



CHRONIC MEDICAL CONDITIONS IN CROATIAN WAR VETERANS COMPARED TO THE GENERAL POPULATION: 25 YEARS AFTER THE WAR

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SUMMARY – Many published reports have documented an increased prevalence of chronic medical conditions among veterans, but there were only a few studies that compared these increases with the general population. The aim of this study was to determine differences in chronic medical conditions between Croatian war veterans and the general population. This study included two groups of subjects, i.e. 1453 participants who are Croatian war veterans and 1429 participants from the general population. Medical history, physical examination, laboratory tests and specific diagnostic procedures were taken during systematic physical examination in both groups. The prevalence of hypertension, diabetes, hyperlipidemia, hypothyroidism and hyperthyroidism, chronic obstructive pulmonary disease, coronary heart disease, malignancy, psychiatric diseases, cholelithiasis, nephrolithiasis, smoking and alcohol consumption was analyzed. Croatian war veterans were found to be more likely to develop hypertension than individuals in the general population (29.5% vs. 24.3%), as well as diabetes (7.3% vs. 3.8%), hyperlipidemia (56.4% vs. 27.3%), hyperthyroidism (3.1% vs. 0.8%), coronary heart disease (4.3% vs. 1%), malignancy (4.1% vs. 2.2%), psychiatric diseases (15.4% vs. 1.1%), and alcohol consumption (53% vs. 29%). Significant difference was found in favor of the general population for hypothyroidism (14.3% vs. 8%). There were no differences in the prevalence of chronic obstructive pulmonary disease, cholelithiasis, nephrolithiasis, and smoking. Our findings confirmed the hypothesis of a higher prevalence of cardiovascular diseases, malignancy and psychiatric diseases among Croatian war veterans and emphasized the need of better control of their medical conditions.

Key words: *War exposure; Croatia; Chronic disease*

Introduction

Long after the Croatian War of Independence from 1991 to 1995, there was an opinion in the general population and within medical professionals

that there were higher rates of illness in the veteran population which consisted of 500,000 individuals immediately after the war or 12% of the total Croatian population. That is a significant portion of the total population and users of national health resources. At the time, they were mostly young members of the population but now, 25 years after the war, they are at a mature age, and with aging they start to develop chronic medical conditions and diseases expected in the general population. Therefore, the Ministry of

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Health and Ministry of Croatian Veterans started the program of systematic medical examinations for veterans and sent them invitations for voluntary medical examinations. We can conclude that it partly motivated veterans to start caring about their health. It has been found that veterans have conditions such as fatigue, pain, cognitive, gastrointestinal and respiratory problems more frequently, but as they age, also other different chronic medical conditions^{1,2}. It was noticed in reports from studies of American Gulf War veteran women that deployed veterans have higher rates of chronic medical conditions compared to the non-deployed ones^{3,4}. In all studies from the Gulf, Iraq and Afghanistan wars before 2019, there was a comparison of medical conditions of deployed *versus* non-deployed veterans, but there were no studies that compared more aging-related chronic conditions in veterans compared with the general population⁵. This fact additionally encouraged us to undertake this study to assess the prevalence of chronic medical conditions in Croatian war veterans, the majority of them males, compared to the general population.

Subjects and Methods

This prospective study was conducted in 2019 and 2020 to investigate two groups, i.e., 1453 Croatian war veterans and 1429 participants from the general population. All participants were invited to a voluntary systematic medical examination by the organizations that gather Croatian war veterans and employers of different companies. All procedures were performed in accordance with ethical standards set by the responsible Ethics Committee (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent for inclusion in the study was obtained from all study subjects.

During systematic medical examination, the following procedures were performed: medical history, physical examinations, blood pressure, laboratory tests, electrocardiograms (ECG), ultrasound (US) of the abdomen, urologist examination in men, routine gynecologist examination, mammograms and breast examination in women, and where necessary, chest x-rays.

