Terrorism, civil war and related violence and substance use disorder morbidity and mortality: A global analysis

Bradley T. Kerridge, Maria R. Khan, Jürgen Rehm, Amir Sapkota

Terrorism, civil war and related violence and substance use disorder morbidity and mortality: A global analysis

Bradley T. Kerridge [a,*], Maria R. Khan [b], Jürgen Rehm [c], Amir Sapkota [d]

[a] Department of Epidemiology and Biostatistics, School of Public Health, University of Maryland, College Park, College Park, MD 20740, USA
[b] Department of Epidemiology, College of Public Health Professions, School of Medicine, University of Florida Health Services Center, University of Florida, Gainesville, FL 32610, USA
[c] Centre for Addiction and Mental Health, 33 Russell Street, Toronto, Ontario M5S 2S1, Canada
[d] Maryland Institute for Applied Environmental Health, Department of Epidemiology and Biostatistics, School of Public Health, University of Maryland, College Park, College Park, MD 20742, USA

Abstract *Introduction:* The purpose of this study is to examine associations between deaths owing to terrorism, civil war, and one-sided violence from 1994–2000 and substance use disorder disability-adjusted life years (DALYs).

Methods: The relationship between terrorism, and related violence and substance use disorder morbidity and mortality among World Health Organization Member States in 2002, controlling for adult per capita alcohol consumption, illicit drug use, and economic variables at baseline in 1994.

Results: Deaths as a result of terrorism and related violence were related to substance use disorder DALYs: a 1.0% increase in deaths as a result of terrorism, war and one-sided violence was associated with an increase of between 0.10% and 0.12% in alcohol and drug use disorder DALYs. Associations were greater among males and 15–44 year-old.

Conclusion: Terrorism, war and one-sided violence may influence morbidity and mortality attributable to substance use disorders in the longer-term suggests that more attention to be given to rapid assessment and treatment of substance use disorders in conflict-affected populations with due consideration of gender and

* Corresponding author. Address: Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY 10032, USA. Tel.: +1 301 345 0994/990 8391.
  E-mail addresses: bkerridg@umd.edu, bradleykerridge@gmail.com (B.T. Kerridge).

age differences that may impact treatment outcomes in these settings. Priorities should be established to rebuild substance abuse treatment infrastructures and treat the many physical and mental comorbid disorders.

1. Introduction

Terrorism, civil war, and one-sided violence (e.g. genocide) have not received the attention from substance abuse researchers as they have other causes of substance use disorder morbidity and mortality. This is surprising in view of the increasing recognition of the indirect or longer-term consequences of civil war and related violence on morbidity and mortality associated with substance use disorders in conflict-affected populations [1—4].

Terrorism and related violence influences substance use disorder morbidity and mortality in the longer-term through several mechanisms. Terrorism and related violence damages health and economic infrastructures vital to the prevention of morbidity and premature mortality [5—6]. Substance abuse health care services are disrupted through damage to water supplies, electricity, and sewage disposal necessary for health services to operate, coupled with injury, death and disappearance of health care workers [7—9]. Agricultural systems are disrupted resulting in food rations, an important ingredient that has been implicated in facilitating home-brewed alcohol production in conflict-affected populations [7—10].

Other longer-term influences of terrorism and related violence on substance use disorders morbidity and mortality are demographic, that is, displacement and forced resettlement of a large number of persons resulting in reduced access to health resources, food, safe water and adequate sanitation [11]. Refugees are exposed to extreme trauma including witnessing and experiencing physical and sexual violence, murder of family and friends, loss of livelihood, self-esteem, social roles, cultural and social support, overcrowding, and poor living conditions [3,12—14]. Exposure to these severe stressors may result in excessive substance use as a coping strategy [4,15].

Populations affected by civil war and related violence also suffer from high rates of a variety of physical [16—18] and mental illnesses including depressive [13,16,19], psychotic [20], and anxiety disorders, especially post-traumatic stress disorder [1,21,22], conditions that have been shown to be highly comorbid with substance use disorders [18,23—25]. Health problems associated with substance use disorders in conflict-affected populations have also been documented, including alcohol-related suicide [26], increased human immunodeficiency virus (HIV) and other blood-borne viruses [27], and gender-based violence [6,28].

To date, two studies have addressed the broader, longer-term health consequences of armed conflict using a summary measure of health that combined information on both morbidity and mortality for a variety of specific diseases [29,30]. The measure was the disability-adjusted life year (DALY) that is derived as the sum of years of life lost to premature mortality and years of life lost due to disability in a population [31]. Ghobarah et al. [29,30] examined the relationship between civil war deaths from 1991—1997 and DALYs in 1999 attributable to all causes and specific diseases, controlling for an array of economic factors (e.g. health expenditures, urban growth), but substance use disorder DALYs were not examined as outcome measures.

Although the work by Ghobarah et al. [29,30] has increased the knowledge of the relationship between civil war and longer-term morbidity and mortality, limitations are noted. This research did not control directly for two major determinants of global morbidity and mortality, that is, the number of refugees/asylum seeker/displaced persons in the host country and the number of persons affected by natural disasters, nor did it consider contributing or pre-existing disease-specific factors that relate differently to different diseases. Foremost, Ghobarah et al. [29,30] also did not assess the impact of terrorist actions and one-sided violence (e.g. genocide, summary execution of prisoners) on longer-term morbidity and mortality. Between 1989 and 2004, the vast majority of fatalities from one-sided violence has taken place in countries experiencing armed conflict and terrorism [32—33]. Less than 1% of the total one-sided violence fatalities took place in countries that did not experience armed conflict and/or terrorism, suggesting that these three forms of intimately-related violence be counted to better reflect the nature and intensity that have increasingly characterized civil conflict.

