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Effect of War on Weapon-Related Deaths in Croatian Children and Youth

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Objective: To identify trends in weapon-related deaths associated with the Homeland War (1991-1995) among children in Croatia.

Design: Retrospective review.

Participants: Croatian children aged from birth through 19 years who died as the result of a weapon-related injury from 1986 through 2005.

Main Exposure: Injury deaths of children by intent (homicide, suicide, operations of war, and unintentional), cause, and age.

Outcome Measures: Number and rate of injury deaths among Croatian children before, during, and after the war.

Results: Compared with the period before the war, weapon-related homicide and suicide rates increased by more than 3-fold, and unintentional weapon-related deaths increased by more than 6-fold during the war. These increases persisted for 5 years following the end of the war and decreased more than 5 years after the war. Death rates from nonweapon causes did not increase during this period. Overall, 81.9% of the weapon-related deaths were caused by firearms and 18.1% were caused by explosive devices.

Conclusions: The Homeland War led to an increase in weapon-related deaths of all intents. Programs that focus on the prevention of weapon-related injuries should be integrated into programs that assist countries in rebuilding after political unrest.

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In many regions of the world, political unrest has exposed civilians and children to military weapons. These weapons may contribute to social and interpersonal violence as well as unintentional traumatic injury.[1] Few studies have examined the effects of war operations on injuries in children, but several studies indicate that war does influence children's injury patterns.[1-3]

As in many other developed countries, injuries are a major cause of death among children in Croatia. However, the Third Balkan War in 1991, known in Croatia as the Homeland War, and the accompanying breakup of the former Yugoslavia introduced a new childhood exposure to firearms and weapons. After World War II until the beginning of the Homeland War in 1991, most children in Croatia were not exposed to firearms and explosives in their homes or communities. Unlike many countries,[4] personal weapon ownership was not a custom in Croatia. Existing firearms were used primarily for hunting or collecting and were predominantly rifles.

This tradition changed with the start of the war in 1991 when the United Nations imposed an arms embargo on the territory of the former Yugoslavia, which restricted purchase of any new weapons and led to a redistribution of existing Yugoslav Army weapons.[5] At the beginning of the war, the former Yugoslav Army, located in Belgrade, Serbia, was supported by local Serbs living in Croatia. Croatian citizens did not possess weapons for defense and no longer had a national army to protect them. As the war moved into Croatian land, citizens sought means to protect their homes and families as well as to arm Croatian fighters. Some citizens took weapons, including firearms, grenades, and other explosive devices, from military barracks located in Croatia after the Yugoslav army officially left Croatia. Other weapons were obtained through a growing black market and local manufacturing of new weapons.

The citizenry of Croatia has remained overly militarized in the wake of war.[6] The latest data from the Ministry of Interior (from 2007) on the territory of

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Croatia identified 371 684 legally owned and registered weapons, primarily firearms, 10 600 of which were owned by women.[7] Some estimate that the circulation of illegal weapons is equal to that of legal ones (1 for every 6 citizens).[8]

This study describes the trends in weapon-related injuries associated with the Homeland War among children in Croatia. Injuries to children aged from birth through 19 years from firearms and explosives were examined during 4 periods: prewar (1986-1990), war (1991-1995), early postwar (1996-2000), and late postwar (2001- 2005). Our analysis addresses 2 primary hypotheses. The first is that the war led to an increase in weapon-related deaths among children for all intents (homicide, suicide, war operations, and unintentional). The second hypothesis is that, when compared with the period before the war, these increases remained significantly high after the war ended.

METHODS

MORTALITY DATA

Vital statistics mortality data from the Republic of Croatia Central Bureau of Statistics prepared by the Croatian National Institute of Public Health were used. Vital statistics systems in Croatia are regulated through national laws and ordinances that were established in the former Yugoslavia and are based on Western European models. In summary, any sudden or unnatural death is under the jurisdiction of the coroner. The coroners are trained medical professionals of whom 95% are physicians and 5% are nurses or similar professionals. Autopsies and notification of law enforcement and prosecutors are mandatory for sudden and unnatural deaths. All autopsies are performed by forensic pathologists. Procedures for death investigations and reporting of vital statistics and the agencies responsible for these functions did not change during or after the war.

