Civil Wars Kill and Maim People—Long after the Shooting Stops

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Abstract

Political scientists have conducted only limited systematic research on the consequences of war for civilian populations. Here we argue that the civilian suffering caused by civil war extends well beyond the period of active warfare. We examine these longer-term effects in a cross-national (1999) analysis of World Health Organization new fine-grained data on death and disability broken down by age, gender, and type of disease or condition. We test hypotheses about the impact of civil wars, and find substantial long-term effects, even after controlling for several other factors. We estimate that the additional burden of death and disability incurred in 1999, from the indirect and lingering effects of civil wars in the years 1991-97, was about equal to that incurred directly and immediately from all wars in 1999. This impact works its way through specific diseases and conditions, and disproportionately affects women and children.

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The direct and immediate casualties from civil wars are only the tip of the iceberg of their longer-term consequences for human misery. That civil wars kill and maim people is hardly surprising. But it is not just a matter of direct war casualties during the conflict. Civil wars continue to kill people indirectly, well after the shooting stops. These new deaths (and disabilities) are overwhelmingly concentrated in the civilian population.[1] The health effects during specific civil wars are relatively well known,[2] but the general and longer-term impact is not. Our aim is to examine the systematic longer-term effects of civil wars on public health. This study represents is part of a larger research program on the comparative analysis of the political determinants of public health conditions in many countries. We believe that politics plays an important role in shaping public health, but there is only limited systematic research by political scientists on the topic (recent examples are Price-Smith 2002, Przeworski, Alvarez, Cheibub, and Limongi 2000). Here we focus on the impact of political violence on public health by developing and testing hypotheses about the long-term consequences of civil war for civilian populations.

In prior research we found that civil wars significantly reduced aggregate measures of national health performance (Ghobarah, Huth, Russett, and King 2001). In that study we worked with national-level data on all countries compiled by the World Health Organization on DALE, or disability-adjusted life expectancy. This measure takes into account both years of life lost to disease and injury and years of healthy life lost to long-term disability. In this study we build on these initial findings to examine more fully both theoretically and empirically the ways in which civil wars produce longer-term impacts on public health conditions in countries. Specifically, we use another WHO data set: one on DALYs, or disability-adjusted life-years, which contains detailed information on 23 major diseases and conditions on categories of the population distinguished by gender and 5 different age groups. We focus on the effects of civil war in increasing the subsequent incidence of death and disability due to particular infectious diseases and conditions in the different population sub-groups.

Overall, WHO (2000: 168, 174) estimates that 269,000 deaths and 8.44 million DALYs were incurred in 1999 as direct and immediate effects of all wars, civil and international. Based on the results we report in this paper, we estimate that nearly as many additional DALYs--another 8.01 million--were lost in 1999 indirectly under various disease groups, as a result of the lingering effects of civil wars during the years 1991-97.

We address two important gaps in existing research on war: 1) the consequences of armed conflict and war for civilian populations (Stein and Russett 1980), and 2) the study of peace building in the aftermath of civil war. Concerning the first gap, the systematic study of war focuses heavily on the onset of armed conflict with additional literatures addressing various aspects of the military conduct and outcome of wars in which states and national armed forces are the primary unit of observation. Political scientists rarely address the wartime consequences for civilians, and even more unusual are studies of the post-war consequences for civilian populations. This is an important omission, since the severity of war for civilians both in the immediate and longer-term varies considerably across wars and deserves careful theoretical and empirical analysis. We begin to address this gap by focusing on the civilian consequences of civil wars that extend into post-war periods.

Regarding the second gap, the literature focuses largely on outside intervention into civil wars and its impact on the termination of wars and the prospects for successful peace building in post-civil war periods (e.g., Doyle and Sambanis 2000, Hartzell et al 2001, Regan 2000, Walter 2002). This valuable peace building literature addresses political consequences such as political stability, the recurrence of violence, and democratization. Our work addresses post-civil war developments, but instead of focusing on political outcomes as dependent variables we concentrate on public health conditions and performance as the outcomes to be explained. These outcomes are important in their own right, and also have consequences for more familiar political variables (e.g. Price-Smith 2002: ch.2).

NEW MEASURES OF PUBLIC HEALTH

WHO's new measure of overall health achievement (DALE) discounts the total life expectancy at birth in each country by the number of years the average individual spends with a major disability as the burden of disease or injury—the gap between total life expectation and expected years without disability. It is estimated from three kinds of information: the fraction of the population surviving to each age level (calculated from birth and death rates), individual-level data on the incidence and prevalence of various diseases and disabilities at each age, and the weight assigned to debilitation from each type of condition. The result is the proportion of the population dying or suffering from disabilities, given the average number of years of healthy life that a newborn member of the population could expect to live.

The measure taps the concept of years of healthy and productive life, and so is expressed in intuitively meaningful units. It varies substantially by region of the world and income level. In rich countries, more disabilities are associated with chronic conditions of old age—and, at that point, relatively short life expectancies. By contrast, in poor tropical countries infant mortality is much higher, and more health problems derive from the burden of infectious diseases, like malaria and schistosomiasis, which are carried by children and young adults who may live a long time with seriously impaired health and quality of life. Empirically, the share of simple life expectancy lost to disability varies from under 9 percent in the healthiest regions of the world to over 14 percent in the least healthy ones (WHO 2000:28).

This information-intensive measure requires not just vital registration data for births and deaths, but expensive health surveys of death, disease, and disability by age and gender--in principle in each country. These data only began to be collected on a global basis by WHO for the year 1990 (Murray and Lopez, eds. 1996), with a comprehensive report being its 1999 survey (WHO 2000). Life tables for 1999 for all 191 WHO members were developed from surveys supplemented by censuses, sample registration systems, and epidemiological analyses of specific conditions. WHO experts provided estimates of their degree of uncertainty about the data's

accuracy, subjected it to a variety of statistical tests for incompleteness and bias, and adjusted it accordingly. Then they estimated disease-specific disability rates for all countries in each of 14 regions of the world defined geographically and epidemiologically, and used these to adjust available data on death rates at different age levels and life expectancy for each country (Mathers et al. 2000). The index of expected disability-free life ranges from 74.5 (Japan) to 29.5 (Sierra Leone), with a median of 60.9 (Belize).

While the limitations need to be borne in mind, these data are the best that have ever been available, and do permit us to make some plausible systematic inferences about the influences on health conditions across countries.[3] Our dependent variable is disaggregated by WHO from the summary DALE estimates. This measure (DALY) measures the effect of death and disability on population groupings comprised of each gender in five age groups (0-4, 5-14, 15-44, 45-59, and 60 and older). These breakdowns are valuable because vulnerability to different diseases varies widely by age and gender. The data were initially compiled on the number of deaths in a year from each of more than 100 categories of disease or health condition. To the deaths are added estimates of the years of healthy life typically lost due to disability from the incidence of the condition and the estimated number of new cases in the period. The number of years of healthy life lost is obtained by multiplying the average duration of the condition (to remission or death) by a severity weight for the disability. Thus the DALYs for 1999—aggregated by WHO into 23 major disease categories for analysis--reflect the life years lost due to deaths from a particular condition contracted during the year plus the expected disability to be incurred by other people who suffered from the same condition in that same year.[4] In other words, these are not disabilities incurred from conditions contracted in earlier years when a civil war was active.[5]

THEORETICAL FRAMEWORK

In developing hypotheses about the longer-term effects of civil war on public health we draw on a general theoretical framework for studying the causes of public health. Within this framework we begin by discussing the general relationships between politics and public health

and then elaborate the more specific causal connections linking civil war to public health. In broad theoretical terms, there are four major influences on public health in societies and political conditions and processes in turn are important causes of each of these major influences on health. To summarize, health conditions are shaped by the interplay of exposure to conditions that create varying risks of death and disease for different groups in society, and the ability of groups in society to gain access to health care and receive the full range of benefits produced by the health care system. Public health performance thus reflects the political competition among groups over investment and resource decisions regarding the level and distribution of health services.