Since the severity and scope of civil war have changed over the last three decades to increasingly include fatalities arising from terrorist actions and one-sided violence [32,34], the major exposure

variable in this study is the sum of these three types of intimately-related violence. It is hypothesized that an increasing number of deaths from terrorism, civil war and one-sided violence from 1994—2000 will be associated with increasing levels of morbidity and mortality as measured by DALYs in 2002 attributable to alcohol, drug and combined substance use disorder DALYs, controlling for disease-specific vulnerability factors (i.e., per capita alcohol consumption, illicit drug use) and an array of economic factors (e.g. health expenditures, urban growth) generally measured at baseline in 1994. Given the numerous mechanisms through which terrorism and related violence impacts substance use disorders, it is further hypothesized that civil war and related violence will adversely impact morbidity and mortality attributable to substance use disorders across the majority of age-sex subgroups of the populace at the risk for these disorders.

2. Methods

2.1. Outcome: disability-adjusted life years

The outcome variables were the number of DALYs (in thousands) due to alcohol, drug and substance use disorders in 2002 among the WHO Member States [35—36]. DALYs are calculated as the sum of years of life lost (YLL) due to premature mortality and healthy years of life lost to disability (YLD) [31]. The YLL measure was derived from multiplying the number of deaths from a particular cause (in this instance from alcohol, drug or substance use disorders) by the standard life expectancy at the age of death in years. To estimate YLD for alcohol, drug or substance use disorders for 2002, the number of incident cases for these disorders is multiplied by their average duration and a weight factor that reflects the severity of diseases on a scale from 0 (perfect health) to 1 (death) [31]. Alcohol use disorder DALYs included those attributable to the harmful use of alcohol and alcohol dependence, while drug use disorder DALYs included those attributable to harmful use of drugs and dependence. Alcohol and drug use disorder DALYs were examined separately and combined into substance use disorder DALYs across age-sex subgroups of the populace.

2.2. Exposure: deaths from terrorism, war and one-sided violence

Data on the number of deaths among victims and perpetrators resulting from terrorist actions from 1994—2000 were derived from the 2010 update of the Global Terrorism Database (GTD) conducted by the National Consortium for the Study of Terrorism and Response to Terrorism [37]. The definition of a terrorist incident includes terrorist incidents that are intentional, achieve some level of violence or threat of violence and are perpetrated by sub-national, non-state actors. In addition, to qualify as a terrorist incident, at least two of the following three criteria must be met: (1) the act must be aimed at attaining a political, economic, religious or social goal; (2) there is evidence of an intention to coerce, intimidate, or convey some other message to a larger audience than the immediate victims; and (3) the action must be outside the context of legitimate warfare activities [37].

Data for civil war deaths occurring between 1994 and 2000 were derived from the Battle Deaths Database [34,38]. Civil war is defined as armed conflict occurring between the government of a State and one or more internal opposition groups with or without intervention from other States. Armed conflict is defined as a contested incompatibility that concerns governments and/or territory where the use of armed force between two parties, of which at least one is the government of the State, results in at least 25 battle deaths [34].

Data on deaths resulting from one-sided violence for the years 1994—2000 were available from the One-sided Violence Database [39]. One-sided violence is defined as the use of armed force by the government of the State or by a formally-organized group against civilians which results in at least 25 deaths. These deaths include genocide and summary execution of prisoners. Only one-sided violence deaths perpetrated by government actors were included in the analyses since those perpetrated by formally-organized groups were included in the GTD.

2.3. Control variables: preexisting vulnerability factors

Per capita alcohol consumption was measured as the total recorded consumption expressed as liters of pure alcohol, computed as the sum of alcohol production and imports, less alcohol exports, divided by the adult population (aged 15 years and older). Country level data for the year 1994, or at baseline, were available from the WHO Global Health Observatory Database [40].

Illicit drug use is defined as the non-medical use of a variety of drugs that are prohibited by international law. The illicit drug use measure was the sum of the annual prevalence of illicit drug use related to cannabis, cocaine, opiates and amphetamine-type stimulants between 1993 and 1997 expressed as the percentage of the population above the

age of 15 years. Data on illicit drug use were derived from the United Nations Global Illicit Drug Trends Report [41].

2.4. Control variables: economic factors

Data on the number of refugees/asylum seekers/ displaced persons (in thousands) residing in each host country at the end of the year 1994 were available from the UN High Commissioner for Refugees (UNHCR) Statistical Yearbook [42,43]. Similar to all control variables used in the present analyses, except the number of deaths/homeless/affected by natural disasters from 1994–2000, the number of refugees/asylum seekers/displaced persons was measured at baseline, that is, as close to the year 1994 as the available data would allow.

The natural disaster variable combined the number of deaths (persons confirmed as dead or missing), number of homeless (persons needing immediate shelter) and number affected (i.e., people requiring immediate assistance in basic survival needs such as food, water and sanitation), in thousands, occurring at the country level for the years 1994–2000. Data were available from the Emergency Events Database maintained by the WHO Collaborating Center for Research on Epidemiology and Disasters [44].