Population estimates were provided by the Republic of Croatia Central Bureau of Statistics, which is responsible for 10-year census counts and intercensus annual estimates. Population movement was substantial during the war years, and annual population counts are not available. Annual population estimates were calculated according to a standard procedure that interpolates interyear population estimates from birth, death, and immigration data. During the war, many people were displaced. For example, from October 10 through December 24, 1991, the Croatian Office for War Victims reported a total of 307 620 displaced persons, of whom 172 268 were children.[9] This study used secondary data with no personal identifiers and received an exempt status from the Human Subject Protection Committee.

All deaths among Croatian citizens were included in the database. We analyzed deaths of children and youth aged from birth through 19 years from 1986 through 2005. The Central Bureau of Statistics considers childhood to extend through age 19 years, because in the school system most 19-year-old youth are in secondary school. During the war, children were not recruited into the army, therefore this sample will not include military personnel. Injury deaths were identified through *International Classification of Disease* (*ICD*) codes on the death certificate. The ninth revision (*ICD-9*) was used for the period from 1986 through 1995 and the tenth revision (*ICD-10*) was used from 1996 and on.[10]

Traumatic injury deaths were classified by intent. For death certificates coded by *ICD-9*, unintentional injuries were identified by codes E800 through E949; suicide by E950 through E959; homicide by E960 through E969; undetermined intent by E980 through E989; and operations of war by E990 through E999. For death certificates coded by *ICD-10*, unintentional injuries were identified by codes V01 through X59; suicide by X60 through X84; homicide by X85 through Y09; undetermined intent by Y10 through Y34; and operations of war by Y35 through Y36.

The primary exposure for this study was death caused by a weapon or explosive device. Weapon-related *ICD-9* codes included E922 and E923 for unintentional intent; E955 for suicide; E965 for homicide; E985 for undetermined intent; and E991, E993, and E998 for operations of war. Weapon-related *ICD-10* codes included W32 through W34 and W40 for unintentional injury; X72 through X75 for suicide; X93 through X96 for homicide; Y22 through Y25 for undetermined intent; and Y36.2, Y36.4, and Y36.8 for operations of war. Based on the data we received from the Central Statistics Office, we could not separate deaths from firearms and explosive devices from 1986 through 1996. For 1996 through 2005, firearm *ICD-10* codes included W32 through W34 for unintentional injury; X72 through X74 for suicide; X93 through X95 for homicide; and X36.4 for operations of war. Explosive device *ICD-10* codes included W40 for unintentional injury; X75 for suicide; X96 for homicide; and Y36.2 and Y36.8 for operations of war.

DATA ANALYSIS

The study was divided into 4 periods. Individual years were not analyzed because the number of deaths by intent was too small to analyze independently. The years 1986 through 1990 represent prewar years; 1991 through 1995 represent the war years; 1996 through 2000 represent the early postwar years; and 2001 through 2005 represent the late postwar years. Mortality rates for these periods were calculated as the mean annual mortality rate for the years in the time frame.

We tested the hypothesis that weapon-related injuries increased from the prewar period to the war period by comparing injury death rate ratios and 95% confidence intervals (CIs) by cause for weapon- and nonweapon-related deaths. War-related injuries were not included in this analysis because they occurred only during the war. We tested the hypothesis that weapon-related injuries remained high in the postwar periods by comparing the early postwar period (1996-2000) with the prewar period, and the late postwar period (2001-2005) with the prewar period.

RESULTS

A total of 312 childhood deaths were identified as operations of war, representing 17% of all childhood traumatic injury deaths during the war period (1991-1995). During the war, the rate of war-related deaths of children exceeded 10 per 100 000 people, and increases in the death rate from suicide, homicide, and unintentional injuries are visible (**Figure**). Nearly three-fourths of war injuries in children were in those aged 15 to 19 years.

