

# Alimentary Infections during War Conditions: Mostar and Tomislavgrad, Bosnia and Herzegovina, 1992–1995

Ivo Curić<sup>1</sup>, Snježana Curić<sup>2</sup>, Ivan Bagarić<sup>1</sup> and Nikola Bradarić<sup>3</sup>

<sup>1</sup> Department for Infectious Diseases, Clinical Hospital »Mostar«, Mostar, Bosnia and Herzegovina

<sup>2</sup> Department of Family Medicine, Primary Health Care »Mostar«, Mostar, Bosnia and Herzegovina

<sup>3</sup> Department for Infectious Diseases, University Hospital »Split«, Split, Croatia

## ABSTRACT

*The aim of this study was to assess the outcome of sanitary and epidemiologic measures undertaken in relation to alimentary infections in the military corps of the Croatian Defense Council (Hrvatsko vijeće obrane) and civilian population in Mostar and Tomislavgrad regions during the 1992–1995 War in Bosnia and Herzegovina. A total of 25 (4.8%) of soldiers and 7 (7.1%) of non-military personnel were not being granted medical clearance to be employed in the food provision services. We recorded a total of 68 alimentary infections cases in military personnel (with an incidence of 536,2 per 100,000 persons), and 436 in civilian population (573,9 per 100,000 person), without significant difference between them ( $p=0.647$ ). We did not record any alimentary infection outbreak in the military personnel, while two smaller epidemics of the abdominal typhus were recorded among civilian populations, but without lethal outcomes. The results of this study suggest that even the most basic adherence to the principle of standard sanitary and epidemiologic preventive measures may substantially reduce the probability of alimentary infections outbreaks, even in the highly disruptive, warfare environment.*

**Key words:** food provision, alimentary infection, Mostar, Tomislavgrad, Bosnia and Herzegovina, war

## Introduction

The War in Bosnia and Herzegovina was a tragic outcome of the preceding disintegration processes within the former Yugoslavia<sup>1–6</sup>. The deterioration of the system of defense that was under the control of legal governance in Republic of Bosnia and Herzegovina resulted in the inability of this ex-Yugoslav republic to defend its sovereignty and offer physical protection to the all ethnic groups that resided there<sup>5–8</sup>. Military actions of the Serbia and Montenegro's paramilitary groups, supported by the logistics, equipment and personnel from the Yugoslav national army, invaded Bosnia and Herzegovina, which at the time practically had no military power of its own, and was without organized military health system, military tactics and without experts that were capable to manage preventive and medical services for the war. In the region with predominantly Croatian population, a dual health system was formed within the remnants of the previous health system. The duality of the newly formed

health system resided in the simultaneous support to both military personnel and to civilian population<sup>8,9</sup>. One of the priority areas for the newly formed health provider was the prevention of the alimentary infections, with special attention being given to the water supplies and food provision services. The surveillance was carried out according to the existing legal requirements<sup>10–17</sup>, military based recommendations<sup>18</sup>, available literature findings<sup>19–22</sup> and guidelines<sup>23</sup> for the use of disinfection, pest control and rat control.

The aim of this paper is to assess the outcome of sanitary and epidemiologic measures that were employed in the Mostar and Tomislavgrad regions during the 1992–1995 war. Additionally, we aimed to report and compare the incidence of the alimentary infections in the investigated period between the military personnel and civilian population.

## Material and Methods

### Setting

Mostar and Tomislavgrad region was consisted of 6,953 km<sup>2</sup> in 1991<sup>24</sup> (Figure 1). A total of 410,767 persons were registered during the 1991 Census, with 25,286 (6.2%) inhabitants being temporarily absent due to employment in the developed countries<sup>24</sup>. Area under the study is characterized by the arid karst, lack of the surface water sources and agricultural areas, small and low quality pastures and rare forest regions. Such infertile areas cover approximately 80% of the entire region<sup>24</sup>.

In this study we employed a retrospective cohort design<sup>25</sup>. The cohort included 88,658 men from the Mostar and Tomislavgrad region, aged 20–54<sup>25</sup>. Two classes were formed within the cohort. The first class contained those directly exposed to war events (military personnel), and it included 12,682 men registered as serving within the Croatian Defense Council<sup>26</sup>. The remaining 75,976 men from the region were civilians and they were formed the second class of the examinees<sup>24</sup>.