This study uses total general government health expenditures as a percentage of total government expenditure (GGHE as a percentage of TGE) as a critical economic control variable of health financing systems. Data on GGHE as a percentage of TGE for 1994 were available from the WHO Global Health Observatory Database [40]. The measure of urbanization was the average percentage change in the urban population between 1990 and 1995, data collected routinely by the UN [45].

The ethnic heterogeneity variable in this study is derived from Vanhanen [46] that combines racial, linguistic and religious division, each measured as the percentage of the largest group of a country's population for the years 1994–1996. The inverse of these three percentages are summed to measure the degree of ethnic heterogeneity. Life expectancy at birth is defined as the average number of years that a newborn is expected to live if current mortality rates continue to apply, data routinely collected by the WHO [40].

2.5. Statistical analyses

Using deaths from terrorism, civil war and one-sided violence in the years 1994–2000 produce a 2-year lag to substance use disorder DALYs in 2002. DALYs in 2002 reflect years of life lost due to deaths from substance use disorders during 2002 plus the disability incurred by people suffering from the same conditions in 2002. Thus, these are not deaths or disabilities experienced in earlier years during which the terrorism and related violence was active.

Prior to the multivariable analyses, descriptive statistics will be presented for all study variables, including totals by age and sex and means as appropriate. Multivariable linear regression analyses were conducted to examine the relationships between deaths from terrorism, war and one-sided violence from 1994–2000 and DALYs due to alcohol, drug and substance use disorders in 2002, controlling for preexisting vulnerability and economic factors. The number of countries excluded from the multivariable analyses due to missing data for control variables was small: $n = 10$, $n = 8$ and $n = 10$ when alcohol, drug and substance use DALYs served as outcome variables, respectively. The countries excluded were largely small islands and microstates. Rwanda was also eliminated from all analyses because this country experienced 500,000 deaths due to genocide in 1994, rendering it an extreme outlier. DALY outcome measures, the war and related violence exposure measure, and three control measures (number of deaths/homeless/affected by natural disasters, number of refugees/asylum seekers/displaced persons and annual prevalence of illicit drug use) were log transformed as the result of skew in order to satisfy the linearity assumption of the linear regression model.

3. Results

In 2002, there were approximately 20.3 million DALYs attributable to alcohol use disorders among WHO Member States. The majority of these DALYs lost was among males (17.2 million) compared with females (3.1 million) and among 15–29 year-old (9.6 million) and 30–44 year-old (7.3 million) relative to 45–59 year-old (2.7 million), and those 60 years and older (431,678). There were approximately 7.4 million DALYs attributable to drug use disorders in 2002, largely among males (5.8 million) compared with females (1.6 million). Similar to alcohol use disorders, the majority of drug use disorder DALYs was lost among 15–29 year-old and 30–44 year-old (4.3 and 2.3 million) relative to 45–55 year-old (651,071), 5–14 year-old (176,389) and those 60 years and older (27,850).

Between 1994 and 2000 there were approximately 43,269; 632,851; and 27,895 deaths from terrorist actions, civil wars, and one-sided violence deaths (excluding 500,000 deaths from genocide in

Rwanda) among WHO Member States. With regard to pre-existing vulnerability factors, mean global per capita alcohol consumption in 1994 was approximately 4.9 l and the mean annual prevalence of cannabis, cocaine-type substances, amphetamine-type substances and opiates between 1993 and 1997 was approximately 1.7%.

With regard to economic control variables, there were 24.2 million refugees/asylum seekers/displaced persons in 1994 and 1.1 billion dead/homeless affected by natural disasters between 1994 and 2000 among the WHO Member States. Mean percentage change in urban population between 1990 and 1995 was 0.9% (SD = 1.01; range: −2.41% to 4.35%) and GGH as a percentage of TGE in 1994 was 10.1% (SD = 4.51; range: 0.00−27.56%). The mean ethnic heterogeneity score between 1994 and 1996 was 43.9% (SD = 35.19; range: 0.00−147.00%). Average life expectancy among WHO Member States in 1994 was 64.8 years (SD = 9.94, range: 38.4−79.5 years).

Table 1 shows the results from the multivariable linear regression analyses examining the relationships between deaths due to terrorism, war and one-sided violence from 1994−2000 and alcohol, drug and substance use disorder DALYs in 2002 by sex. Regardless of sex, deaths due to terrorism, war and one-sided violence were significantly related to alcohol, drug and substance use disorder DALYs. Overall, the coefficient for the association between deaths due to terrorism, civil war and one-sided violence and alcohol use disorder DALYs was 0.10, indicating that a 1.0% increase in deaths due to terrorism, war and one-sided violence from 1994−2000 was associated with a 0.10% increase in alcohol use disorder DALYs in 2002 (a 1% increase in deaths due to terrorism and related violence and is associated a 0.10% increase in alcohol use disorder DALYs). Further, a 1.0% increase in deaths due to terrorism, war and one-sided violence was associated with 0.12% and 0.14% increase in DALYs lost to drug use disorders and substance use disorders, respectively. The magnitude of the associations was somewhat greater for males relative to females.

