

Most of these risks can be mitigated by strict adherence to a comprehensive Force Health Protection plan. Regarding operational health, there is more than one publication that addresses preventive measures.

According to the Health Support in Joint Operations manual of the Ministry of Defense:

> Operational Health is the set of actions related to the conservation of human potential in the best conditions of physical and psychological fitness, aiming to maintain the operational capacity of a Force regarding health aspects; its scope is to mitigate the effects that diseases and injuries can generate on the efficiency, availability and morale of a troop, contributing to the fulfillment of its mission. (BRASIL, 2017a)

While there is a manual from the Ministry of Defense, there is also a Doctrinal Coordination Note (DCN) on 01/2016, prepared by the Department of Education and Culture of the Army. There, the Health Support in the Operations of the Component Ground Force can be found, whose purpose is to present the structuring of operational health in the Brazilian Army and describe the characteristics necessary for the Functional Health Group to support health operations at the Component Ground Force level. Its focus is on operative medicine, whose actions aim to minimize the effects of injuries, diseases and illnesses acquired in military operations, in addition to conducting health actions in peacekeeping missions and in response to disaster situations and humanitarian support in Brazil and abroad, with the objective of safeguarding the physical and mental health of the military and the assisted population (BRASIL, 2016a).

The NCD mentions that, to ensure the health of the military, measures of sanitary and environmental surveillance, zoonosis control, inspection of food and water consumed by the troops and preventive medicine (sanitation, hygiene, disease control, immunization and sanitary education) should be applied. It highlights health intelligence as a vital activity for the planning and success of health support in operations (BRASIL, 2016a).

Health Intelligence "deals with the collection, evaluation, analysis, interpretation and dissemination of health-related knowledge, such as environmental, medical, epidemiological, public health information" (BRASIL, 2018a), among others. It has several purposes, for example, detecting, identifying and minimizing health threats, collaborating in the search for data, contributing to measure the health and environmental risks that troops may be exposed to, with recommendations related to the protection of the health of the Force. It is useful for the development and execution of preventive medicine actions and necessary prophylactic measures (BRASIL, 2016a).

The Ground Military Logistics Field Manual, of the Land Operations Command, says that:

> Health Logistics Function is the set of activities related to the conservation of human capital in the appropriate conditions of physical and psychological fitness, through sanitary measures of prevention and recovery (BRASIL, 2018a).

In addition, it lists measures aimed at disease prevention, water analysis, purification and treatment; environmental management; and, finally, sanitary measures for prevention, sanitary control and food inspection, food safety and biological defense, control of zoonoses and pests. Among the activities of the Health Logistics Function are health protection and health intelligence. Health protection "is related to the conservation and preservation of the general health of contingents, through the prevention of diseases and injuries", through prophylactic measures and adequate sanitary conditions (sanitation, hygiene, disease control, immunization and sanitary education), among others (BRASIL, 2018a).

Prevention of disease is one of the responsibilities of command; however, the importance of health education cannot be underestimated. For the commander to play his primary role, it is necessary that the importance of prevention be emphasized for him, through the communication of environmental risks and infectious diseases for the health of the troops. This awareness has to be made by the health officer, who must assess the risks, specify the prevention and control measures of the diseases, guide the command and the troop and inspect if the measures are being complied with (LYNCH *et al*., 2014). Correct and timely perception of the threat is essential, as protective behavior is linked to risk perception. This can be achieved if the soldier has real knowledge about the risk to which they are exposed, if a health team is available to pass on this knowledge and oversee its execution, if the command is committed to ensuring that protection and control measures are complied with.

Another fundamental factor is the availability of health data for the correct dimensioning of risk and prevention planning by the health team (KUNWAR; PRAKASH, 2015). The awareness of each military is important as disease prevention and control measures are not intuitive, and the risk will not be reduced if not implemented or poorly executed. The importance of prevention must be constantly reinforced by theoretical and practical instructions. The commander should work closely with the health officer and his team (CROFT; BAKER ; VON BERTELE, 2001). Campaign manuals with these guidelines must be published. The military veterinarian, as a health officer, may exercise this function with the commander.

The veterinarian has a wide range of activities such as prevention and treatment of animal diseases, hygiene and inspection of animal products, animal health defense, public

health (control and eradication of zoonotic infections, food safety), environmental and ecological preservation. The veterinarian's training presents a multidisciplinary nature, enabling the professional to work both with humans and with animals, especially when it comes to public health. Moreover, the veterinarian has a fundamental role in the promotion, prevention and assistance to human, animal, and environmental health (POSSAMAI, 2011).