### Sources of information

The main information sources for this study were the medical records of the military personnel and civilian population. We collected information from the infectious disease reports, general practitioner records and medical facilities protocols. We also used Institute for Public Health and Registries as the information sources. Additionally, we used patient information from the transfusion and clinical microbiology wards from the wartime hospitals from Mostar and Livno, as well as Clinical Hospital in Split, Croatia (some of the patients were hospitalized there). The information was further supplemented with the Infectious Diseases periodicals of the Intercounty Public Health Institute from Mostar<sup>27</sup>.



Fig. 1. Map of the area under study.

The 1991 Census data was used as the source of demographic data<sup>25</sup>, further supplemented from the Surveillance Register for certain employees from the Intercounty Public Health Institute in Mostar<sup>28</sup>. Information on the food and water status was obtained from the Intercounty Institute for Public Health<sup>29</sup> and Central Archive of the Croatian Defense Council<sup>30</sup>. Military personnel documentation was also used, with sickness and death records, military personnel medical charts, military corps medical history data, and various other Registry information<sup>30</sup>.

### Measurements

We investigated the occurrence of alimentary infections, including acute enterocolitis, salmonellosis, other alimentary infections, helminthiasis, dysentery, acute viral hepatitis A, and abdominal typhus. Preventive actions were presented through the measures in the food provision services, which were closely related to the possible spread and outbreak of the infective diseases. These included two main elements: 1) food provision services surveillance, including health check-ups, fecal swab check-ups, microbiological food provision facilities swabs, and 2) surveillance of the stored food and materials<sup>12,14–16</sup>.

Rat control was primarily carried out by the environmental sanitation measures<sup>21,22</sup>, further supplemented by the anticoagulant-based rat poison, mechanical measures (traps), and increased biological agents (cats). Pest control was obtained by the 0.5% permethrin powder, 0.2% lindane solution and 2% malathion solution<sup>22</sup>. Disinfection of the working surfaces in food provision facilities was carried out with Isosane<sup>®</sup> (triclosene sodium, Pliva, Zagreb), in the concentration of 20 g per 100 liters of water<sup>23</sup>.

### Statistical analysis

Several epidemiologic measures were calculated<sup>24</sup>: cumulative incidence and relative risk, expressed as the estimate and 95% confidence intervals. Chi-square test was used in the analysis of categorical data. Statistical Package for the Social Sciences (SPSS) was used, with significance level set at  $p < 0.01$ .

## Results

A total of 517 soldiers were recruited into the food provision services during the investigated period. Among them, 25 (4.8%) were immediately excluded from the services, as they hadn't had a medical clearance to work in the food provision services. Additionally, 7 non-military individuals (7.1%) were also excluded from the civilian food provision services. We did not detect significant differences between these two groups ( $p = 0.483$ ).

A total of 583 individuals were microbiologically surveyed (nose and pharynx swabs), out of which a total of 492 (84.4%) were military personnel, while remaining 91 (15.6%) were civilians. We did not detect significant differences between these two groups (Table 1).

In order to assess microbiological status a total of 2,216 microbiological swabs were taken from the food

provision facilities, with 1,414 from the military facilities, and 802 from the civilian food provision facilities. A total of 183 items from the military food supplies and 217 items from the civilian food supplies were screened for this purpose.

We did not detect any significant differences between swabs (nose, throat, hands and fecal) between military and civilian food provision services (Table 1). We did not detect significant differences between the two investigated groups in either microbiological swabs, or microbiological and chemical status of the food (Table 1). Additionally, we didn't detect significant differences in various food components (animal or plant food, additives and

ready meals) as shown in Table 2. Finally, we also didn't detect significant differences in the alimentary infections incidence between the two categories of examinees included in the large cohort (Table 3).

## Discussion

The results of this study suggest no difference between safety of military and civilian food provision services during the 1992–1995 war, regarding those individuals who were excluded from the food provision services. Additionally, microbiological status of military and civilian food provision services seems not to have significant

**TABLE 1**  
EMPLOYEES AND EQUIPMENT SWABS AND STORED FOOD QUALITY IN CROATIAN DEFENSE COUNCIL AND CIVILIAN POPULATION IN THE MOSTAR AND TOMISLAVGRAD REGION, DURING THE 1992–1995 WAR