Tables 2 and 3 show the relationships between deaths due to terrorism, war and one-sided violence from 1994−2000 and alcohol and drug use disorder DALYs in 2002 by sex and age subgroups of the world populace, respectively. The results were generally consistent with the overall results with the following exception: terrorism, war and one-sided violence deaths were significantly related to alcohol and drug use disorder DALYs with the strongest associations observed among

15−44 year-old relative to the older age groups. In general, associations remained somewhat greater among males than females across all age subgroups of the population.

4. Discussion

Deaths from terrorist actions, civil war and one-sided violence from 1994−2000 were positively associated to alcohol, drug and substance use disorder DALYs occurring in 2002, after controlling for baseline alcohol consumption, illicit drug use and a variety of economic measures empirically shown to affect public health. In contrast with prior studies [29,30], the adverse impact of terrorism, civil war and one-sided violence on DALYs attributable to substance use disorders was found across a majority of sex-age subgroups of the populace. Although Ghobarah et al. [29,30] did not find evidence for an association between conflict and alcohol, drug and substance use disorders, they did observe sex-and-age-specific relationships between conflict and DALYs from other causes that have been associated with alcohol, including Human Immunodeficiency Virus (HIV), tuberculosis, transportation accidents, homicide, and stomach and liver cancers. These discrepancies may, in part, be due to broadening the major exposure variable, civil war deaths, to include deaths due to terrorist actions and one-sided violence, applying appropriate logarithmic transformations to DALY outcome measures to render the data suitable for linear regression analysis and differences in the years in which conflict and DALY measures were examined in each study.

Prior research on the longer-term public health consequences of terrorism, war and one-sided violence has not focused on neuropsychiatric disorders, including substance use disorders, while the existing terrorism and war trauma literature has primarily focused on one longer-term mental health outcome of trauma, that is, post-traumatic stress disorder [16,17,21,22]. However, psychological stresses associated with terrorism, war and one-sided violence arising from displacement, loss, grief and fear, social isolation, insecurity, loss of status and community, and witnessing and experiencing acts of violence such as summary execution, rape and assassinations can manifest in a variety of mental disorders. These disorders include a variety of depressive, anxiety and psychotic disorders [1,13,16−17,19], many of which are highly comorbid with substance use disorders [23−24]. Excessive substance use may also reflect self-medication for these psychiatric conditions,

Table 1 Multivariable linear regression analyses between terrorism, civil war, and one-sided violence deaths from 1994—2000 and DALYs attributable to alcohol, drug and substance use disorders in 2002 by sex.

Measures	Alcohol Use Disorder DALYs, 2002			Drug Use Disorder DALYs, 2002			Substance Use Disorder DALYs, 2002		
	Male B (t)	Female B (t)	Total B (t)	Male B (t)	Female B (t)	Total B (t)	Male B (t)	Female B (t)	Total B (t)
Terrorism, war and one-sided violence deaths, 1994—2000	0.10* (3.02)	0.06* (2.49)	0.10* (3.06)	0.12* (3.77)	0.08* (3.33)	0.12* (3.81)	0.14* (4.27)	0.10* (3.83)	0.14* (4.31)
Per capita alcohol consumption, 1994	0.15* (6.59)	0.12* (6.64)	0.16* (6.76)	—	—	—	0.11* (4.56)	0.08* (4.35)	0.11* (4.60)
Prevalence of drug use, 1992—1997	—	—	—	0.46* (4.66)	0.38* (4.91)	0.48* (4.68)	0.05* (1.83)	0.05* (2.55)	0.05* (1.97)
Number of refugees/asylum seekers/ displaced persons, 1994	0.10* (2.20)	0.06* (1.70)	0.10* (2.19)	0.15* (3.54)	0.11* (3.21)	0.16* (3.56)	0.12* (2.70)	0.10* (2.54)	0.12* (2.68)
Number of deaths/homeless/affected by natural disasters, 1994—2000	0.35* (11.46)	0.24* (10.38)	0.36* (11.46)	0.23* (8.02)	0.17* (7.62)	0.24* (8.03)	0.36* (11.86)	0.28* (11.09)	0.36* (11.77)
Urban growth, 1990—1995	0.10 (1.07)	0.05 (0.75)	0.09 (1.05)	0.04 (0.49)	0.02 (0.25)	0.04 (0.49)	0.09 (1.00)	0.05 (0.72)	0.09 (0.96)
Health expenditures, 1994	0.02 (1.16)	0.03 (1.86)	−0.03 (1.34)	−0.03 (−1.60)	−0.02 (−1.00)	−0.03 (−1.45)	−0.01 (−0.35)	<−0.01 (−.03)	−0.01 (−0.24)
Ethnic heterogeneity, 1994—1996	<0.01 (1.07)	<0.01 (0.58)	0.01 (1.15)	<0.01 (0.29)	<−0.01 (0.48)	<0.01 (0.24)	<0.01 (0.59)	<0.01 (0.34)	<0.01 (0.64)
Life expectancy at birth, 1994	0.07* (5.84)	0.06* (6.49)	0.07* (5.95)	0.04* (3.42)	0.03* (3.11)	0.04* (3.32)	0.07* (5.63)	0.05* (5.88)	0.07* (5.58)
Adjusted R^2	0.64	0.62	0.65	0.58	0.55	0.58	0.66	0.64	0.66

Note: N for alcohol use disorder DALYs = 182 countries; N for drug use disorder DALYs = 184 countries; N for substance use disorder DALYs = 182 countries; Beta-coefficients with asterisks significant at $p < 0.05$; Figures in parentheses are t-values.