1) *The extent to which populations are exposed to conditions that increase the risk of death, disease, and disability*. At the most basic level, populations across and within countries are exposed in varying degrees to the risk of disease, injury, and death. Geography and levels of economic development are basic factors. People in tropical climates are at greater risk of many infectious diseases. In poor countries much of the population lives in rural areas where access to health care and its quality are generally lower than in urban areas. As a result, preventive care is less available and the treatment of disease and injury is less extensive and effective. At the same time, health care systems often lag in large urban areas experiencing rapid population growth, with the result that some urban populations are at greater risk to a variety of health problems (Foege 2000, Garrett 2001, Shah 1997).

2) *The financial and human resources available for addressing the public health needs of populations*. Higher levels of income and wealth provide a larger pool of financial and human resources to draw upon. Public and private actors can afford to spend more on health care needs and to support the development and purchase of more advanced medical technologies. A larger pool of available financial resources will enable greater investments in developing human resources for medical care through training more doctors and health care specialists. One major influence of politics on the pool of available resources for the public health care system stems largely from the disruptive effects of political instability on economic growth. Irregular transfers

of political power and political unrest in non-democratic systems reduce growth rates (Przeworski et al. 2000 ch.4).

3) *The level of resources actually allocated to public health needs by the private and public sectors.* Public health analysts consistently argue that education levels in society affect public health (e.g. Evans et al 2000a). A more educated population is likely to be more knowledgeable of health risk factors, to support greater investments and expenditures, and to utilize heath care services. But claims to resources for public health compete with other demands, and politics can prove crucial in deciding how resources are allocated. Political leaders wish to retain power. They must form a winning coalition and satisfy a sufficient portion of those who are politically active. To do so they distribute private goods to their supporters, and provide collective goods widely for the population. All leaders provide both private and collective goods in some degree. But since democratic leaders have to satisfy a wider range of supporters, not just a small segment of their cronies and the military, they are less able than authoritarian ones to extract rents for the private benefit of small groups, and must respond more to broad demands for public well-being (Olson 1993, Bueno de Mesquita et al. 1999, Lake and Baum 2001). They are more likely to invest in public goods such as better public health services because populations will hold them accountable for failing to address basic and pressing health care problems. For example, famines are much more common in authoritarian states (Sen 1981), which spend less either to prevent them or to relieve their consequences. Przeworski et al. (2000: 239) report that the strong effect of democracy in lowering infant mortality operates largely through health expenditures, and our previous research found a strong impact of democracy in increasing public health expenditures (also Ghobarah et al. 2001, Dasgupta 1993, Moon 1991: ch.6.).

4) *The degree to which resources actually allocated to public health are efficiently utilized.* Public health services may not be directed to groups with the greatest need. Political institutions and practices increase or decrease health risk factors for populations by influencing their access to services offered by the public health care system. Political influence plays a

crucial role in determining who has full or limited access to the benefits offered by the health care system. For example, income inequalities in society often translate into political inequalities; consequently the health needs of low income groups may be neglected (Foege 2000, Moon 1991, Moon and Dixon 1992, Szreter 2001, Wilkinson 1996). Although lower income groups are often at greater risk of health problems and therefore in need of public health services, such groups are likely to be less effectively represented in the political competition for scarce resources. Consequently, access to health care services is skewed in favor of wealthy segments of the population who on average are healthier and less at risk.

HYPOTHESES ON CIVIL WAR AND PUBLIC HEALTH

This outline of general causal connections between politics and public health allows us to focus specifically on the theoretical linkages between civil war and long-term health. Our central claim is that civil wars produce adverse longer-term consequences for public health that extend well beyond immediate wartime effects to the post-war period. We posit two related hypotheses.

H1: More DALYs are lost with the occurrence and increasing severity of civil wars within a country.

H2: More DALYs are lost if a geographically contiguous state has had a civil war.

The logic behind these hypotheses corresponds to the four major influences on public health identified above.

1) *Civil wars raise the exposure of the civilian populations to conditions that increase the risk of disease, injury, and death.* Prolonged and bloody civil wars are likely to displace large populations, either internally or as refugees. The Rwanda civil war generated not only 1.4 million internally displaced persons, but another 1.5 million refugees into neighboring Zaire, Tanzania, and Burundi. Often these people do not return to their original homes after the war ends, but remain in makeshift camps for years. Epidemic diseases—tuberculosis, measles, pneumonia, cholera, typhoid, paratyphoid, and dysentery--are likely to emerge from crowding, bad water, and poor sanitation in camps, while malnutrition and stress compromise people's immune systems.

As a result, in many countries ravaged by civil wars the crude mortality rates among newly arrived refugees were five to twelve times above the normal rate (Toole 2000). Children may be especially vulnerable to infection.

Non-displaced populations at greater risk as the camps become vectors for transmitting disease to other regions. Prevention and treatment programs already weakened by the destruction of health care infrastructure during civil wars become overwhelmed as new strains of infectious disease bloom. For example, efforts to eradicate Guinea worm, river blindness, and polio—successful in most countries--have been severely disrupted in states experiencing the most severe civil wars. Drug resistant strains of tuberculosis can develop and in turn weaken resistance to other diseases. It is likely that the spread of AIDS in Africa has been greatly increased by war-induced refugee movements (Reid 1998, Epstein 2001).

Finally, violence is likely to rise in the aftermath of long and severe civil wars (Pederson 2002, Bracken and Petty 1998). Homicide and other crime rates rise within countries during international wars, tending to peak in the first year after the war (Stein 1980, Archer and Gartner 1976). Gerosi and King (2002) report a significant rise in homicides and suicides, transportation deaths, and other unintentional injuries (both the latter are likely to include misclassed suicides) in the U.S. population immediately following the Korean and Vietnam wars. If international war has this effect, certainly the direct and immediate experience of civil war will do so. These social and psychological changes are magnified by the widespread availability of small arms after many civil wars. The victims as well as perpetrators may be disproportionately among young men.

2) *Civil wars produce longer-term negative consequences for public health by reducing the pool of available financial resources for expenditures on the health care system.* Civil war is an extreme form of political instability which reduces economic growth. Poor economic performance cuts the pool of tax revenues that governments can draw upon to finance health care. One study concludes that civil wars typically have a severe short-term (approximately 5-years) negative impact on economic growth (Murdoch and Sandler 2002). A weak economy and lower

profit margins also decrease the contributions the private sector can devote to employee health, and the resources individuals can draw on to compensate for reductions in state or employer contributions to health care.

Civil wars also deplete the human and fixed capital resources needed for a health care system. For example, heavy fighting in urban areas is likely to damage or destroy clinics, hospitals, and health care centers; rebuilding this infrastructure is unlikely to be completed quickly in the post-war period. Finally, severe civil wars may induce a substantial flight of highly trained medical professionals, and this loss of human capital may not be reversed by their prompt return or replacement by newly trained health workers until long after the wars end.