Risk factors of smoking and alcohol consumption were also analyzed in both groups, as well as the

presence of chronic medical conditions such as hypertension, diabetes, hyperlipidemia, thyroid gland disease (hypothyroidism and hyperthyroidism), chronic obstructive pulmonary disease (COPD), coronary heart disease, malignancy, psychiatric diseases, cholelithiasis, and nephrolithiasis. Smoking and alcohol consumption were detected during the medical history interview. Cessation of smoking more than 20 years before at the age younger than 30 years was not considered a risk factor. The criteria for hypertension were blood pressure values $>140/90$ mm Hg on three consecutive measurements by brachial cuff or if the participant used antihypertensive therapy and dietary restrictions. The criteria for diabetes were fasting blood glucose level >6.4 mmol/L, glycated hemoglobin (HbA1c) value >6.0 or the participant was on antidiabetic therapy with insulin, oral hypoglycemic drugs or a diabetic diet. Hyperlipidemia was defined as blood cholesterol level >5.2 mmol/L or when participants were on lipid-lowering therapy. Hypothyroidism was defined by the values of thyrotropic stimulating hormone (TSH) >4.2 mIU/L, free thyroxine (FT4) <12 pmol/L or when participants were taking substitution therapy; and hyperthyroidism by TSH values <0.27 mIU/L, FT4 >22 pmol/L or when participants were taking antithyroid therapy. The criteria for COPD were positive history data or respiratory functional tests (spirometry and carbon monoxide diffusion). The presence of coronary artery disease was estimated by history data on the disease confirmed by noninvasive (ergometry) or invasive (coronary angiography) diagnostic procedures or it was estimated during the examination and later confirmed by coronary angiography. The presence of psychiatric and malignant disease was detected by history data or during systematic medical examination. Cholelithiasis and nephrolithiasis were detected by US during examination or there was positive medical history.

Statistical analysis was performed by Statistica program (TIBCO Software Inc.) comparing two groups, but for more precise distinction between generations and incidence of some diseases with aging of the population, we subdivided the groups according to age into the 40-49, 50-59 and >60 years groups. The χ^2 -test was used to find out differences in the frequency of risk factors and in associations between the variables and correlation methods. Results were expressed as mean with standard deviation. A value of $p < 0.05$ was considered statistically significant.

Results

This study was conducted in two groups of participants, i.e., 1453 Croatian war veterans, including 1325 (91%) males, mean age 57.3 (range 42-84; SD=8.4) years. The other group consisted of employees of different companies who performed systematic medical examinations within the same period. This group consisted of 1429 participants, 863 (58%) females and 593 (42%) males, mean age 48.98 (range 22-70; SD=8.97) years.

There were significant differences according to gender between the veteran group and general

population group ($\chi^2=799.20$; $df=1$; $p<0.01$), which was expected because soldiers in the war were predominantly men. Between samples there was a statistically significant age difference, with the veteran group being significantly older ($t=25.74$; $df=2880$; $p<0.01$). In additional interpretation of data on both samples, we compared the frequency of some chronic medical diseases between specific age groups (Table 1).

Demographic characteristics of participants according to the age groups are illustrated in Figure 1, supporting comparison of particular age groups (40-49, 50-59 and >60 years) because the general

Table 1. Demographic characteristics of study participants

Age group (years)		Frequency (%)	Mean age (SD)
<40	General population	209 (14.6)	34.2 (4.7)
	Veterans	0	
40-49	General population	548 (38.3)	45.03 (3.2)
	Veterans	369 (25.4)	46.7 (2.3)
50-59	General population	541 (37.8)	55.4 (2.7)
	Veterans	540 (37.1)	55.6 (2.9)
>60	General population	131 (9.2)	62.6 (1.5)
	Veterans	544 (37.4)	66.2 (4.5)