In the military sphere, there are several activities related to the health of the personnel that can be performed by a veterinarian, both in peacetime and in operations. These activities involve food security, prevention of waterborne diseases, control of zoonotic infections, control of pests and vectors, and health intelligence (MARQUES; ANDRADE LIMA, 2016).

According to the Ground Military Logistics Campaign Manual, the

> Veterinary officer acts with the objective of preserving the health of the troop, through sanitary and environmental surveillance measures, water and food inspection and control of zoonotic infections and pests. It also performs clinical and surgical treatment of work animals used in military operations, as well as composes multidisciplinary health teams, in order to evaluate the possible health threats inherent to the operational environment. (BRASIL, 2018a)

To reduce the risk of the troop becoming ill, MRs need to employ the ability of the veterinarian to control the biological risks to the health of the troop: to carry out epidemiological surveillance of the areas in which the OMs are located and where operations occur; depending on the biological risks identified, to propose prevention and control measures for the troop, especially those related to vectors and zoonotic diseases; to carry out sanitary surveillance of the facilities where food is produced and stored, as well as to carry out the inspection of the food itself, including the quality of the water consumed; to control vectors, pests and rodents; to propose measures to avoid and/or reduce environmental damage arising from military activities; to carry out the planning of troop sanitary education, with matters related to protection against vectors, rodents and venomous animals, care with storage and consumption of food and water and the importance of good personal hygiene.

## 5 CONCLUSION

We found that, for some diseases and in some regions of the country, the risk of getting sick is higher in the military personnel than in the general population, especially concerning vector diseases. According to the data analyzed in this article, the main biological risks to which military personnel were exposed to were those caused by chikungunya, dengue, Zika, Chagas disease, yellow fever, cutaneous leishmaniasis, visceral leishmaniasis, leptospirosis, and malaria.

The main hypothesis for this risk is the greater exposure to reservoirs and vectors of zoonotic infections during the performance of their activities, especially those of operational nature. However, more studies are needed to confirm and deepen these results.

Among the limitations of the research, we can mention the difficulties of obtaining data on diseases in the general population, since for some of them there was no information

regarding 2018. In addition, we face the lack of standardization of elements or provision of seasonal information, such as for the systematization of yellow fever. We also had to deal with the unavailability of data by category of workers, which otherwise would have resulted in a more reliable comparison between populations, since the comparison made in this article was between the military (population of workers aged 18-60 years) and the general population (range 0-90 years). Finally, by surveying the diseases that affect the military personnel, we found data on some compulsory notification diseases; however, it was not possible to identify if all reported cases occurred in active-duty military personnel, since military hospitals also serve reserve military personnel and military dependents.

The military veterinarian is qualified to exercise the role of health officer in the prevention and control of biological risks, as the veterinarian is a professional qualified for this task due to the multidisciplinary nature of the career, conferring knowledge about human, animal and environmental health.

## AUTHORSHIP AND COLLABORATIONS

All authors participated equally in elaborating the article.

## REFERENCES

ANDRADE, M. S. **Epidemiologia da leishmaniose tegumentar americana em centro de treinamento militar na Zona da Mata de Pernambuco, Brasil**. 2004. Dissertação (Mestrado em Saúde Pública) – Departamento de Saúde Coletiva, Fundação Osvaldo Cruz, Recife, 2004. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/lil-398490. Access: March 27, 2023.

ANDRADE, M. S. *et al*. Novo surto de leishmaniose tegumentar americana em área de treinamento militar na Zona da Mata norte do Estado de Pernambuco. **Revista da Sociedade Brasileira de Medicina Tropical**, Uberaba, v. 42, n. 5. p. 594-596, 2009. Available from: https://www.scielo.br/j/rsbmt/a/cx9CS4dDFJ3y6XRw5GfzsrH/abstract/?lang=pt. Access: March 27, 2023.

BIENZ, M.; TOMASZEWSKI, M.; MCDONALD, E. G. Severe pet-transmitted zoonosis in a patient with a compromised immune system. **Canadian Medical Association Journal**, Ottawa, v. 190, n. 45, p. 1332–1336, 2018. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6232001/. Access: March 27, 2023.

BISELLI, R. *et al*. A historical review of military medical strategies for fighting infectious diseases: from battlefields to global healths. **Biomedicines**, Bethesda, v. 10, n. 8, p. 2050, 2022. Available from: https://pubmed.ncbi.nlm.nih.gov/36009598/. Access: March 27, 2023.