3) *Civil wars produce strong pressures to constrain the level of resources allocated to the public health care system in the aftermath of war.* Leaders in post-civil war governments face multiple and pressing competing demands for public expenditures. Long and destructive civil wars produce such fundamental needs for a) a broad range of economic reconstruction, b) to reform and rebuild army and police forces, judicial systems, and state administrative capacity, and c) military and security spending in response to continuing military threats. Pressures to devote resources to military capabilities raise the classic question about tradeoffs between military spending and non-defense needs such as public health (e.g. Adeola 1996, Ball 1988, DeRouen 2000, Mintz 1989). Security threats may derive from internal insurgent groups, or from a powerful military force built up by a neighboring state to fight its own civil war. (See Braveman et al. 2000 on Nicaragua and Grobar and Gnanaselvam 1993 on Sri Lanka, as well as Collier and Hoeffler 2001, Murdoch and Sandler 2002.) Despite needs for better health care, the multifaceted demands of post-civil war peace building and recovery require make resource trade-offs involving health care spending hard to avoid (Collier 1999; Stewart 1993).

4) *Civil wars reduce the efficient use of resources that are allocated to public health, and those reductions in efficiency extend into the post-civil war period.* The destruction of health infrastructure that supported surveillance and control programs for diseases like tuberculosis,

malaria, yellow fever sows the seeds of both short- and long-term health problems. Civil wars reduce the productivity of the entire economy, especially of facilities needed to maintain previous levels of health care. Wartime destruction and disruption of transportation infrastructure (roads, bridges, railroad systems; communications and electricity) weakens the ability to distribute clean water, food, medicine, and relief supplies, both to refugees and to others who stay in place. It also means, as previously noted, the destruction of hospitals and other health care facilities, and the departure of medical personnel. Military forces often deliberately target health care facilities so as to weaken the opposition. Much of this takes years to restore. Shortages and limited access severely strain health care professionals' ability to deliver treatment and aid efficiently.

These theoretical underpinnings for the causal impact of war on health lead us to the measurement of our key variable: civil wars. For *H1* we use deaths from civil war in the years 1991 to 1997, which becomes a measure of both the existence and severity of civil war when expressed as the number of deaths per 100 people in the country.[6] Civil wars are defined as armed conflicts resulting in 1,000 or more fatalities per year among regular armed forces, rebel armed forces, and civilians directly targeted by either. Years and fatality figures were derived from the leading data sets on civil war compiled by scholars (Singer and Small 1994, Licklider 1995, Doyle and Sambanis 2000, Regan 2000, Wallensteen and Sollenberg 2000). For most countries the value is 0; for the 34 countries experiencing civil war during the period it ranges from .2 to 9.69. (Rwanda).

Using civil war deaths in the years 1991-97 gives us a lag to the DALY rates for 1999. Theory does not tell us that there is a single correct lag. For most infectious diseases--which we hypothesize as the principal cause of indirect civil war deaths--the lag time would seem short (less than five years) while the effects of damage to the health care system would probably last longer (between five and ten years). The lag for some cancers could be so long that we cannot reasonably test for many of them.[7]

For *H2* the operational measure is a dichotomous variable, coded 1 if any contiguous state experienced a civil war in the period 1989-1998, and 0 if not.[8] Contiguity is defined as sharing a land border or separated by 12 miles or less of water.

CONTROLLING FOR OTHER CAUSES OF PUBLIC HEALTH

While our primary focus is on the impact of civil wars on public health, we need to control for several other factors which public health scholars and health economists have argued are important causes of cross-national variation in public health.

H3: The higher the level of total health expenditures the fewer DALYs lost.

Higher income improves health *through* public and private decisions to spend money on hospitals, preventative and curative health care, sanitation, and nutrition. Earlier work by economists such as Pritchett and Summers (1996) showed that "wealthier is healthier;" and we build on their findings with a wider set of countries and a finer-grained causal argument about *how* higher income leads to better health. Per capita income does not directly determine the production of health outputs. Rather, it permits a high level of health expenditures, and though highly collinear (r = .90) with income, expenditure levels are also influenced by political process and institutions. And expenditures are subsequently distributed in a political process that produces actual health outcomes. Thus our full two-stage model, in the economics tradition of production function analysis, treats income as a key variable in explaining the level of health expenditures. In this analysis we follow WHO (Evans et al. 2000a: 13) in using total health expenditures per capita (1998) as a theoretically satisfying variable to incorporate those prior political processes that affect spending, which in turn makes a direct impact on health outcomes.[9]

We use the estimates of total health expenditure compiled by WHO, which began with IMF and national sources, supplemented by national accounts data from United Nations and OECD sources and household surveys and WHO estimates (Pouillier and Hernandez 2000). Total health spending per capita ranges from $4,055 (United States) to $11 (Somalia), with a median of $197 (Thailand). WHO authors estimate that it is very difficult for countries to

provide good health outputs below a total expenditure of about $60 per capita, and that it would cost just over $6 billion per year to bring up to this threshold the 41 countries with lower expenditures (Evans et al., 2000a: 24). Because these distributions are skewed we used the natural logarithms; that also reflects the declining marginal product of additional dollars at higher levels of spending. Following WHO's practice, we use total health expenditures as an explanatory variable in this equation, rather than public or private spending alone. There is some complementarity between public and private health spending in achieving health goals, and the measure of total health expenditures has more explanatory power than does either alone.

H4: The more educated the population the fewer DALYs lost.

At higher levels of education, preventive and treatment programs become more widespread and effective; i.e., demand for better health care rises as does more knowledgeable and effective consumption throughout the population. Education is strongly associated with the health of both children and adults in both rich and poor countries. It constitutes the other independent variable, with total health expenditures, in WHO analyses of health attainment (Evans et al. 2000a: 13).

WHO regards average level of schooling in the adult population as the most widely available and sensitive measure, logged to correct skewness and to reflect the declining marginal impact of education.[10] It ranges from only 1.04 years of education (Mali) to 11.5 years (United States), with a median of 6.03 years (Costa Rica).

H5: The higher the pace of urbanization the more DALYs lost.

New urban residents will be exposed to new disease vectors, and will lack adequate access to care since the supply of health services to large numbers of new residents is likely to lag behind the surge in need (Garrett 2001, Szreter 2001). Surveillance, immunization, and the provision of safe water all become more difficult. A high rate of urbanization often reflects the influx of poor and marginalized people from rural areas. These new city dwellers (largely in urban slums) are under-organized in unions and under-represented in established political parties.

They find it hard to create effective pressure for health care either politically or in the workplace, leaving a gap between need and delivery. Marginal utility analysis predicts that individuals or groups receiving less than an equal supply of health care lose more disability-adjusted life expectancy than is gained by those receiving more than an equal share of care.

Our measure of recent urbanization is the average annual percentage change in the urban portion of the population, 1990-95 (United Nations 1998: 132-35). It ranges from –0.41 percent (Belize) to 7.35 percent (Botswana), with a median of 0.88 (Grenada).

H6: The more unequal the distribution of income, the more DALYs lost.

The more unequal the income distribution, fewer public resources will be committed to the health care system and the more unequal will be access to health facilities. Economically advantaged groups will be more able to dominate the political system for their own benefit rather than that of the majority. As a result, state spending is diverted from public to private goods; what is spent is more concentrated on the privileged and politically powerful segments of the population. The large poor segment of the population will have lower incomes, less leverage with employers, and fewer private resources for health. High quality health care is thus limited to a smaller segment of the general population, producing lower overall levels of health performance. The rich get more access—at low marginal utility, and the poor get less.