SD = standard deviation

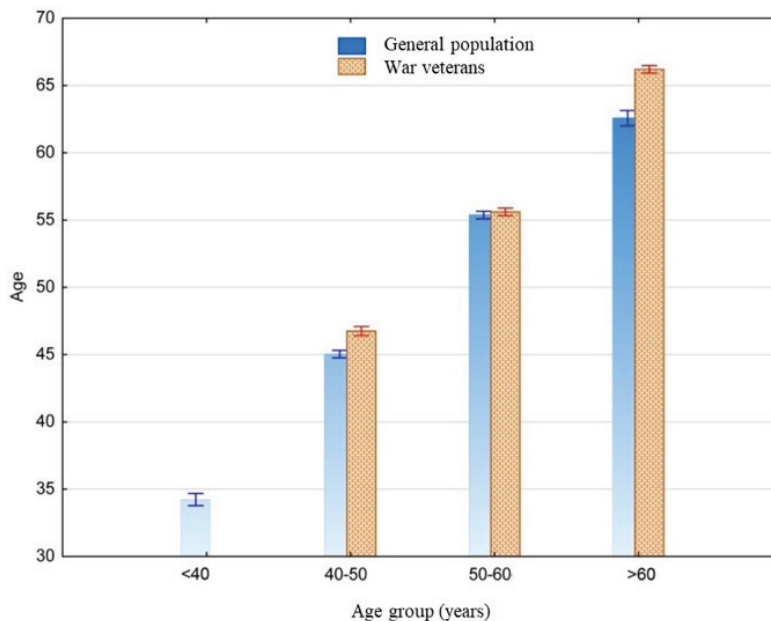


Fig. 1. Distribution of study participants according to median age within defined age groups.

population group consisted of active population and therefore the possibility of age older than 60 in this group was less probable because the working age before retirement in Croatia is 65. At the same time, a significant proportion of the veteran group are retired and so there are no members younger than 40. Therefore, both groups were generally equivalent and could be compared.

Smoking as a risk factor for cardiovascular and malignant diseases was significant in both groups; smoking was present in 31% of the veteran group and 29% of the general population group. There was no statistically significant difference between the two study groups. Alcohol consumption was present in 53% of the veteran group and 29% of the general population

Table 2. Frequency distribution of hypertension, diabetes and thyroid gland diseases in different age groups

	ICD-10	Age group (years)	General population (N=1429)			Veterans (N=1453)			χ^2 (general population vs. veterans)	
			Present	Not present	Number of participants	Present	Not present	Number of participants		
Hypertension	I10	<40	20 (9.6%)	189 (90.4%)	209	-	-	0		
		40-49	66 (12%)	482 (88%)	548	58 (15.7%)	311 (84.3%)	369	$\chi^2=2.55$; df=1	p>0.05
		50-59	181 (33.5%)	360 (66.5%)	541	151 (28%)	386 (72%)	540	$\chi^2=3.60$; df=1	p>0.05
		>60	64 (49%)	67 (51%)	131	211 (38.8)	333 (61.2%)	544	$\chi^2=4.43$; df=1	p<0.05
	I11	<40	2 (1%)	207 (99%)	209	-	-	0		
		40-49	3 (0.5%)	545 (99.5%)	548	1 (0.3%)	368 (99.7%)	369	$\chi^2=0.38$; df=1	p>0.05
		50-59	4 (0.7%)	537 (99.3%)	541	1 (0.2%)	539 (99.8%)	540	$\chi^2=1.80$; df=1	p>0.05
		>60	0	131 (100%)	131	0	544 (100%)	544	$\chi^2=2.55$; df=1	p>0.05
Diabetes	E10	<40	1 (0.5%)	208 (99.5%)	209	-	-	0		
		40-49	1 (0.2%)	547 (99.8%)	548	2 (0.5%)	367 (99.5%)	369	$\chi^2=0.87$; df=1	p>0.05
		50-59	1 (0.2%)	540 (99.8%)	541	13 (2.4%)	527 (97.6%)	540	$\chi^2=10.44$; df=1	p<0.01
		>60	0	131 (100%)	131	19 (3.5%)	525 (96.5%)	544	$\chi^2=4.71$; df=1	p<0.05
	E11	<40	2 (1%)	207 (99%)	209	-	-	0		
		40-49	7 (1.3%)	541 (98.7%)	548	25 (6.8%)	344 (93.2%)		$\chi^2=19.79$; df=1	p<0.01
		50-59	30 (5.5%)	511 (94.5%)	541	69 (12.8%)	471 (87.2%)	540	$\chi^2=16.99$; df=1	p<0.01
		>60	13 (9.9%)	118 (90.1%)	131	124 (22.8%)	420 (77.2%)	544	$\chi^2=10.81$; df=1	p<0.01
Thyroid gland diseases	E03	<40	11 (5.3%)	198 (94.7%)	209	-	-	0		
		40-49	74 (13.5%)	474 (86.5%)	548	31 (8.4%)	338 (91.6%)	369	$\chi^2=5.66$; df=1	p<0.05
		50-59	58 (10.7%)	483 (89.3%)	541	28 (5.2%)	512 (94.8%)	540	$\chi^2=11.31$; df=1	p<0.01
		>60	12 (9%)	119 (91%)	131	54 (9.9%)	490 (90.1%)	544	$\chi^2=0.07$; df=1	p>0.05
	E04	<40	4 (2%)	205 (98%)	209	-	-	0		
		40-49	23 (4.2%)	525 (95.8%)	548	2 (0.5%)	367 (99.5%)	369	$\chi^2=11.11$; df=1	p<0.01
		50-59	15 (2.8%)	526 (97.3)	541	1 (0.2%)	539 (99.8%)	540	$\chi^2=12.41$; df=1	p<0.01
		>60	8 (6.1%)	123 (93.9%)	131	1 (0.2%)	543 (99.8%)	544	$\chi^2=28.15$; df=1	p<0.01
	E05	<40	0	209 (100%)	209	-	-	0		
		40-49	2 (0.4%)	546 (99.6%)	548	10 (2.7%)	359 (97.3%)	369	$\chi^2=9.39$; df=1	p<0.01
		50-59	4 (0.7%)	537 (99.3%)	541	12 (2.2%)	528 (97.8%)	540	$\chi^2=4.07$; df=1	p<0.05
		>60	2 (1.5%)	129 (98.5%)	131	22 (4%)	522 (96%)	544	$\chi^2=1.95$; df=1	p>0.05