From the prewar to the war period, the rate of homicides with weapons increased from 0.22 to 0.73 homicides per 100 000 children for a rate ratio of 3.32 (95% CI, 1.99-5.53), while the rate of homicides not involving weapons remained unchanged (**Table 1**). Youth suicide rates were higher than homicide rates in all of the periods. Suicide rates among Croatian children in-

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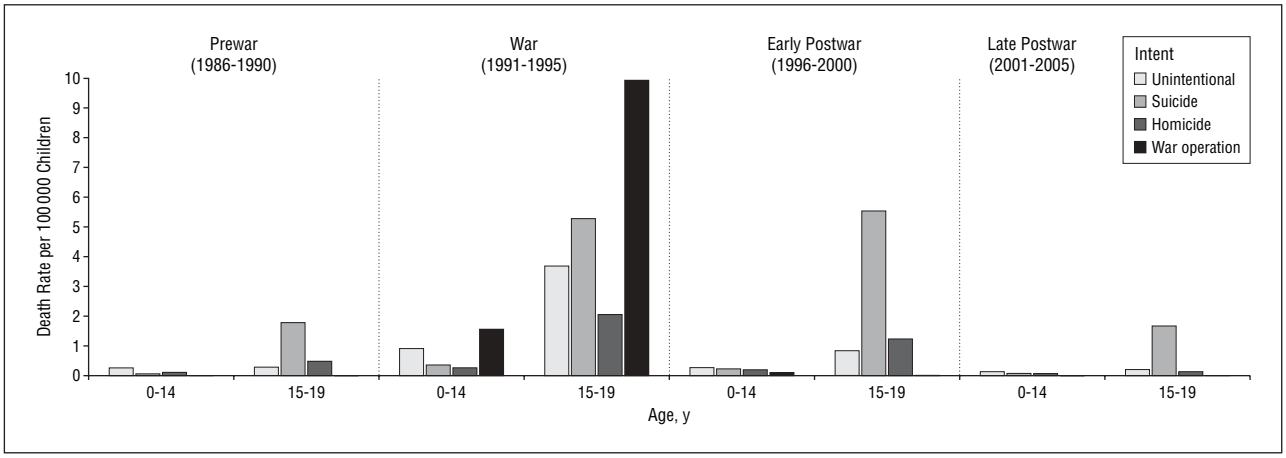

Figure. Crude rates of deaths due to firearms or explosives by intent, age, and period in Croatian children aged birth through 19 years.

Table 1. Injury Death Rates of Croatian Children Aged Birth Through 19 Years by Intent and War Period[a]

	Prewar (1986-1990)	War (1991-1995)		Early Postwar (1996-2000)		Late Postwar (2001-2005)	
Intent	Deaths, No. (Rate[b])	Deaths, No. (Rate[b])	RR (95% CI)	Deaths, No. (Rate[b])	RR (95% CI)	Deaths, No. (Rate[b])	RR (95% CI)
Homicide							
Weapon	14 (0.22)	46 (0.73)	3.32 (1.99-5.53)	27 (0.45)	2.05 (1.29-3.26)	4 (0.08)	0.36 (0.27-0.48)
Nonweapon	39 (0.6)	39 (0.62)	1.03 (0.62-1.71)	22 (0.36)	0.6 (0.38-0.96)	10 (0.2)	0.33 (0.25-0.44)
Total	53 (0.82)	85 (1.35)	1.65 (0.99-2.75)	49 (0.81)	0.99 (0.62-1.58)	14 (0.28)	0.34 (0.26-0.45)
Suicide							
Weapon	33 (0.51)	104 (1.64)	3.28 (2.38-4.51)	96 (1.59)	3.12 (2.27-4.29)	27 (0.53)	1.04 (0.81-1.34)
Nonweapon	124 (1.93)	92 (1.46)	0.76 (0.55-1.05)	109 (1.80)	0.93 (0.68-1.28)	89 (1.74)	0.96 (0.67-1.16)
Total	157 (2.44)	196 (3.10)	1.27 (0.92-1.75)	205 (3.39)	1.39 (1.01-1.91)	116 (2.27)	0.93 (0.72-1.20)
Unintentional							
Weapon	16 (0.25)	103 (1.63)	6.52 (4.12-10.31)	25 (0.41)	1.64 (1.12-2.41)	8 (0.16)	0.64 (0.48-0.85)
Nonweapon	1084 (16.83)	1129 (17.86)	1.06 (0.67-1.68)	785 (12.98)	0.77 (0.52-1.13)	635 (12.46)	0.74 (0.56-0.98)
Total	1100 (17.08)	1232 (19.49)	1.14 (0.72-1.80)	810 (13.39)	0.78 (0.53-1.15)	643 (12.62)	0.74 (0.56-0.98)

Abbreviations: CI, confidence interval; RR, relative risk.
[a] *International Classification of Diseases* codes did not differentiate between firearms and explosives.
[b] Per 100 000 people.

creased from the prewar period to the war period; this increase was driven by a 3.28-fold rise in suicides with weapons (95% CI, 2.38-4.51). In contrast, suicides by other means showed a slight but nonsignificant decrease (relative risk, 0.76; 95% CI, 0.55-1.05). The unintentional childhood death rate involving weapons increased 6.52-times during the war (95% CI, 4.12-10.31), while the rate for unintentional injury deaths not involving weapons remained unchanged (Table 1).