The measure of inequality is the Gini index of income distribution in 1997. This common index is derived from a Lorenz curve of the actual distribution of income by households, with the index representing the total area between the curve and the 45 degree line of a totally equal distribution of income. We have estimates for 111 countries published by the World Bank, supplemented by WHO with multiple imputation estimates using information on socio-economic development and life expectancy at birth (Evans et al. 2000b). Theoretically the Gini index ranges from zero (complete equality) to 1.00 (one person has all the income); in practice our national Gini indices for income distribution range from a very equal .187 (Slovakia) to .609 (Sierra Leone), with a median of .374 (Uganda).

H7: Tropical countries will suffer from more DALYs lost.

Tuberculosis, other infectious respiratory and diarrheal diseases, and malaria are often endemic to tropical countries, where conditions for their spread are more favorable despite public health programs to contain them.[11] If civil wars are more likely to occur in such countries, we risk mistakenly identifying civil wars as the cause of diseases that are already prevalent because of these background conditions. To protect against this inferential error we add a dummy variable, *tropical*, with all countries where the majority of the population resides in tropical regions coded 1 and all other countries coded 0.

H8: The more democratic countries are the fewer the DALYs lost.

H9: The more ethnically and linguistically diverse the population, the more DALYs lost.

Finally we include two additional control variables that may be causes of civil wars. One might argue that our measure for the incidence and severity of civil wars is simply a proxy for other economic and political variables likely to be associated with civil wars. To answer this fully we would also need a model to explain the incidence and severity of civil wars. The systematic empirical literature lacks consensus, but several influences emerge as probable contributors to the likelihood of civil war. In a cursory overview of this research we discuss some possible variables to control for the structural conditions that may promote civil wars, and relate them to variables already in our model.

The influences affecting the initiation of civil war are not necessarily the same as those affecting its continuation or intensity. For our purposes the intensity of war is more relevant than its initiation or mere occurrence. Our measure of deaths over the duration of the war, controlled for size of population, captures duration and especially severity. The control for population also addresses the likelihood that large states will have more potentially-disaffected groups able to mount a war effort.

The initial level of economic development raises the opportunity costs of violence. In richer countries employment opportunities are better, and governments have more resources to

satisfy discontented elements of the population. Whereas some analyses find that a low rate of economic growth contributes to the likelihood of civil war (Collier and Hoeffler 2002), a low level of development seems a more robust influence (Sambanis 2001, 2002; Elbadawi and Sambanis 2002). Although we do not include GDP per capita as a direct influence in this model, it makes a prior contribution through its influence on total health expenditures per capita, and also is closely related to educational attainment. Collier and Hoeffler (2000) also identify low educational level as a key influence. Thus our model already controls for level of development.

Political system affects health as discussed in our initial theoretical framework, and it also probably influences the incidence of civil war--especially for ethnic wars since lack of democratic rights can threaten the core of ethnic identity and reduce the chances for redress of grievances (Gurr 2000). Whereas there is some evidence that civil wars are more likely to break out in countries that are between the extremes of full democracy and full autocracy (Hegre et al. 2001, Reynal-Querol 2002), that distinction is less important in the continuation of wars (Elbadawi and Sambanis 2002). So a linear measure—better to ascertain the direct effect of democracy on health--should suffice for a first cut.

We measure political system type by the Polity project's average score for 1997 and 1998, using the Polity IV data from their website (www.bsos.umd.edu/cidcm/polity). For the 22 countries in our sample with no regime score in the Polity database we imputed a regime score from the Freedom House scores, which correlate highly (r = .95) with Polity where both exist. Following common practice (e.g., Maoz and Russett 1993) we create a 21-point index for each state from two scales: one degree of autocracy ranging from –10 (most autocratic) to 0 (least autocratic), and one for democracy from 0 (least democratic) to + 10 (most democratic), and then produce the composite index by summing the two components. This scale, which we treat as interval, runs from –10 (e.g., North Korea, Myanmar) to +10 (Japan, Norway), with a median of 7 (Ukraine). Other measures of contemporary democracy correlate highly with it (Vanhanen 2000).

Ethnic heterogeneity may contribute to discrimination, which in turn increases the risk of ethnic war. Again there is some evidence of non-linearity, in that ethnically polarized societies may be more war-prone than either homogenous ones or highly fragmented states whose small minorities may suffer from collective action problems in organizing for violence (Horowitz 1985, Bates 1999, Collier and Hoeffler 2000, Reynal-Querol 2002). As with democracy, using different functional forms might help, but a linear measure serves as an approximation.

We use Vanhanen's (1999) index of racial-linguistic-religious heterogeneity. This index, stable over moderate time-periods, measures the percentage of the largest ethnic group identified by each of these three criteria, giving each equal weight by summing the three percentages and subtracting the sum from 300 (a completely homogeneous state by all three criteria). It is conceptually somewhat different from Taylor and Hudson's (1972) index of ethnolinguistic heterogeneity, when logged correlating with an r of .69 with Taylor and Hudson's But it was created with their effort in mind, and covers more countries. It ranges from a high of 177 (Suriname) to a low of 0 (North Korea, completely homogeneous), with a median of 38 (Uzbekistan). Because the index is skewed, we use its natural log.

Other influences on the ability to sustain a dissident group at war may include rugged terrain and the availability of "lootable" natural resources—particularly for non-ethnic wars (Collier and Hoeffler 2000). Ethnic wars may derive from a different mixture of influences than do non-ethnic wars. But since over 70 percent of all civil wars between 1960 and 1999 can be characterized as wars between ethnic groups (Sambanis 2001) we pay more attention to the causes of ethnic wars. In sum, we believe our key explanatory variable—deaths from civil wars—is not simply a proxy for the structural conditions that produce civil wars, and that the diseases bringing death and disability after civil wars are not simply a consequence of those conditions.

A MULTIVARIATE ANALYSIS OF ALL DEATHS AND DISABILITIES

We test these hypotheses using cross-sectional least squares regression analysis on data for 177 countries: nearly all the 191 members of the WHO, omitting only some small states lacking data on several of the explanatory variables. Table 1 shows in separate rows ten equations for deaths and disabilities from *all causes combined* by the five age groups for each gender. Thus ten regressions are presented as rows in this table. The explanatory variables are listed across the top, and each column gives the estimated coefficient and the t-ratio. Coefficients and t-ratios that reach the 0.05 level of significance (one-tailed) are in bold face. Remember that DALY represents years of healthy life *lost*, so we anticipate positive coefficients for all variables except health expenditures and education.

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Table 1 about here

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First, note that most of our hypotheses are supported. For 7 of the 10 equations, total health spending has a strong and statistically significant impact in reducing the loss of healthy life expectancy. Only for females and males in the 15-44 year age group is there no effect. A high average level of education also strongly reduces DALYs in six of the groups. Rapid urbanization is strongly correlated with increased loss of healthy life expectancy (highly significant in six categories, at a lower level in two). So too is high income inequality (five groups at $p < .05$, and three at $p < .06$). The direct impact of democracy is marginal (significant as hypothesized in one group, and in the opposite direction for two others). This confirms the findings of our earlier research on the primary effect of democracy on public health; it operates earlier in the causal chain by influencing the level of resources allocated to health expenditures (Ghobarah et al 2001). Likewise, ethnic heterogeneity has the expected positive sign in every group, but its direct effects are never significant, in accordance with previous research that found its effects operate largely indirectly, by reducing total spending allocated to health. Simply being in a tropical country had

no discernable impact, which may attest to the success of the public health systems in several tropical countries at neutralizing this risk factor.