BRANDÃO-FILHO, S. P. *et al*. Leishmaniose tegumentar americana em centro de treinamento militar localizado na Zona da Mata de Pernambuco, Brasil. **Revista da Sociedade Brasileira de Medicina Tropical**, Uberaba, v. 31, n. 6, p. 575-578, 1998. Available from: https://www.scielo.br/j/rsbmt/a/SGdhxZYj5hSfZzGByp475Nj/?lang=pt. Access: March 27, 2023.

BRASIL. Ministério da Saúde. Organização Pan-Americana de Saúde. **Doenças relacionadas ao trabalho**: manual de procedimentos para os serviços de saúde. Brasília, DF: Ministério da Saúde, 2001. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/doencas_relacionadas_trabalho_manual_procedimentos.pdf. Access: March 27, 2023.

BRASIL. Ministério da Saúde. **Curso Básico de Vigilância Epidemiológica**. Brasília, DF: Ministério da Saúde, 2005. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/Curso_vigilancia_epidemio.pdf. Access: March 27, 2023.

BRASIL. Ministério do Trabalho. **Riscos Biológicos – Guia Técnico: os riscos biológicos no âmbito da Norma Regulamentadora no** 32. Brasília, DF: Ministério do Trabalho, 2008.

BRASIL. Ministério da Defesa. **Portaria Normativa no 1.631 – Ministério da Defesa, de 27 de junho de 2014**. Institui o Calendário de Vacinação Militar. Brasília, DF: Ministério da Defesa, 2014. Available from: https://mdlegis.defesa.gov.br/norma_pdf/?NUM=1631&ANO=2014&SER=A. Access: March 27, 2023.

BRASIL. Ministério da Defesa. Brazilian Army. **Portaria no 206 – Departamento de Educação e Cultura do Exército, de 28 de novembro de 2016**. Nota de Coordenação Doutrinária nº 01/2016-DECEx, o Apoio de Saúde nas Operações da Força Terrestre Componente. Brasília, DF: Ministério da Defesa, 2016a. Available from: http://www.sgex.eb.mil.br/sg8/006_outras_publicacoes/07_publicacoes_diversas/08_departamento_de_educacao_e_cultura_do_exercito/port_n_206_decex_28nov2016.html. Access: March 27, 2023.

BRASIL. Ministério da Saúde. **Portaria n° 204, de 17 de fevereiro de 2016**. Define a Lista Nacional de Notificação Compulsória de doenças, agravos e eventos de saúde pública nos serviços de saúde públicos e privados em todo território nacional, nos termos do anexo, e dá outras providências. Brasília, DF: Ministério da Saúde, 2016b. Available from: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2016/prt0204_17_02_2016.html. Access: March 27, 2023.

BRASIL. Ministério da Defesa. Estado-Maior Conjunto das Forças Armadas. **Instrução Normativa nº 2/EMCFA, de 10 de agosto de 2017**. Aprova o Manual Apoio de Saúde em Operações Conjuntas – MD42-M-04 (1ª Edição/2017). Brasília, DF: Ministério da Defesa, 2017a. Available from: https://www.gov.br/defesa/pt-br/arquivos/legislacao/emcfa/publicacoes/logistica_mobilizacao/md42a_ma_04a_apoioa_dea_saudea_opa_cja_1a_eda_2017.pdf. Access: March 27, 2023.

BRASIL. Ministério da Saúde. **Emergência epidemiológica de febre amarela no Brasil, no período de dezembro de 2016 a julho de 2017**. Boletim Epidemiológico, v. 48, n. 28. Brasília, DF: Ministério da Saúde, 2017b.

BRASIL. Ministério da Defesa. Brazilian Army. **Portaria no 131 – Comando de Operações Terrestres, de 8 de novembro de 2018**. Aprova o Manual de Campanha EB70-MC 10.238 Logística Militar Terrestre. Brasília, DF: Ministério da Defesa, 2018a. Available from: http://www.sgex.eb.mil.br/sg8/003_manuais_carater_doutrinario/01_manuais_de_campanha/port_n_131_coter_08nov2018.html. Access: March 27, 2023.

BRASIL. Ministério da Saúde. **Monitoramento do período sazonal de febre amarela Brasil – 2017/2018**. Informe n. 3, outubro de 2018. Brasília, DF: Ministério da Saúde, 2018b.