ICD = International Statistical Classification of Diseases and Related Health Problems, 10th revision; I10 = Essential (primary) hypertension; I11 = Hypertensive heart disease; E10 = Type 1 diabetes mellitus; E11 = Type 2 diabetes mellitus; E03 = Other hypothyroidism; E04 = Other nontoxic goitre; E05 = Thyrotoxicosis (hyperthyroidism)

group, which was significantly different ($p < 0.001$). These results were expected because the veteran group were predominantly men in which alcohol consumption is more frequent.

When comparing the veteran group with the general population group, we found a statistically significantly higher prevalence of hypertension ($p < 0.01$) and diabetes ($p < 0.01$) in the former. Croatian war veterans were more likely to develop hypertension than the general population ($p < 0.01$). The prevalence of essential hypertension was 29% in the veteran group and 23.7% in the general population group. Diagnosis of secondary hypertension was very rare (less than 0.5%) but the prevalence was equivalent in both populations. According to χ^2 for essential hypertension (I10, $\chi^2 = 12.33$, $p < 0.01$), a significant difference was probably noticed because of the age difference between the groups, as there were 209 participants younger than 40 years in the general population and none younger than 40 in the veteran group, which probably influenced the results suggesting that the general population seemed to be healthier with a lower prevalence of hypertension.

Therefore, much more realistic is presentation according to age groups, where there was no difference in hypertension prevalence between the 40–49 and 50–59 years subgroups of veterans and general population. Only the oldest age subgroup (>60 years) showed a statistically significant difference in favor of the veteran group ($p < 0.05$). These results are shown in Table 2. The prevalence of diabetes was significantly higher in the veteran group (17.3%), representing a high proportion of the veteran group, as compared with the general population group (3.8%). Thyroid gland diseases were present in both populations with the prevalence of hypothyroidism of 14.3% in the general population group and 8% in the veteran group, while

the prevalence of hyperthyroidism was significantly higher in the veteran group (3.1%) than in the general population group (0.8%). Results according to age groups are shown in Table 2.

Hyperlipidemia was present in a large proportion of the veteran group (56.4%), while it was significantly lower in the general population group (27.3%). The prevalence of coronary heart disease was 4.3% in the veteran group and 1% in the general population group ($\chi^2 = 34.74$, $df = 1$; $p < 0.01$), which was statistically significant.

In contrast to cardiovascular diseases, difference in the prevalence of COPD was not statistically significant between the two study groups (2.5% in the veteran group and 3.5% in the general population group). Similar results were recorded for cholecystolithiasis (6.5% in the veteran group and 6% in the general population group) and nephrolithiasis (3% in the veteran group and 2% in the general population group).

Various malignant diseases were present more often in the veteran group (4.1%) than in the general population group (2.2%), which was statistically significant. Although the total number of malignant diseases was relatively low, we noticed a slightly higher incidence of prostate cancer and colorectal carcinoma. A higher presence of psychiatric diseases among veterans was found (15.4% in the veteran group vs. 1.1% in the general population group), which was statistically significant. Results on the prevalence of psychiatric and malignant diseases are shown in Table 3.