These relationships are not, however, the focus of attention in this article—*civil war is*. For that, we do see some strong effects. Experiencing a civil war earlier in the 1990s is strongly associated with a subsequent increased loss of healthy life for six groups ($p < .05$ or better), and $p < .06$ for two others. Only for the aged does civil war have no significant impact. Three of the four most statistically significant impacts are among children. Furthermore, the substantive impact is very severe for the two youngest groups, females and males under five years of age. For instance, the coefficients mean that the impact in 1999 of living in a country that had experienced an intense civil war a few years earlier (such as Bosnia with 6.8 civil war deaths per 100 people) rather than in a median country with no war at all is a loss of about 28.5 healthy life years in 1999 per 100 girls under 5 years of age--long after the war ended in a settlement. In Rwanda's extreme case (9.7 civil war deaths per hundred people, mostly in 1994), the subsequent losses amounted to a staggering 53 DALYs per 100 children under 5--and that is in addition to the impact of all the other socio-political and economic variables in our model.

Finally, even living in a country adjacent to a state that experienced a civil war made a big difference for four of these groups, together encompassing men and women aged 15-59. These huge impacts on the economically productive parts of the population (substantively, a loss of healthy life years from about 3 to over 12 per 100 people, depending on age and sex) are over and above the negative effects they experienced if there also had been a civil war in their own country.[12] We can evaluate this better by looking at the impact of civil wars on the incidence of specific diseases and conditions.

THE WHO AND HOW OF CIVIL WAR EFFECTS

We proceed to do just that. The WHO data on impacts of various diseases by age and gender allow us to compute 210 equations.[13] Using a threshold of $p < .05$ for a one-tailed test of statistical significance, we would expect, purely by chance, to find that 10 or 11 equations

produced a "significant" relationship for civil war's impact on an individual grouping. In fact, we find much more than that: 48 equations in which the civil war coefficient is significant at $p < .05$. Furthermore, most of the significant coefficients make sense in terms of our expectations. Table 2 shows the effects of the variable for preceding civil war deaths (using the same model as in Table 1, but only listing the civil war deaths coefficients for clarity). It gives a row for each such equation, arraying the equations by major disease/condition groups, and within groups in descending order of the t-ratios. The columns show first the coefficient for the effect of civil wars, and then the t-ratio.

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Table 2 about here

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By far the most common impact is through infectious diseases, as is consistent with our theoretical expectations and our review of the case study material on the effects of civil wars. Seven out of the ten age-gender groups are affected by malaria, essentially all but those aged 60 years and over. In fact, by t-value, 5 of the 25 groups most impacted by civil wars are from raising the incidence of malaria. At their highest, the coefficients for impact indicate 15 years (per 100 people in the case of Rwanda) of healthy life lost in 1999 by very young children, controlling for all other factors. Regrettably, that is the lingering impact of civil war through only one disease out of 23; the misery accumulates with each of the other 22 categories of disease.

The three other most affected disease groups are tuberculosis, respiratory infections, and other infectious diseases--each reaching statistical significance with six of ten possible age and gender groups. The age and gender group effects are strikingly similar, for each category affecting older children and adults 15-59 more than the very young or the old. The coefficients for the impact of war on tuberculosis are generally much lower (ranging around .1) than for malaria. Almost exactly the same pattern applies to respiratory infections, with coefficients of about .1 for civil wars and .4 to .8 for the dummy variable. For other infectious diseases--

something of a catch-all category--the impact of civil wars is greater (from about .2 to 1.8). Together, the four groups of infectious disease account for 26 of the 48 equations showing a significant effect of civil wars.

The next most common effect is from transportation accidents, and may in part reflect the deterioration of roads and vehicles. But it is also consistent with our expectations of an increase in stress and a breakdown of law and order in post-civil war societies. We cannot satisfactorily map the causal relationships without detailed micro-level analysis. Nonetheless, while the impact is small (.05 to .15 years), it affects five of the ten groups: mostly young and middle-aged adults. More obvious from an expectation of a breakdown of social order is the elevated homicide rate, the victims being girls between 5 and 14 years old and especially men between 15 and 44. The substantive effect (.02 on girls and .14 on men) is similar to that of transportation accidents.

The two entries for unintentional injuries may also derive from stress, and may include unreported suicides. With a lower level of statistical significance ($p < .12$), three more adult age groups would make it into the table for unintentional injury. Notice also the item for suicides of women of childbearing age, perhaps reflecting the trauma of rape. They also are subject to post-war maternal ills. Chronic respiratory diseases not included elsewhere (as tuberculosis and respiratory infections) for girls aged 5-14 may reflect stress-induced loss of resistance.

We also find an apparent effect of civil wars in raising the rate of cervical cancer for three of the four female groups above age 4, (plus the other, weakly at $p < .16$ for women aged 15-44). While cervical cancer may develop too slowly for the time lag used in our analysis, there may be two possible connections to civil wars. First, it fits our expectation of a breakdown in social norms, in these cases norms against forced sexual relations, though the coefficients are very small (no larger than .06). Second, recent medical research indicates that in low income countries infection plays an important etiologic role in cancer and our other results show that civil wars increase the incidence of infectious disease.[14] It is also likely that other sexually transmitted diseases of women in traditional societies are reported as cervical cancer.

The six remaining statistically significant groupings show little pattern, and with this lag we have no explanation. Overall, females constitute 33 out of the 54 affected groups, and the two gender groups of children aged 5-14 account for 15 (chance would mean 9 or 10 groups). *Whoever the actual combat deaths during the war may represent, in their long-term impact the greatest victims are women and children.*

CONTIGUOUS CIVIL WARS

Finally, Table 3 shows the effect of civil war in a contiguous country, above any effect of civil war at home. The presentation corresponds to that in Table 2. Our initial analysis found that having a civil war in an adjacent country was itself a major contributor to loss of healthy life expectancy overall. The disease-specific analysis finds 32 disease-age-gender groups for which a contiguous civil war significantly increased death and disability. This too is well above the 10 or 11 we would expect by chance to cross the line of statistical significance in 210 equations.

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Table 3 about here

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The enormous impact of a neighboring civil war on HIV/AIDS is immediately apparent as it occupies all top ten slots of statistical significance in Table 3. If anything, the t-ratios understate the impact. For the susceptible age groups of both genders (very young children, infected through their mothers; young and middle-aged adults) the coefficients are higher than for any other DALY disease or condition in the table. For these groups the average loss of healthy life ranges from more than two years to nearly 10 years (for women aged 15-44).[15]

Recall that, by contrast with the effects of civil wars at home on most infectious diseases, we found no impact of a civil war at home in raising AIDS rates in that state. This is true even in an equation without the variable for contiguous civil war. However, most civil wars have a neighboring civil war as well. A civil war at home may have some decelerating effects--such as war deaths among young males--on HIV transmission. Infection may be slowed as communities

become isolated by war and the disruption of commerce and transportation but, following the war, the resumption of normal interactions within and across borders may spread the disease to neighboring states that did not experience the initial reduction (Mock and Mathys 2002; Davis and Kuritsky (2002) report lower HIV rates for countries in civil conflict). Also, most DALYs from HIV/AIDS are derived from reports of HIV infections rather than deaths. Infections likely are underreported in countries themselves undergoing civil wars. At this stage in the analysis, collinearity and data questions make it impossible to sort out fully the relative impact of own and neighboring civil wars on HIV/AIDS rates.