BRASIL. Ministério da Defesa. Exército. **O Exército em números (Anuário Estatístico do Exército)**. Brasília, DF: Ministério da Defesa, 2019a. Available from: http://sistemaslegado2.eme.eb.mil.br/anuario-estatistico/home/tabelas_por_assunto/25. Access: Sept. 11, 2019.

BRASIL. Ministério da Saúde. **Monitoramento do período sazonal de febre amarela Brasil – 2018/2019**. Informe n. 27, janeiro de 2019. Brasília, DF: Ministério da Saúde, 2019b.

BRASIL. Ministério da Saúde. **Monitoramento dos casos de arboviroses urbanas transmitidas pelos *Aedes* (dengue, chikungunya e Zika), Semanas Epidemiológicas 1 a 34**. Boletim Epidemiológico, v. 50, n. 22. Brasília, DF: Ministério da Saúde, 2019c.

BRASIL. Ministério da Saúde. **Monitoramento dos casos de dengue, febre de chikungunya e doença aguda pelo vírus Zika até a Semana Epidemiológica 52 de 2018**. Boletim Epidemiológico. v. 50, n. 4. Brasília, DF: Ministério da Saúde, 2019d.

BRASIL. Ministério da Saúde. Sala de Apoio à Gestão Estratégica. **gov.br**. Brasília, DF, 2019e. Available from: http://sage.saude.gov.br/#. Access: Sept. 11, 2019.

BRASIL. Ministério da Saúde. Saúde de A a Z. **gov.br**. Brasília, DF, 2019f. Available from: http://www.saude.gov.br/saúde-de-a-z. Access: Sept. 11, 2019.

BRASIL. Ministério da Saúde. Vigilância em Saúde. Doenças e Agravos de Notificação – De 2007 em diante (Sinan). **gov.br**. Brasília, DF, 2019g. Available from: http://www2.datasus.gov.br/DATASUS/index.php?area=0203&id=29878153. Access: Sep. 11,2019.

BRAZ, M. B. M. **O dano endotelial, tubular e de glicocálice na lesão renal aguda da leptospirose**. 2014. Dissertação (Mestrado em Clínica Médica) – Faculdade de Medicina, Universidade Federal do Ceará, Fortaleza, 2014.

BROWN, J. Emerging Pandemic Threats. **United States Agency for International Development**, Washington, DC, 2013. Available from: https://www.usaid.gov/news-information/fact-sheets/emerging-pandemic-threats-program. Access: Sept. 02, 2019.

CENTRO ROSA DA FONSECA. **Centro Rosa da Fonseca**, 2023. Regiões Militares. Available from: https://rosadafonseca.org/regioes-militares/. Access: Sep. 10, 2023

CROFT, A. M.; BAKER, D.; VON BERTELE, M. J. An evidence-based vector control strategy for military deployments: the British Army experience. **Médecine Tropicale**, Bordeaux, v. 61, n. 1, p. 91-98, 2001.Available from: https ://pubmed.ncbi.nlm.nih.gov/11584666/. Access: March 27,2023.

DAVOUST, B.; MARIÉ, J. L.; BONI, M. Pour une approche préventive des zoonoses: la création d'une cellule de détection précoce des infections animales. **Bulletin de l'Académie Nationale de Médecine**, Paris, n. 3, v. 192, p. 541-554, 2008. Available from: https://www.sciencedirect.com/science/article/pii/S0001407919328110. Access: March 27, 2023.

ANDRADE LIMA, J. R. P. Saúde única e operacionalidade nas missões de paz: o papel estratégico do veterinário militar. **Military Review**, Fort Leavenworth, v. 71, n. 1, p. 29-37, 2016.

DE LORENZI, A. G. **Medicina operativa: perspectivas. Defesa Biológica em situações de conflito e em tempos de paz**. 2014. Monografia (Curso de Política e Estratégia Marítimas) – Escola de Guerra Naval, Rio de Janeiro, 2014.

DHIMAN, S. *et al*. Malaria incidence among paramilitary personnel in an endemic area of Tripura. **Indian Journal of Medical Research**, Mumbai, v. 133, n. 6, p. 665-669, 2011. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3135997/. Access: March 27, 2023.

FRICKMANN, H.; HERCHENRÖDER, O. Chikungunya Virus Infections in Military Deployments in Tropical Settings—A Narrative Minireview. **Viruses**, Bethesda, n. 6, v. 11, p. 550, 2019. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6631184/. Access: March 27, 2023.