Weapon-related childhood injury death rates remained significantly elevated in the early postwar period compared with the prewar period (Table 1). The weapon-related homicide rate in the early postwar period remained 2.05 times higher than before the war (95% CI, 1.29-3.26), and the weapon-related suicide rate remained 3.12 times higher (95% CI, 2.27-4.29). Compared with the prewar period, the weapon-related unintentional injury death rate remained 1.64 times higher in the early postwar period (95% CI, 1.12-2.41), though this is substantially lower than the 6-fold increase found during the war.

During the late postwar period, homicide and unintentional injury death rates were significantly lower for both weapon- and nonweapon-related deaths (Table 1). Suicides showed no statistical difference in the postwar period compared with the prewar period.

We examined the proportion of weapon-related deaths caused by firearms and explosives for the periods and intents that were available (**Table 2**). During the war, firearms and explosives could be separately identified for deaths coded as unintentional or operations of war. Of the deaths coded as operations of war, 99.2% were caused by firearms and 0.8% were caused by explosives. Of those coded as unintentional, 71.8% were caused by firearms and 28.2% were caused by explosives. During the postwar years, 81.9% of all weapon-related deaths were caused by firearms and 18.1% were caused by explosives. Nearly one-quarter of unintentional weapon-related deaths were caused by explosives (24%) compared with 10% of homicides and 15.5% of suicides. All 5 of the weapon-related deaths attributed to war in the postwar period were caused by explosive devices.

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Table 2. Firearm and Explosive Device Deaths of Croatian Children Aged Birth Through 19 Years by Intent and War Period

	No. (%)								
	Prewar (1986-1990)			War (1991-1995)			Postwar (1996-2005)		
Intent	Firearms	Explosives	Total	Firearms	Explosives	Total	Firearms	Explosives	Total
Total	14 (87.5)	2 (12.5)	16	310 (90.9)	31 (9.1)	341	158 (81.9)	35 (18.1)	193
Undetermined	0	0	0	0	0	0	2 (100)	0	2
Suicide	NA	NA	NA	NA	NA	NA	104 (84.6)	19 (15.4)	123
Homicide	NA	NA	NA	NA	NA	NA	27 (90)	3 (10)	30
Unintentional	14 (87.5)	2 (12.5)	16	74 (71.8)	29 (28.2)	103	25 (75.8)	8 (24.2)	33
War operations	0	0	0	236 (99.2)	2 (0.8)	238	0	5 (100)	5

Abbreviation: NA, not applicable (*International Classification of Diseases* codes did not differentiate between firearms and explosives).

COMMENT

The Homeland War in Croatia changed the composition of fatal traumatic injury in children and youth. Traumatic injuries that were a direct consequence of the war composed 17% of all childhood deaths during the war. There was a significant increase in weapon-related deaths for homicide, suicide, and unintentional injury deaths during the war, and this increase persisted for the 5-year period following. These findings confirm those of 2 smaller studies that examined the number of war-time traumatic injuries in Croatian children, though ours is the first study to present population-based rates. In the Croatian district of Karlovac from 1991 to 1993, 57 children were treated for war injuries: 23 for direct and 34 for indirect injuries.[2] Stevanovic et al[3] compared 4 prewar years in Croatia (1987-1990) with 4 war years (1991-1994). They identified a large number of deaths in children and youth that were caused by direct operations of war and also documented a constant increase in the proportion of unintentional, self-harm, and homicide deaths due to firearms and explosive devices during the war.

Our study shows that even after war operations ceased, weapons posed a long-term hazard for children and youth. For the 5-year period following the end of the war, the number and rates of weapon-related deaths among children increased significantly for homicide, suicide, and unintentional injuries. The combination of psychological effects of war on children with an increased presence of weapons may present a particularly important area for prevention. The presence of weapons has been found to influence childhood injuries in other studies. One study documented a 3-fold increase in the risk of homicide and a 9-fold increased risk for suicide when weapons were stored in the home.[11] Previous studies have documented unsafe firearm storage practices even with adolescents in the home.[12] Safe storage is likely to be a challenge for weapons owned for war operations.