After AIDS, another major effect of neighboring civil war is in raising the incidence of homicide. Males of all but the oldest age group are the principal victims, with a coefficient of .25 per men aged 15-44. Unintentional injuries (other than transport) have a serious impact on young children of both sexes, and to a lesser extent on older children (about .3 years to 1.1 years per 100 people). This too probably reflects political and social tensions in the society. Digestive disease may also be a product of stress. Cancers of various types show up eight times among children, but the coefficients are usually small. They do not fit any of our expectations, and it is too soon to attribute much importance to them without further research.

Overall, the strongest effect of civil war in a contiguous country is to boost drastically the rate of infection from HIV/AIDS. Its devastating impact is concentrated in the most economically productive age groups and on very young children, striking both genders more or less equally. When we tally all the effects in this table, both genders are affected more or less equally (17 female groups, 15 male), but with 10 in the two gender categories for children aged 5-14 and 13 more for children 0-4. As with civil wars at home, many of the long-term victims of contiguous civil wars are the young.

CONCLUSION

We developed the argument that civil wars should produce long-term damage to public health care systems that extend well beyond the period of active warfare, and tested it in the

context of a more general political-economic model of conditions affecting death and disability cross-nationally. Using newly-available data on disability-adjusted life years lost from various diseases and conditions by age and gender groups, we found that, controlling for the other influences, civil wars greatly raise the subsequent risk of death and disability from many infectious diseases, including malaria, tuberculosis, and other infectious respiratory diseases. We have some evidence, though weaker, that civil wars increase the risk of death and disability through the breakdown of norms and practices of social order, with possible increases in homicide, transportation accidents, other injuries, and cervical cancer. The disability and death from AIDS is much greater if a neighboring country recently experienced a civil war.

Overall, women and children were the most common long-term victims. For all categories we estimate that 8.01 million disability years were lost in 1999 from civil wars during the period 1991-97. That is only slightly below WHO's estimate for the immediate losses from all the wars fought in 1999. The victims will bear these burdens for the rest of their lives. Moreover, our estimate of death and disability from previous civil wars applies only to those incurred in 1999. Since that is a single cut into a lag structure of new deaths and disabilities that probably extends over a decade, the total could be an order of magnitude higher yet.

These results are intriguing though not conclusive. Certainly we need to comprehend better the micro-level political, social, and epidemiological processes. We also must elaborate theories that accommodate complex interrelations, and drive backward in the full system of influences to understand how civil wars may interact with income inequality, ethnic diversity, and type of political system to affect people's health and well-being. One improvement in subsequent research should be a more nuanced and medically-informed consideration of appropriate lag times. Our rather crude one-size-fits-all lag, of civil war deaths from 1991 to 1997 to explain DALYs 1999, is not a bad fit to the descriptive literature on the spread of many diseases, and it gives the best empirical fit for disability/health-adjusted life expectancy (DALE) overall. Still, something more fine-grained is necessary for further analysis of specific diseases, notably AIDS

and long-term non-infectious conditions (e.g., cancers) that are slow in developing. Cross-temporal analysis will provide better guidance when the necessary data become available.

The kind of information analyzed here must be combined with more contextual information and field reports from countries that have experienced civil wars. Further analyses could provide projections on the likely effect of major civil violence that could be used by peacekeeping and post-conflict peace-building missions, national governments, and non-governmental organizations. They could help in predicting the effects of civil violence, and may suggest possible key interventions, such as in caring for refugees and assessing priorities for post-conflict efforts to rebuild devastated and overburdened health care systems. They indicate the number of long-term deaths and disabilities to be anticipated from various diseases, which in turn can be used, in cost-benefit analyses, to estimate the price of averting each death or disability through the best post-conflict allocations to prevention and treatment. Knowing the type and magnitude of the effects is an essential step in preventing or mitigating the misery.

References:

Adeola, Francis. 1996. "Military Expenditures, Health, and Education," *Armed Forces and Society* 22(3):441-55.

Ahlstram, C. 1991. *Casualties of Conflict: Report for the Protection of Victims of War*. Uppsala: Uppsala University, Department of Peace and Conflict.

Archer, Dane, and Rosemary Gartner. 1976. "Violent Acts and Violent Times: A Comparative Approach to Postwar Homicide Rates," *American Sociological Review* 41(4): 937-63.

Ball, Nicole. 1988. *Security and Economy in the Third World.* Princeton: Princeton University Press.

Bates, Robert H. 1999. "Ethnicity, Capital Formation, and Conflict." Working Paper No. 27. Cambridge, MA: Harvard Center for International Development.

Bracken, Patrick and Celia Petty. 1998. *Rethinking the Trauma of War*. London: Save the Children.

Braveman, Paula, Alan Meyers, Thomas Schlenker, and Curt Wands. 2000. "Public Health and War in Central America." In Bary S. Levy and Victor W. Sidel, eds., *War and Public Health*. Washington, DC: American Public Health Association, updated edition, pp. 238-53.

Bueno de Mesquita, Bruce, James Morrow, Randolph Siverson, and Alastair Smith. 1999. "An Institutional Explanation of the Democratic Peace," *American Political Science Review* 93(4): 791-807.

Centers for Disease Control and Prevention. 1992. "Famine-affected, Refugee, and Displaced Populations: Recommendations for Public Health Issues," *Morbidity and Mortality Weekly Report*, 41 (RR-13): 1-76.

Collier, Paul. 1999. "On the Economic Consequences of Civil War," *Oxford Economic Papers* 51: 168-83.

Collier, Paul, and Anke Hoeffler. 2000. "Greed and Grievance in Civil War." Policy Research Paper 2355. Washington, DC: World Bank.

Collier, Paul, and Anke Hoeffler. 2001. "Regional Military Spillovers." Paper for the Annual Bank Conference on Development Economics. Washington, DC: World Bank.

Collier, Paul, and Anke Hoeffler. 2002. "On the Incidence of Civil War in Africa," *Journal of Conflict Resolution* 46(1): 13-28.

Dasgupta, Partha. 1993. *An Inquiry into Well-Being and Destitution*. New York: Oxford University Press.

Davis, David, and Joel Kuritsky. 2002. "Violent Conflict and Its Impact on Health Indicators in Sub-Saharan Africa, 1980 to 1997." Paper presented at the annual meeting of the International Studies Association, New Orleans, LA, March.

DeRouen, Karl. 2000. "The Guns-Growth Relationship in Israel," *Journal of Peace Research* 37(1):69-84.

Doyle, Michael, and Nicholas Sambanis. 2000. "International Peacebuilding: A Theoretical and Quantitative Analysis," *American Political Science Review* 94(4): 779-803.

Elbadawi, Ibrahim, and Nicholas Sambanis. 2002. "How Much War Will We See? Explaining the Prevalence Civil War," *Journal of Conflict Resolution* 46(2): 307-34.

Epstein, Helen. 2001. "AIDS: The Lesson of Uganda," *New York Review of Books* 48(11): 18-23.

Evans, David B., Ajay Tandon, Christopher J.L. Murray, and Jeremy A. Lauder. 2000a. "The Comparative Efficiency of National Health Systems in Producing Health: An Analysis of 191 Countries," GPE Discussion Paper No. 29. Geneva: World Health Organization.

Evans, David B., L. Bendib, A. Tandon, J. Lauer, S. Ebenezer, R.C.W. Hutubessy, Y. Asada, and C.J.L Murray. 2000b. "Estimates of Income Per Capita, Literacy, Educational Attainment, Absolute Poverty, and Income Gini Coefficients for the World Health Report 2000,"

Global Programme on Evidence for Health Policy Discussion Paper No. 7. Geneva: World Health Organization.