	Croatian Defense Council		Civilian population		p
	Total (N)	Failed to satisfy the legal requirements; N (%)	Total N	Failed to satisfy the legal requirements; N (%)	
Employees' swabs*					
Nose swab	492	39 (7.9)	91	8 (8.8)	0.945
Throat swab	492	26 (5.3)	91	6 (6.6)	0.800
Fecal swab	492	4 (0.8)	91	2 (0.7)	0.524
Hand swabs	124	16 (13)	29	5 (17)	0.755
Equipment swabs*					
Food preparation surfaces	371	141 (38)	259	102 (45)	0.790
Food preparation equipment	371	98 (26)	259	75 (33)	0.540
Dishes	548	81 (15)	255	44 (20)	0.436
Stored food status†					
Microbiological status	183	17 (9.3)	217	25 (12)	0.574
Chemical status	183	19 (10)	217	30 (14)	0.372

\* According to the Guidelines for the medical clearance for people who are subjected to medical examination and control <sup>(12,14)</sup>,

† According to the Guidelines for the health control of the food supplies <sup>(15,16)</sup>

**TABLE 2**  
NUMBER OF INAPPROPRIATE ITEMS IN STORED FOOD IN CROATIAN DEFENSE COUNCIL AND CIVILIAN POPULATION IN THE MOSTAR AND TOMISLAVGRAD REGION, DURING THE 1992–1995 WAR

Food type	Failed to satisfy the legal requirements; N (%)*			p†
	Total	Croatian Defense Council	Civilian population	
Animal origin	15 (7.2)	6 (6.4)	9 (7.8)	0.894
Plant origin	37 (13)	16 (11)	21 (14)	0.453
Additives	9 (17)	3 (13)	6 (20)	0.713
Ready meals	30 (12)	11 (11)	19 (9.5)	0.714
Total	91 (11)	36 (9.8)	55 (13)	0.251

\*According to the Guidelines for the health control of the food supplies <sup>(15,16)</sup>,

† Differences between the Croatian Defense Council and civilian population,  $p < 0.01$  was considered significant

**TABLE 3**  
NUMBER OF REGISTERED ALIMENTARY INFECTIONS IN AMONG MILITARY PERSONNEL AND CIVILIAN POPULATION IN THE MOSTAR AND TOMISLAVGRAD REGION, DURING THE 1992–1995 WAR

Alimentary infections	Number (incidence rate per 100,000)		RR (95% CI)	p <sup>†</sup>
	Croatian Defense Council	Civilian population		
Acute enterocolitis	33 (260.2)	190 (250.0)	1.04 (0.72–1.51)	0.908
Salmonellosis	13 (102.5)	106 (139.5)	0.74 (0.41–1.31)	0.356
Other alimentary infections	14 (110.4)	66 (86.8)	1.27 (0.71–2.62)	0.511
Helminthiasis	3 (23.7)	26 (34.2)	<0.69 (0.21–2.38)	0.731
Dysenteric syndrome	2 (15.8)	23 (30.3)	0.52 (0.12–2.21)	0.539
Acute viral hepatitis A	2 (15.8)	23 (30.3)	0.52 (0.12–2.21)	0.539
Abdominal typhus	1 (7.9)	2 (2.6)	3.00 (0.27–33.03)	0.907
Total	68 (536.2)	436 (573.9)	0.93 (0.72–1.21)	0.647

<sup>†</sup> Differences between the Croatian Defense Council and civilian population,  $p < 0.01$  was considered significant

tly varied. One of the possible reasons for lack of differences between these groups might be related to the possibility that some of these people who were mobilized worked in the food provision service prior to the war. Additional difficulty related to their working conditions was the proximity to the warfare. Lack of differences in the stored food status might be related to the same sources of both military and civilian supplies, and the same sanitary and storage principles that were applied in storing and handling these supplies<sup>15,16,18</sup>.

Warfare conditions can substantially disrupt water supply, increasing the chances of acquiring alimentary infections, and enabling their fast and widespread outbreaks, especially in military personnel<sup>31–33</sup>. The situation may be further aggravated by being stationed in the regions that are endemic to certain alimentary infection diseases, complicated by the lack of sufficient water supplies for both drinking and both fecal and other waste disposal<sup>31–36</sup>. Other negative factors include insufficient diet, difficulties in exercising daily hygiene (and lack of daily hygiene in extreme cases), with reduced immune responsiveness to external causes due to prolonged psycho-physical stress, as well as lack of the appropriate vaccines<sup>33,36–40</sup>. This may be the reason why military personnel experienced higher rates of vaccination diseases than civilians<sup>36–38</sup>. According to literature findings from other warfare, we expected to encounter increased incidence rates of alimentary infections among military personnel, especially in those diseases that involve fecal-oral disease transmission<sup>34–38</sup>. However, the results of this study deny such association, even suggesting lower incidence of alimentary infections in military personnel. The lack of significant differences was recorded for all investigated alimentary infection causes. These results confirm previous reports that typhus is no longer a disease that may cause severe outbreaks, although failures in water chlorination may have severe consequences, as per findings from the neighboring Vitez county during the war<sup>32,33, 39,40</sup>.