Table 2 Multivariable linear regression analyses between terrorism, civil war, and one-sided violence deaths from 1994—2000 and DALYs attributable to alcohol use disorders in 2002 by sex and age.

Measures	Male				Female			
	15—29 B (t)	30—44 B (t)	45—59 B (t)	60+ B (t)	15—29 B (t)	30—44 B (t)	45—59 B (t)	60+ B (t)
Terrorism, war and one-sided violence deaths, 1994—2000	**0.08**[*]	**0.08**[*]	**0.06**[*]	**0.04**[*]	**0.06**[*]	**0.04**[*]	**0.03**[*]	0.01
	(2.63)	(2.69)	(2.70)	(2.30)	(2.39)	(1.88)	(1.86)	(1.57)
Per capita alcohol consumption, 1994	**0.14**[*]	**0.12**[*]	**0.09**[*]	**0.04**[*]	**0.09**[*]	**0.09**[*]	**0.06**[*]	**0.02**[*]
	(6.38)	(6.15)	(5.70)	(3.34)	(5.54)	(5.80)	(5.07)	(3.62)
Number of Refugees/asylum seekers/displaced, 1994	0.06	**0.11**[*]	**0.08**[*]	**0.05**[*]	0.02	**0.07**[*]	**0.05**[*]	**0.03**[*]
	(1.32)	(2.68)	(2.39)	(2.06)	(0.65)	(2.29)	(2.22)	(2.77)
Number affected by natural disasters, 1994—2000	**0.33**[*]	**0.29**[*]	**0.23**[*]	**0.13**[*]	**0.22**[*]	**0.17**[*]	**0.12**[*]	**0.05**[*]
	(11.26)	(10.97)	(10.47)	(8.51)	(9.94)	(8.78)	(7.83)	(5.76)
Urban growth, 1990—1995	0.10	0.08	0.04	0.03	0.04	0.03	0.02	<0.01
	(1.13)	(0.96)	(0.57)	(0.64)	(0.67)	(0.55)	(0.38)	(0.19)
Health expenditures, 1994	0.02	0.01	0.01	0.01	**0.03**[*]	0.02	0.01	0.01
	(1.16)	(0.74)	(0.94)	(0.81)	(1.84)	(1.47)	(0.98)	(0.70)
Ethnic heterogeneity, 1994—1996	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<−0.01	<0.01
	(0.93)	(0.70)	(0.10)	(−0.30)	(0.36)	(0.28)	(−0.13)	(0.29)
Life expectancy at birth, 1994	**0.06**[*]	**0.06**[*]	**0.05**[*]	**0.03**[*]	**0.05**[*]	**0.05**[*]	**0.03**[*]	**0.01**[*]
	(5.40)	(6.10)	(6.19)	(5.73)	(6.49)	(6.10)	(5.31)	(3.96)
Adjusted R^2	0.61	0.62	0.61	0.50	0.58	0.57	0.51	0.38

Note: N = 182 countries; Beta-coefficients with asterisks significant at $p < 0.05$; figures in parentheses are t-values.

Table 3 Multivariable linear regression analyses between terrorism, civil war, and one-sided violence deaths from 1994—2000 and DALYs attributable to drug use disorders in 2002 by sex and age.

Measures	Male				Female			
	15—29 B (t)	30—44 B (t)	45—59 B (t)	60+ B (t)	15—29 B (t)	30—44 B (t)	45—59 B (t)	60+ B (t)
Terrorism, war and one-sided violence deaths, 1994—2000	**0.09***	**0.09***	**0.06***	**<0.01***	**0.06***	**0.05***	**0.03***	0.01
	(3.34)	(3.53)	(3.02)	(2.37)	(2.82)	(2.90)	(2.51)	(1.61)
Prevalence of illicit drug use, 1993—1997	**0.42***	**0.39***	**0.26***	**0.05***	**0.33***	**0.30***	**0.18***	**0.03***
	(4.86)	(4.78)	(4.21)	(3.17)	(4.83)	(5.13)	(4.65)	(3.95)
Refugees/asylum seekers/displaced, 1994	**0.12***	**0.12***	**0.08***	0.01	**0.08***	**0.08***	**0.04***	**0.01***
	(3.23)	(3.37)	(2.90)	(1.00)	(2.84)	(3.04)	(2.67)	(1.71)
Number affected by natural disasters, 1994—2000	**0.21***	**0.17***	**0.10***	**0.02***	**0.15***	**0.11***	**0.06***	**0.01***
	(8.18)	(6.99)	(5.54)	(4.01)	(7.21)	(6.62)	(4.93)	(3.81)
Urban growth, 1990—1995	0.03	0.03	<0.01	−0.01	<−0.01	<0.01	<−0.01	−0.01
	(0.41)	(0.44)	(0.11)	(−0.56)	(−0.04)	(0.23)	(−0.07)	(−0.74)
Health expenditures, 1994	−0.02	**−0.03***	**−0.04***	**<−0.01***	<−0.01	<−0.02	**−0.02***	**−0.01***
	(−1.09)	(−2.15)	(−2.99)	(−2.36)	(−0.22)	(−1.49)	(−2.60)	(−1.73)
Ethnic heterogeneity, 1994—1996	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	(0.49)	(0.43)	(0.49)	(1.28)	(0.77)	(0.68)	(0.72)	(1.21)
Life expectancy at birth, 1994	**0.03***	**0.04***	**0.03***	**0.01***	**0.02***	**0.02***	**0.01***	**0.01***
	(2.74)	(4.27)	(3.93)	(2.29)	(2.43)	(3.47)	(3.31)	(2.64)
Adjusted R^2	0.57	0.54	0.45	0.30	0.51	0.50	0.41	0.27