Feachem, Richard, Dean Jamison, and Eduard Bos. 1991. “Changing Patterns of Disease and Mortality in Sub-Saharan Africa,” in Richard Feachem and Dean Jamison eds., *Disease and Mortality in Sub-Saharan Africa*. New York: Oxford University Press.

Filmer, Deon, and Lant Pritchett. 1999. "The Impact of Public Spending on Health: Does Money Matter?" *Social Science & Medicine* 49(4): 1309-1323.

Foege, William. 2000. “Arms and Public Health: A Global Perspective.” In Barry S. Levy and Victor Sidel, *War and Public Health*, updated edition. Washington, DC: American Public Health Association.

Garrett, Laurie. 2001. “The Return of Infectious Disease,” in Andrew T. Price-Smith ed., *Plague and Politics.* New York: Palgrave.

Gerosi, Frederico, and Gary King. 2002. “Short Term Effects of War Deaths on Public Health in the U.S.” Cambridge, MA: Harvard Center for Basic Research in the Social Sciences, working paper.

Ghobarah, Hazem, Paul Huth, Bruce Russett, and Gary King. 2001. “The Comparative Political Economy of Human Misery and Well-being.” Paper presented at the annual meeting of the American Political Science Association, San Franciso, CA, August.

Goldstein, Joshua. 2001. *War and Gender: How Gender Shapes the War System and Vice Versa*. New York: Cambridge University Press.

Grobar, L.M., and Gnanaselvam, S. 1993. “The Economic Effects of the Sri Lankan Civil War,” *Economic Development and Cultural Change* 41(2): 395-405.

Gurr, Ted Robert. 1993. *Minorities at Risk: A Global View of Ethnopolitical Conflict*. Washington, DC: United States Institute of Peace.

Gurr, Ted Robert. 2000. *Peoples Versus States: Minorities at Risk in the New Century*. Washington, DC: United States Institute of Peace.

Gustafson, Per, Victor Gomes, Cesaltina Veiira, Henrik Jaensen, Remonie Seng, Renee Norberg, Badara Samb, Anders Naucler, and Peter Aaby. 2001. "Tuberculosis Mortality During a Civil War in Guinea-Bissau," *Journal of the American Medical Association* 286(5): 599-603.

Hartzell, Caroline, Matthew Hoddie, and Donald Rothchild. 2001. "Stabililizing the Peace After Civil Wars," *International Organization* 55(1):183-208.

Hegre, Havard, Tanja Ellingsen, Scott Gates, and Nils Petter Gleditsch. 2001. "Toward a Democratic Civil Peace? Democracy, Political Change, and Civil War, 1816-1992," *American Political Science Review* 95(1): 33-48.

Horowitz, Donald. 1985. *Ethnic Groups in Conflict*. Berkeley: University of California Press.

Lake, David, and Mathhew Baum. 2001. "The Invisible Hand of Democracy: Political Control and the Provision of Public Services," *Comparative Political Studies* 34, 6: 587-621.

Licklider, Roy. 1995. "The Consequences of Negotiated Settlements in Civil Wars, 1945-1993," *American Political Science Review* 89(3): 681-90.

Maoz, Zeev, and Bruce Russett. 1993. "Normative and Structural Causes of Democratic Peace, 1946-1986," *American Political Science Review* 87(3): 624-38.

Mathers, Colin, Ritu Sadana, Joshua Salomon, Christopher Murray, and Alan Lopez. 2000. "Estimates of DALE for 191 countries: Methods and Results," Global Programme on Evidence for Health Policy Working Paper No. 16. Geneva: World Health Organization.

Mintz, Alex. 1989. "Guns Versus Butter," *American Political Science Review* 83(4):1285-93.

Mock, Nancy, and Ellen Mathys. "Conflict and HIV: A Framework for Risk Assessment to Prevent HIV in Conflict Settings." Paper presented at the annual meeting of the International Studies Association, New Orleans, LA, March.

Moon. Bruce. 1991. *The Political Economy of Basic Human Needs*. Ithaca: Cornell University Press.

Moon, Bruce, and William Dixon. 1992. "Domestic Political Conflict and Basic Need Outcomes: An Empirical Assessment," *Comparative Political Studies* 22(2): 178-98.

Moon, Bruce, and William Dixon. 1992. "Basic Needs and Growth-Welfare Tradeoffs," *International Studies Quarterly* 36(2):191-212.

Moscicki, Anna-Barbara, Nancy Hill, Steve Shiboski, Kim Powell, Naomi Jay, Evelyn Hanson, Susana Miller, Lisa Clayton, Sepideh Farhat, Jeanette Broening, Teresa Darragh, and Joel Palefsky. 2001. "Risks for Incident Human Papillomavirus and Low-Grade Squamous Intrepithelial Lesion Development in Young Females," *Journal of the American Medical Association* 285(23): 2995-3002.

Murdoch, James, and Todd Sandler. 2002. "Economic Growth, Civil Wars, and Spatial Spillovers," *Journal of Conflict Resolution* 46(1): 91-110.

Murray, Christopher, and Alan Lopez. 1996. *The Global Burden of Disease*. Cambridge, MA: Harvard School of Public Health on behalf of the World Health Organization and the World Bank.

Murray, Christopher, and Alan Lopez. 2000. "Progress and Directions in Refining The Global Burden of Disease Approach: A Response to Williams," *Health Economics* 9(1): 69-82.

Olson, Mancur. 1993. "Dictatorship, Democracy, and Development," *American Political Science Review* 87(3): 567-76.

Pouillier, J.P., and P. Hernandez. 2000. "Estimates of National Health Accounts: Aggregates for 191 Countries in 1997," GPE Discussion Paper No. 26. Geneva: World Health Organization.

Price-Smith, Andrew T. 2002. *The Health of Nations: Infectious Disease, Environmental Change, and Their Effects on National Security and Development.* Cambridge: MIT Press.

Pritchett, Lant, and Lawrence Summers. 1996. "Wealthier is Healthier," *Journal of Human Resources* 31(4): 841-68.

Przeworski, Adam, Michael Alvarez, Jose Antonio Cheibub, and Fernando Limongi. 2000. *Democracy and Development: Political Institutions and Well-Being in the World, 1950-1990*. Cambridge: Cambridge University Press.

Regan, Patrick. 2000. *Civil Wars and Foreign Powers*. Ann Arbor: University of Michigan Press.

Reid, Elizabeth. 1998. "A Future, If One is Still Alive: The Challenge of the HIV Epidemic." In Jonathan Moore, ed., *Hard Choices: Moral Dilemmas in Humanitarian Intervention*. Lanham, MD: Rowman & Littlefield: 269-86.

Reynal-Querol, Marta. 2002. "Ethnicity, Political Systems, and Civil Wars," *Journal of Conflict Resolution* 46(1): 29-54.

Roberts, Les, Charles Hale, Fethi Belyakdoumi, Laiura Cobey, Roselida Ondeko, Michael Despines, and John Keys. 2001. *Mortality in Eastern Democratic Republic of Congo.* Atlanta, GA: International Rescue Committee.

Sambanis, Nicholas. 2001. "Do Ethnic and Nonethnic Civil Wars Have the Same Causes? A Theoretical and Empirical Inquiry (Part I)," *Journal of Conflict Resolution* 45(3): 259-82.

Sambanis, Nicholas. 2002. "A Review of Recent Advances and Future Directions in the Literature on Civil War," *Defence and Peace Economics* 14(3): 215-43.

Sen, Amartya. 1981. *Poverty and Famine*. New York: Oxford University Press.