Discussion

Long after the Croatian War of Independence, which ended 25 years ago, the Croatian veteran population had a higher rate of morbidity from

Table 3. Prevalence of psychiatric and malignant diseases in two study groups

Diagnosis (ICD 10)	General population (N=1429)		Veterans (N=1453)		χ^2 (general population vs. veterans)	p
	Present	Not present	Present	Not present		
F diagnosis	16 (1.1%)	1413 (98.9%)	224 (15.4%)	1229 (84.5%)	$\chi^2 = 192.9$; $df = 1$	p < 0.01
C diagnosis	31 (2.2%)	1398 (97.8%)	60 (4.1%)	1393 (95.9%)	$\chi^2 = 9.1$; $df = 1$	p < 0.01

chronic diseases, which was also noticed in many other studies that investigated medical conditions of US Veterans of Gulf War, and wars in Iraq and Afghanistan⁵⁻⁹. In this study, we noticed a higher proportion of hypertension in veterans than in the general population, but when the prevalence of hypertension was compared according to age groups, the difference vanished. In the age subgroups (40-49 and 50-59 years) there was no statistically significantly higher prevalence of hypertension. In this study, we noticed a slightly lower prevalence of hypertension in both study groups, which is consistent with the results of the Epidemiology of Hypertension in Croatia (EHUH) study reporting a prevalence of hypertension in Croatia of 37.5%, with a slightly higher frequency in women (39.7%) than in men (35.2%). When we compared these data with the results recorded in some other countries, we found different reports according to country, e.g., Germany 55.3%, Sweden 38.4%, England 37%, Czech Republic 39.1%, USA 27.8%, and Canada 27.5%¹⁰. One of the possible explanations for such results in our study is a higher proportion of men (91%) in veteran population, which according to the lower prevalence of hypertension in men may have contributed to this result. Another explanation could be in methodological approach because in each participant in whom we measured elevated blood pressure values, repeat measurements were performed at least twice at 5-minute intervals to avoid the impact of white coat hypertension, the prevalence of which in the population is 10%-40%¹¹.

We noticed a statistically significantly higher prevalence of diabetes in the veteran group, not only in the total sample but also according to age groups. This fact is more concerning because the prevalence of diabetes in veterans was remarkably higher than the reports from the Croatian Institute of Public Health on the prevalence of diabetes in the Republic of Croatia, which is around 7.5% for the whole population and 8.7% for the 20-79 age groups¹². One of the possible explanations for this finding is the large proportion of men in the veteran group, who have higher body mass index (BMI), so they are at a higher risk to develop diabetes than women. Nevertheless, this fact calls for action because it is still twice as high as the prevalence in Croatia and other European countries¹³.

Hyperlipidemia as a risk factor for cardiovascular diseases was more often recorded in the veteran group

than in the general population group, which contributes to the higher cardiovascular risk in veteran population. These data are similar to the reports from studies in US Gulf War veterans and US general population, which is around 50%, but it is higher than the reports from some studies on European population where the prevalence of hyperlipidemia is 15%-25%¹⁴⁻¹⁶.

Smoking as a risk factor was equally present in the veteran and general population groups, which is completely equivalent to the prevalence of smoking in Croatia reported in other studies. According to the reports from the Croatian Institute of Public Health, there are 31.5% of smokers in Croatia, but some other reports point to a higher proportion of smokers in the population of up to 35%¹⁷. Alcohol consumption is traditionally present in Croatia and according to our data, there were 53% of alcohol consumers in the veteran group and 29% in the general population group. These findings are encouraging because these figures are lower than the reports from the EU Joint Action on Reducing Alcohol Related Harm (JA RARHA), which estimates alcohol consumption in Croatia at 78.1% of the grown-up population, i.e., 85.3% for males and 71% for females¹⁸.

The prevalence of coronary heart disease was statistically significantly higher in the veteran group than in the general population group. The general population group was younger with a higher proportion of women, which could contribute to these findings. COPD was present in 2.3% of the veteran group and there was no statistical difference from the general population group. These results are consistent with the results of the US study in which Karlinsky *et al.* did not find higher prevalence of COPD in the US veteran population¹⁹. The estimated proportion of COPD prevalence in Croatia is 10% of total population, but in some reports, it is slightly higher, up to 12%²⁰. A lower prevalence recorded in this study could arise from methodological reasons because we included only cases with positive pulmonary function tests.