Note: N = 184 countries; Beta-coefficients with asterisks significant at $p < 0.05$; figures in parentheses are t-values.

thereby increasing incidence and severity of substance use disorders in conflict-affected populations. From an epidemiological perspective, the magnitude and distribution of a variety of trauma-related disorders as a collective experience in populations exposed to terrorism and related violence are far from being understood. The results of this study, however, clearly highlight substance use disorders as major longer-term trauma-related outcomes of terrorism, war and one-sided violence for which interventions must be developed and implemented in conflict-affected populations.

Prior research on the public health consequences of terrorism, war and one-sided violence has also generally not considered other contributing factors to specific disorders such as pre-existing vulnerability factors [16—17]. Per capita alcohol consumption and illicit drug use at baseline were included as control variables consistent with the GBD perspective that substance use disorder DALYs are highly related to substance use. Per capita alcohol consumption and illicit drug use in 1994 were significantly related to alcohol and drug use disorder DALYs in 2002, respectively, a result generalizing to the majority of sex-age subgroups of the populace. Unlike per capita alcohol consumption, illicit drug use may have also served as a proxy control measure in this study for the availability of illicit substances as lootable natural resources. With the end of the Cold War, State financing for terrorism and insurgent movements were dramatically reduced and the cultivation and sale of psychotropic substances became a lucrative source of alternative funding [47]. This was particularly true for coca, opium and cannabis that are easily appropriated, highly lucrative, and not easily stopped due to their high value-to-size ratio.

The somewhat stronger associations between terrorism, war and one-sided violence and alcohol and drug use disorder DALYs among males than females may in large part be due to the greater prevalence and the risk of alcohol and drug use disorders among males consistently observed in numerous nationally representative surveys [24,48—49]. Stronger associations between terrorism and related violence and alcohol and drug disorder DALYs among 15—44 year-old relative to older age groups (45 years and older) likely reflect the distribution of ages of onset of these disorders that peak during early adolescence through early adulthood, declining sharply after the fourth decade of life [23,49—50]. Understanding the sex and age differences observed in associations between terrorism and related violence and alcohol and drug use disorder DALYs will be critical in developing and implementing effective gender-and-age-specific interventions for these disorders in conflict-affected populations.

Although not the focus of attention in this study, health expenditures as a percentage of total government expenditure were negatively related to drug use disorder DALYs, an association not observed for alcohol use disorders. These findings highlight the need for future research on conflict and health to include control measures on health financing specific to substance use disorders. However, the data on alcohol and drug treatment services with respect to setting (e.g. mental health vs. specialized services), financing (e.g. tax revenue, social health insurance), efficiency, accessibility, service quality, cost-effectiveness and degree of cohesiveness are not yet available for the majority of WHO Member States (WHO 2011b). Country-level information on health services for substance use disorders, and possible differentials in treatment financing characteristics for alcohol and drug use disorders, will be vital in the future to implementing national and international responses to burden of disease and disability resulting from substance use disorders in conflict-affected populations.

Future research on the association of terrorism, civil war and one-sided violence would benefit from replication using different data years in which terrorism and related violence and DALYs due to alcohol, drug and substance use disorders are measured. The substance use disorder DALYs examined in this study could also be extended to the study of other alcohol-related diseases, including HIV, transportation accidents, tuberculosis, homicide and certain cancers. Selection of additional pre-existing vulnerability and economic factors specific to these other alcohol-related disease DALYs will, however, be subject to the availability of ecological data at the country level and a more nuanced consideration of appropriate time lags. Foremost, the quantitative data analyzed here should be combined with more contextual information and field reports in countries that have experienced terrorism, civil war and one-sided violence in order to more fully understand the epidemiological, political and social processes that drive the association between terrorism and related violence and people's health and well-being.

This study combined deaths from terrorist actions and one-sided violence with deaths from civil war to more fully characterize the nature of violence occurring during armed conflict. The present study has also benefitted from three new databases designed to separately measure deaths from ter-

rorism, civil war and one-sided violence more reliably than in the past and the use of appropriate data transformations to ensure the suitability of the data for statistical models employed. This study uniquely focused on substance use disorders as major adverse longer-term consequences of terrorism and related violence and underscored the importance of including pre-existing disease-specific covariates as explanatory variables in associated models. Limitations, however, are noted. Although there always exists a potential of omitting an important variable from the analyses presented herein, model R^2s were high, indicating a relatively complete specification of influences. The ecological design of this study cannot fully capture within-country variability, and future research in this area is warranted. However, this study can play an essential role in defining the impact of major public health problems such as terrorism, war and one-sided violence that operate at a population level to influence morbidity and mortality. Further, measures used in the present study are associated with various levels of reliability across WHO Member States. Accordingly, the results of this study and their interpretation should be tempered by the limits of the psychometric properties of the data. However, the measures of interest in this research are the most reliable that have ever been available [51—53], permitting plausible inferences of the longer-term influences of civil war and related violence on DALYs attributable to substance use disorders that can begin to form the evidence-based substance abuse interventions among conflict-affected populations.