We did not detect a single disease outbreak in military personnel during the investigated period, but we did de-

tect two smaller abdominal typhus outbreaks among civilian population<sup>27,30,39,40</sup>. Refugees from the Jajce region (Vitez county) were affected in both outbreaks, which probably ingested contaminated water during their refuge<sup>39,40</sup>. Total of 20 individuals were affected in the first outbreak, in 1992<sup>27,39</sup>. Second outbreak was recorded in January 1993, affecting a total of 10 individuals<sup>27,40</sup>. *Salmonella typhi* fagotype A biotype II was isolated from both outbreaks<sup>39,40</sup>. One of the affected individuals was later involved in the military corps<sup>30</sup>. This person was a refugee from Jajce, who was later mobilized into the military service. Overall, both outbreaks were successfully controlled, without secondary disease cases.

The totalitarian nature of the war in Bosnia and Herzegovina was marked by the ethnic cleansing and mass destruction<sup>4,5,7</sup>, destroying numerous factories, hospitals, medical and cultural objects, but also water provision facilities and sewer systems<sup>41–44</sup>. The blow affected agricultural sector as well, disrupted communication system and transport<sup>4,5,7</sup>. Consequently, individual hygiene measures were diminished and epidemiological situation worsened<sup>4,5,7,8</sup>. Psycho-physical weariness of the population and military personnel with difficulties in deploying appropriate surveillance and preventive measures warranted increased chances of alimentary disease outbreaks<sup>34–36</sup>. The investigated region is known for its difficulties in the fresh water supply<sup>45</sup> and endemic typhus regions<sup>7,34</sup>, the warfare seemed to have created a favorable conditions for typhus outbreaks from both natural reservoirs and human carriers. This was further complicated by the »salvage pathways«<sup>5,7</sup> and small local water supply systems that are irregularly maintained<sup>45</sup>, alimentary infections outbreaks were almost inevitable<sup>36</sup>.

However, the results of this study alone may not be used in the direct evaluation of the sanitary and preventive measures. Nevertheless, it seems that rigorous and continuous exercising of the available preventive measures in both military personnel and civilian population had a favorable effect on the population health, especially in reducing the incidence of alimentary infections<sup>32,33</sup>.

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I. Curić

Clinical Hospital Mostar, Kardinala Stepinca b.b. 88000 Mostar, Bosnia and Herzegovina  
e-mail: snjezanacu@yahoo.com

## CRIJEVNE INFEKCIJE U RATNIM UVJETIMA: MOSTAR I TOMISLAVGRAD, BOSNA I HERCEGOVINA, 1991.–1995. GODINE

### SAŽETAK

Svrha ovog istraživanja bila je provesti analizu provedenih higijensko-sanitarnih mjera i incidencije crijevnih zaraznih bolesti u vojnim postrojbama Hrvatskog vijeća obrane (HVO-a) i civilnom pučanstvu na zbornim područjima Mostar i Tomislavgrad tijekom ratnog razdoblja, od 1992. do 1995. godine. U istraživanom razdoblju 25 (4,8%) vojnika i 7 (7,1%) civilnog osoblja nije obavilo obavezni liječnički pregled za rad u pripremi hrane. Zabilježeno je 68 alimentarnih infekcija među vojnicima (incidencija 536,2 and 100.000 osoba) i 436 među civilima (573,9 na 100.000 osoba), bez statistički značajne razlike među njima ( $p=0,647$ ). Nije zabilježen niti jedan slučaj epidemije među vojnicima, dok su dvije manje epidemije trbušnog tifusa zabilježene među civilnim stanovništvom, ali bez zabilježenih smrtnih ishoda. Rezultati ukazuju na to da pridržavanje temeljnih higijensko-epidemioloških mjera može značajno utjecati na pojavnost alimentarnih infekcija, čak i u ratnim uvjetima.