Thyroid gland diseases, hypothyroidism and hyperthyroidism, immune mediated diseases in which stress exposure plays an important role, were recorded at a higher prevalence after the War for Independence in Croatia, so we included them in this study. We found a statistically higher prevalence of hypothyroidism in the general population group. At the same time, the prevalence of hyperthyroidism was higher in the veteran

group. The prevalence of hyperthyroidism is 1%–3% and of hypothyroidism 5%, while in obese patients, it could be up to 14%. Hypothyroidism is often present in women, so this distribution was not surprising in our study. Hyperthyroidism could be associated with high stress levels, permanent or abrupt, which could be a triggering factor to which war veterans were more exposed than the general population^{21–23}.

Abdominal US was performed in each study subjects, so it was easy to estimate the prevalence of cholelithiasis and nephrolithiasis. There was no significant difference between the study groups.

The prevalence of malignant diseases was statistically significantly higher in the veteran group than in the general population group, with a slightly higher incidence of colorectal cancer and prostate cancer than other malignant diseases, which was expected because of the male predominance in the veteran group. Older age and male predominance could contribute to the higher prevalence of malignant disease in the veteran group. In comparison with data from studies on US veterans, where the prevalence of malignant diseases was 14.9% and did not differ statistically significantly from the general population, in our study, we noticed a lower prevalence of malignant diseases in the Croatian war veteran population^{5,24}.

Numerous studies report on a higher prevalence of psychiatric disorders in veterans²⁵ and we confirm the results recorded in our study, with a significantly higher prevalence of psychiatric disorders in the veteran group than in the general population group.

Conclusion

In this study, we found a higher prevalence of various chronic medical diseases in the veteran population and some of them were established during systematic medical examinations. These findings draw attention to the program of systematic medical examinations, emphasizes the need of better control of medical conditions of veterans, and calls for further efforts to include a wider range of veterans, as much as possible.

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Sažetak

KRONIČNE NEZARAZNE BOLESTI KOD HRVATSKIH BRANITELJA U ODNOSU NA OPĆU POPULACIJU: 25 GODINA NAKON RATA

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Povećana učestalost kroničnih bolesti među veteranima dokumentirana je kroz brojna istraživanja, no samo ih je nekoliko studija uspoređivalo s općom populacijom. Cilj ovog istraživanja bio je utvrditi razlike u pojavnosti kroničnih bolesti između hrvatskih branitelja i opće populacije. Ovo istraživanje obuhvatilo je dvije skupine ispitanika, 1453 hrvatskih branitelja i 1429 sudionika iz opće populacije. Anamneza, fizikalni pregled, laboratorijske pretrage i specifični dijagnostički postupci provedeni su tijekom sistematskog fizikalnog pregleda u obje skupine. Analizirana je učestalost hipertenzije, šećerne bolesti, hiperlipidemije, hipotireoze i hipertireoze, kronične opstruktivne plućne bolesti, koronarne bolesti, malignih bolesti, psihijatrijskih bolesti, kolelitijaze, nefrolitijaze, pušenja i konzumacije alkohola. Utvrđeno je da hrvatski branitelji imaju veću vjerojatnost za razvoj hipertenzije (29,5% prema 24,3%), dijabetesa (17,3% prema 3,8%), hiperlipidemije (56,4% prema 27,3%), hipertireoze (3,1% prema 0,8%), koronarne bolesti srca (4,3% naspram 1%), zloćudne bolesti (4,1% naspram 2,2%), psihijatrijske bolesti (15,4% naspram 1,1%) i češću konzumaciju alkohola (53% naspram 29%) nego pojedinci u općoj populaciji. Uočena je značajna razlika u korist opće populacije za hipotireozu (14,3% naspram 8%). Nije bilo razlika u učestalosti kronične opstruktivne plućne bolesti, kolelitijaze, nefrolitijaze i pušenja. Naši nalazi potvrdili su hipotezu o višoj učestalosti kardiovaskularnih bolesti, malignih i psihijatrijskih bolesti među hrvatskim braniteljima te naglasili potrebu bolje kontrole njihovog zdravstvenog stanja.

Ključne riječi: Izloženost ratu; Republika Hrvatska; Kronične bolesti