In summary, violence associated with terrorist actions, civil wars and one-sided violence appears to have a significant longer-term impact substance use disorder morbidity and mortality independent of pre-existing alcohol and illicit drug use and economic factors whose relationship to mortality and morbidity attributable to a variety of diseases and conditions has been well established in the literature. The results of the present study suggest that greater attention can be given to the prevention and treatment of substance use disorders in conflict-affected populations, including brief interventions targeted at high-risk substance use, provisions for needles and syringes, and management of withdrawal and other acute conditions [54—55]. It will also be critical for future intervention programs to identify phenomena that drive the observed gender and age differences in associations between terrorism and related violence and substance use disorder DALYs that may be unique to conflict-affected populations, with a view toward improving treatment effectiveness in these settings. This study also highlights the need to strengthen substance abuse treatment systems among conflict-affected populations that will be critical to implementing more comprehensive treatment services for substance use disorders including cognitive, behavioral and drug therapies for substance dependence and identification and treatment of a variety of physical and psychiatric disorders that are often comorbid with substance use disorders [7].

Role of funding

Acknowledgements

References

[1] DiMaggio C, Galea S. The behavioral consequences of terrorism: a meta-analysis. Acad Emer Med 2006;13:559—66.

[2] Murray CJL, King G, Lopez AD, Tomijima N, Krug G. Armed conflict as a public health problem. Brit Med J 2002;324:346—9.

[3] Strathdee SA, Stachowiak JA, Toss CS, Al-Delaimy WK, Wiebel W, Hankins C, et al. Complex emergencies, HIB, and substance use: no ''big easy'' solution. Sub Use Mis 2006;14:1637—51.

[4] Weaver H, Roberts B. Drinking and displacement, a systematic review of the influence of forced displacement on harmful alcohol use. Sub Use Mis 2010;45:2340—55.

[5] Colombatti R, Vieria CS, Bassani F, Cristofoli R, Coin A, Bertinato L, et al. Contamination of drinking water sources during the rainy season in an urban post-conflict community in Guinea Bissau: implications for a sanitation priority. Afr J Med Sci 2009;38:155—61.

[6] World Health Organization. Violence — a global public health problem. Geneva, Switzerland: World Health Organization; 2010.

[7] Ezard N, Oppenheimer E, Burton A, Schilperoord M, McDonald D, Adelekan M, et al. Six rapid assessments of alcohol and other substance use in populations displaced by conflict. Conf Health 2011;5:1—15.

[8] Hansch S, Burkholder B. When chaos reigns: responding to complex emergencies. Harv Int Rev 1996;18:53—4.

[9] Perrin P. War and public health. Geneva, Switzerland: International Committee of the Red Cross; 1996.

[10] Adelekan M. Rapid assessment of substance use and HIV vulnerability in Kakuma refugee camp and surrounding community; Kakuma, Kenya. Geneva, Switzerland: United Nations High Commissioner for Refugees; 2006.

[11] Asgary R, Segar N. Barriers to health care among refugee asylum seekers. J Health Poor Und 2011;22:506—22.

[12] Bonger B, Brown LM, Beutler LE, Breckenridge JN, Zimbardo PG. Psychology of terrorism. New York: Oxford University Press; 2007.

[13] de Jong K, van der Kam S, Ford N, Hargreaves S, van Oosten R, Cunningham D, et al. The trauma of ongoing conflict and displacement in Chechnya: quantitative assessment of living conditions, and psychosocial and general health status among war displaced in Chechnya and Ingushetia. Conf Health 2007;1:1—13.

[14] Porter M, Haslam N. Predisplacement and postdisplacement factors associated with mental health of refugees and internally displaced persons: a meta-analysis. JAMA 2005;294:602—12.

[15] Johnson TP. Alcohol and drug use among displaced persons: a review. Subst Use Misuse 1996;31:1853—89.

[16] Levy BS, Sidel VW. Terrorism and public health. New York (NY): Oxford; 2003.

[17] Levy BS, Sidel VW. War and public health. New York (NY): Oxford University Press; 2007.

[18] Schnurr PP, Green BL. Trauma and health: physical consequences to extreme stress. Washington (DC): American Psychological Association; 2004.

[19] Priebe S, Bogic M, Adjukovic D, Franciskovic T, Galeazzi GM, Kucukalic A, et al. Mental disorders following war in the Balkans, a study in 5 countries. Arch Gen Psychiatry 2010;67:518—28.

[20] Jones L, Asare JB, El Masri M, Moharaj A, Sherief H, von Ommeren M. Severe mental disorders in complex emergencies. Lancet 2009;374:654—61.

[21] Murthy RS. Mass violence and mental health: recent epidemiological findings. Int Rev Psych 2007;19:183—92.

[22] Pederson D. Political violence, ethnic conflict, and contemporary wars: broad implications for health and social wellbeing. Soc Sci Med 2002;55:175—90.

[23] Compton WM, Thomas YF, Stinson FS, Grant BF. Prevalence, correlates, disability and comorbidity of DSM-IV drug abuse and dependence in the United States. Arch Gen Psychiatry 2007;64:566—76.

[24] Hasin DS, Stinson FS, Ogburn E, Grant BF. Prevalence, correlates, disability and comorbidity of DSM-IV alcohol abuse and dependence in the United States. Arch Gen Psychiatry 2007;64:830—42.