A decrease in weapon-related deaths was found only after 5 years of peace in Croatia. The cause of this decrease is largely unknown, though efforts that focused on reducing weapons and children's exposure to weapons could be related.[13] The Croatian government, as well as international agencies such as the United Nations Children's Fund (UNICEF), conducted many activities to reduce weapon ownership. Educational programs were initiated to educate civilians, especially children and parents, about the danger of weapons and explosive devices.[14,15] Efforts to retrieve war-related and unregistered weapons were also conducted. In 1996, the Croatian Ministry of the Interior initiated a weapons buy-back program called A Farewell to Arms in an effort to decrease the number of all weapons in circulation. During the first year of this program, the Croatian government paid more than HRK 12.2 million (US $2.2 million) to collect 23 915 automatic firearms, 1 559 000 bombs, mines, and bullets, and 2486 kg of explosives.[16] The end of the program was extended 6 times until December 31, 2002.

After the buy-back program concluded, an individual possessing an unregistered weapon faced a 6-month to 3-year prison term and a fine of between US $3000 and US $21 000. Programs to reduce land mines were also implemented. In 1996, the United Nations reported that Croatia ranked third in the prevalence of land mines in the world, after Bosnia/Herzegovina and Cambodia, with 49 land mines/km^2.[17] A National Mine Action plan was enacted in 2000 and revised in 2003 with a goal of making Croatia mine free by March 2009. The original plan focused on more than 4000 km^2 of mine-contaminated land, which was estimated to have been reduced to 1010 km^2 by 2007.[18]

More than 80% of postwar weapon-related deaths were caused by firearms, though often the focus of postwar safety is on explosive devices. Our findings suggest that firearm injury prevention is a critical focus for prevention in war and postwar periods. Our findings also suggest that suicide, which among Croatian children was 2 to 3 times more frequent than homicide before, during, and after the war, should also be a focus of postwar health and safety efforts. Currently, little evidence has been collected to describe weapon availability or storage practices in the homes of Croatian children. More research is needed to identify prevalence and social norms related to weapon ownership and the relationship of different types of firearms to homicide and suicide and to evaluate the effectiveness and feasibility of firearm-injury prevention approaches.

This study addresses an important international health issue for which very little information is available. However, this study has several limitations. Population esti-

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mates were difficult during the war years because of the large population displacement. The last census before the war was conducted in 1991 and identified the total Croatian population to be 4 784 265, with 1 252 469 children and youth aged up to 19 years. The next census was conducted in 2001 and found the population of Croatia to be 4 437 460, with 1 053 240 children and youth aged up to 19 years.[19] However, annual approximations between these census counts were based on population estimates from multiple sources and their accuracy is difficult to assess. This study includes death certificates for all Croatian children. Although the vital statistics system was unchanged during and following the war, it is possible that some information about Croatian children was coded incorrectly. Underreporting of childhood deaths and the proportion caused by weapons is thus possible, though this is likely to be a small proportion of the overall deaths. During the last year of the war, death certification switched from the *ICD-9* to the *ICD-10* coding system. This change could have introduced differences in coding practices that are difficult to measure.

This is the first national study of the effects of war on childhood injury deaths in Croatia. Our study indicates that the Homeland War began an increase in weapon-related deaths among children for all causes of death, and these increases persisted during the 5-year period following the war. The war led to the emergence of an epidemic of weapon-related childhood injuries, and these increases did not drop until at least 5 years following the war. Future research to identify the direct role of governmental programs to educate and reduce weapon ownership would be very important for postwar prevention efforts.

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Author Contributions: The authors had full access to the data and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Mujkic and Peek-Asa. *Acquisition of data:* Mujkic and Rodin. *Analysis and interpretation of data*: Mujkic, Peek-Asa, Young, and Rodin. *Drafting of the manuscript:* Mujkic and Peek-Asa. *Critical revision of the manuscript for important intellectual content:* Young and Rodin. *Statistical analysis:* Peek-Asa and Young. *Obtained funding:* Mujkic and Peek-Asa.
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