GIBBONS, R. D. *et al*. Dengue and US Military Operations from the Spanish-American War through today. **Emerging Infectious Diseases**, Bethesda, v. 18, n. 4, p. 623-630, 2012. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3309667/. Access: March 27, 2023.

GUERRA, J. A. O. *et al*. Aspectos clínicos e diagnósticos da leishmaniose tegumentar americana em militares simultaneamente expostos à infecção na Amazônia. **Revista da Sociedade Brasileira de Medicina Tropical**, Uberaba, v. 36, n. 5, p. 587-590, 2003. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/lil-348030. Access: March 27, 2023.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **População residente enviada ao Tribunal de Contas da União Brasil, Grandes Regiões e Unidades da Federação – 2001-2018**. Rio de Janeiro: IBGE, 2019. Available from: https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?=&t=resultados. Access: Sept. 10,2019.

IZURIETA, R. O. *et al*. Assessing yellow Fever risk in the Ecuadorian Amazon. **Journal of Global Infectious Diseases**, Bethesda, v. 1, n. 1, p. 7-13, 2009. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2840941/. Access: March 27,2023.

KUNWAR, R.; PRAKASH, R. Dengue outbreak in a large military station: have we learnt any lesson? **Medical Journal Armed Forces India**, Pune, v. 71, n. 1, p. 11-14, 2015. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4297823/. Access: March 27, 2023.

LEGGAT, P. A. Tropical Diseases of Military Importance: A Centennial Perspective. **Journal of Military and Veterans Health**, Melbourne, v. 18, n. 4, p. 25-31, 2010. Available from: https://search.informit.org/doi/abs/10.3316/INFORMIT.894607197197058. Access: March 27,2023.

LEGGAT, P. A.; FREAN, J. Health countermeasures for military deployment. **Occupational Health Southern Africa**, Johannesburg, v. 12, n. 2, p. 4-11, 2006. Available from: https://researchonline.jcu.edu.au/4163/. Access: March 27, 2023.

LYNCH, J. H. *et al*. Bites, stings, and rigors: clinical considerations in African operations. **Journal of Special Operations Medicine**, Petersburg, v. 14, n. 4, p. 113-121, 2014. Available from: https://prolongedfieldcare.org/wp-content/uploads/2016/02/jsom-2014-this-is-africa-bites-stings-and-rigors-clinical-considerations-in-african-operations.pdf. Access: March 27, 2023.

MACEDO, P. A.; PETERSON, R. K.; DAVIS, R. S. Risk assessments for exposure of deployed military personnel to insecticides and personal protective measures used for disease-vector management. **Journal of Toxicology and Environmental Health A**, London, v. 70, n. 20, p. 1758-1771, 2007. Available from: https://pubmed.ncbi.nlm.nih.gov/17885933/. Access: March 27,2023.

MARASCHIN, M. S.; ESTRELA, S. V. B.; FERREIRA, M. F. A. P. L. Ocorrência atípica de casos de leptospirose no município de Cascavel/PR. **In**: SEMINÁRIO NACIONAL ESTADO E POLÍTICAS SOCIAIS NO BRASIL, 2., 2005, Cascavel. **Anais** [...] Cascavel: Universidade Estadual do Oeste do Paraná, 2005.

MARQUES, F. S.; DE ANDRADE LIMA, J. R. P. O veterinário militar como partícipe do processo one health. **Revista Interdisciplinar de Ciências Aplicadas à Atividade Militar**, Salvador, v. 6, n. 1, 2016. Available from: http://www.ebrevistas.eb.mil.br/RICAM/article/view/1190. Access: March 27, 2023.

PAGES, F. *et al*. The past and present threat of vector-borne diseases in deployed troops. **Clinical Microbiology and Infection**, Amsterdam, v. 16, n. 3, 2010. Available from: https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X(14)60825-9/fulltext. Access: March 27,2023.

POSSAMAI, M. H. P. O papel do médico veterinário na educação e formação na vigilância ambiental em saúde. **Revista Electrónica de Investigación y Docencia**, Lagunilla, n. 1, p. 59-73, 2011. Available from: https://revistaselectronicas.ujaen.es/index.php/reid/article/view/1139. Access: March 27, 2023.

WAGNER, M. B.; CALLEGARI-JACQUES, S. M. Medidas de associação em estudos epidemiológicos: risco relativo e odds ratio. **Jornal de Pediatria**, Rio de Janeiro, v. 74, n. 3, p. 247-251, 1998. Available from: https://lume.ufrgs.br/handle/10183/54354. Access: March 27,2023.