[25] Pietrzak R, Goldstein RB, Southwick SM, Grant BF. Prevalence of axis I comorbidity of full and partial posttraumatic stress disorder in the United States: results from wave 2 of the national epidemiologic survey on alcohol and related conditions. J Anx Disord 2011;25:456—65.

[26] Bosnar A, Stemberg V, Cuculic D, Zambolo G, Stifter S, Cocklo M. Suicide rate after the 1991—1995 war in South-western Croatia. Arch Med Res 2004;35:344—7.

[27] Strathdee SA, Zafar T, Brahmbhatt H, Baksh A, Al Hassan S. Rise in needle sharing among injection drug users in Pakistan during the Afghanistan War. Drug Alc Depend 2003;71:17—24.

[28] Ondeko R, Purdin S. Understanding the causes of gender-based violence. Forced Migr Rev 2004;19:30.

[29] Ghobarah HA, Huth P, Russett B. Civil wars kill and maim people-long after the shooting stops. Am Pol Sci Rev 2003;97:189—202.

[30] Ghobarah HA, Huth P, Russett B. The post-war public health effects of civil conflict. Soc Sci Med 2004;59:869—84.

[31] Murray CJL, Lopez AD. The global burden of disease. Geneva, Switzerland: World Health Organization; 1996.

[32] Eck K, Hultmann L. One-sided violence against civilians in war: insights from new fatality data. J Peace Res 2007;44:233—46.

[33] Ericksson M, Wallenstein P, Sollenberg M. Armed conflict 1989—2002. J Peace Res 2003;40:593—607.

[34] Lacina B, Gleditsch NP. Monitoring trends in global combat: a new dataset of battle deaths. Eur J Pop 2005;21:145—66.

[35] Mathers CD, Bernard C, Iburg KM, Inoue M, Fat DM, Shibuya K, et al. Global burden of disease in 2002: data sources, methods and results. Geneva, Switzerland: World Health Organization; 2003.

[36] World Health Organization. Disability-adjusted life years by country, sex and age. Geneva, Switzerland: World Health Organization; 2004.

[37] National Consortium for the Study of Terrorism and Response to Terrorism. Global terrorism database code-book, 1970—2010. College Park (MD): National Consortium for the Study of Terrorism and Response to Terrorism; 2010.

[38] Lacina B. Battle deaths dataset 1946—2005, codebook for version 3.0. Oslo, Norway: Center for the Study of Civil War, International Peace Research; 2009.

[39] Kreutz J, Eck K. One-sided violence codebook, version 1.3. Uppsala, Sweden: Department of Peace and Conflict Research; 2011.

[40] World Health Organization. Global health observatory database. Geneva, Switzerland: World Health Organization; 2011.

[41] United Nations Office of Drug Control and Crime Prevention. Global illicit drug trends, 1999. New York: United Nations; 1999.

[42] United Nations High Commissioner for Refugees. Populations of concern to UNHCR. A statistical overview. Geneva, Switzerland: United Nations High Commissioner for Refugees; 1995.

[43] United Nations High Commissioner for Refugees. The state of the world's refugees: fifty years of humanitarian action. Oxford, England: United Nations High Commissioner for Refugees; 1995.

[44] Guha-Sapir D, van Panhuis W. Conflict-related mortality: an analysis of 37 datasets. Disasters 2004;28, 418—8.

[45] United Nations. United Nations millennium goals database. New York: United Nations; 2011.

[46] Vanhanen T. Domestic ethnic conflict and ethnic nepotism: a comparative analysis. J Peace Res 1999;36:55—73.

[47] Cornell SE. The interaction of narcotics and conflict. J Peace Res 2005;42:751—60.

[48] Demyttenaere K, Bruffaerts R, Posada-Villa J, Gasquet I, Kovess V, Lepin JP. Prevalence, severity and unmet need for treatment of mental disorders in the World Health Organization Mental Health Surveys. JAMA 2004;291:2581—90.

[49] Kessler RC, Angermeyer M, Anthony JC, de Graaf R, Demyttenaerek K, Gasquet I. Lifetime prevalence and age-of-onset distributions of mental disorders in the World Health Organization's World Mental Health Survey Initiative. World Psych 2007;62:168—76.

[50] Degenhardt L, Hall W, Werner-Smith M, Lynsky M. Illicit drug use. In: Ezzati M, Lopez AD, Rogers A, Murray CJL, editors. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors, vol. 1. Geneva, Switzerland: World Health Organization; 2004. p. 1109—76.

[51] Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL. Global burden of disease and risk factors. Washington (DC): World Bank; 2006.

[52] Mathers CD. Uncertainty and data availability for global burden of disease estimates, 2000—2002. Geneva, Switzerland: World Health Organization; 2006.

[53] Mathers CD, Ma F, Inoue M, Rao C, Lopez AD. Counting the dead and what they died from: an assessment of the global status of cause of death data. Bull World Health Org 2000;83:171—7.

[54] United Nations High Commissioner for Refugees/World Health Organization. Rapid assessment of alcohol and other substance use in conflict-affected and displaced populations: a field guide. Geneva, Switzerland: United Nations High Commissioner for Refugees; 2008.

[55] World Health Organization. Global status report on alcohol and health. Geneva, Switzerland: World Health Organization; 2011.

Available online at www.sciencedirect.com

ScienceDirect