Shah, Ghanshyam. 1997. *Public Health and Urban Development: The Plague in Surat.* London: SAGE.

Singer, J. David, and Melvin Small. 1994. "Correlates of War Project: Data on Civil Wars, 1816-1992." Ann Arbor: Inter-university Consortium for Political and Social Research, University of Michigan, #9905.

Starr, Harvey, and G. Dale Thomas. 2002. "The 'Nature' of Contiguous Borders: Ease of Interaction, Salience, and the Analysis of Crisis," *International Interactions* 28(3): 213-35.

Stein, Arthur A. 1980. *The Nation at War*. Baltimore, MD: Johns Hopkins University Press.

Stein, Arthur A., and Bruce Russett: 1980. "Evaluating War: Outcomes and Consequences," in Ted Robert Gurr, ed., *Handbook of Political Conflict*. New York: Free Press.

Stewart, F. 1993. "War and Underdevelopment: Can Economic Analysis Help Reduce the Costs?" *Journal of International Development* 5(4): 357-80.

Szreter, Simon. 2001. "Economic Growth, Disruption, Deprivation, Disease, and Death," in Andrew T. Price-Smith ed., *Plague and Politics.* New York: Palgrave.

Taylor, Charles L., and Michael C. Hudson. 1972. *World Handbook of Political and Social Indicators*, 2nd. ed. New Haven, CT: Yale University Press.

Toole, Michael J. 1997. "Complex Emergencies: Refugee and Other Populations," in Eric Noji, ed., *The Public Health Consequences of Disasters*. New York: Oxford University Press.

Toole, Michael J. 2000. "Displaced Persons and War." In Barry S. Levy and Victor W. Sidel, eds., *War and Public Health*, updated edition. Washington, DC: American Public Health Association.

United Nations. 1998. *World Urbanization Prospects: The 1996 Revision*. New York: United Nations.

Vanhanen, Tatu. 1999. "Domestic Ethnic Conflict and Ethnic Nepotism: A Comparative Analysis," *Journal of Peace Research* 36(1): 55-73.

Vanhanen, Tatu. 2000. "A New Data Set for Measuring Democracy, 1810-1998," *Journal of Peace Research* 37(2): 251-65.

Wallensteen, Peter, and Margareta Sollenberg. 2000. "Armed Conflict, 1989-99," *Journal of Peace Research* 37(5): 635-50.

Walter, Barbara. 2002. *Committing to Peace.* Princeton: Princeton University Press.

Ward, Michael D., and Kristian S. Gleditsch. 2002. "Location, Location, Location: An MCMC Approach to Modeling the Spatial Context of War and Peace," *Political Analysis* 10: 244-60.

Wilkinson, Richard. 1996. *Unhealthy Societies: The Afflictions of Inequality*. New York: Routledge.

Williams, Alan. 1999. "Calculating The Global Burden of Disease: Time For a Strategic Reappraisal?" *Health Economics* 8 (1): 1-8.

World Health Organization (WHO). 2000. *The World Health Report 2000: Health Systems: Improving Performance*. Geneva: World Health Organization.

Table 1: DALYs lost to all disease categories

Gender	Age Group	DALYs lost per year per 100 people	Statistic	Intercept	Civil war deaths 1991- 97	Contiguous Civil War	Total health spending	Education	Urban growth	Income Gini	Tropical	Polity Score	Ethnic hetero-geneity	Adjusted R-square	Sigma
Male	04 or less	63.57	Coefficient	264.89	5.45	2.13	-21.10	-60.27	0.49	11.86	-8.33	0.64	1.58	0.72	35.92
			T-ratio	**9.38**	**2.02**	0.35	**-6.26**	**-7.44**	0.16	0.30	-1.08	1.35	0.58		
Female	04 or less	58.3	Coefficient	240.63	4.19	4.48	-18.35	-58.02	1.58	5.16	-7.29	0.55	1.77	0.72	33.92
			T-ratio	**9.02**	1.65	0.78	**-5.77**	**-7.58**	0.56	0.14	-1.01	1.23	0.69		
Male	05_14	9.05	Coefficient	26.51	1.11	0.14	-2.92	-5.34	0.87	11.49	0.14	0.13	0.20	0.68	5.33
			T-ratio	**6.33**	**2.78**	0.15	**-5.84**	**-4.44**	**1.96**	**1.99**	0.12	**1.91**	0.50		
Female	05_14	8.31	Coefficient	25.17	1.31	0.59	-2.73	-5.32	0.94	8.96	-0.44	0.12	0.35	0.67	5.23
			T-ratio	**6.12**	**3.35**	0.66	**-5.56**	**-4.51**	**2.16**	1.58	-0.39	**1.77**	0.89		
Male	15_44	26.1	Coefficient	6.65	2.15	7.84	-2.12	-3.74	5.93	52.24	4.61	0.22	0.62	0.46	16.75
			T-ratio	0.50	**1.71**	**2.74**	-1.35	-0.99	**4.26**	**2.88**	1.29	0.98	0.50		
Female	15_44	25.67	Coefficient	5.99	2.99	12.52	-1.56	-7.41	8.54	50.10	4.34	0.05	0.59	0.44	22.48
			T-ratio	0.34	**1.78**	**3.27**	-0.74	-1.46	**4.57**	**2.06**	0.90	0.18	0.35		
Male	45_59	23.95	Coefficient	34.29	1.52	5.60	-4.16	-2.45	4.09	25.73	1.12	0.22	1.11	0.50	12.77
			T-ratio	**3.42**	1.59	**2.57**	**-3.47**	-0.85	**3.85**	**1.86**	0.41	1.31	1.16		
Female	45_59	30.78	Coefficient	37.48	1.52	2.85	-2.63	-7.21	2.38	10.64	2.73	-0.01	0.70	0.62	8.99
			T-ratio	**5.30**	**2.25**	**1.86**	**-3.12**	**-3.55**	**3.18**	1.09	1.42	-0.09	1.04		
Male	60plus	36.32	Coefficient	48.31	0.33	1.00	-2.75	-2.21	2.02	14.80	-2.09	-0.05	0.69	0.26	11.43
			T-ratio	**5.38**	0.39	0.51	**-2.57**	-0.86	**2.13**	1.19	-0.86	-0.32	0.80		
Female	60plus	39.75	Coefficient	48.54	0.86	0.46	-1.79	-8.57	1.79	24.55	-1.53	-0.42	0.46	0.39	12.83
			T-ratio	**4.81**	0.90	0.21	-1.49	**-2.96**	**1.68**	**1.77**	-0.56	**-2.44**	0.48		

N=177, bolded cells are significant at 0.05 one-tailed level

Table 2: The long-term impact of civil wars: DALYs lost by disease categories

Cause Name	Gender	Age Group	Civil war deaths per 100 people (1991-97) Coefficient	Civil war deaths per 100 people (1991-97) t-ratio	Adjusted R-square
Malaria	Female	0_4	1.3706	**2.07**	0.53
Malaria	Male	0_4	1.5259	**2.33**	0.52
Malaria	Female	5_14	0.2945	**2.44**	0.51
Malaria	Male	5_14	0.2978	**2.38**	0.51
Malaria	Female	15_44	0.0370	**3.03**	0.57
Malaria	Male	15_44	0.0528	**2.49**	0.56
Malaria	Female	45_59	0.0080	**2.08**	0.54
Tuberculosis	Female	5_14	0.0910	**2.80**	0.56
Tuberculosis	Male	5_14	0.0782	**2.37**	0.54
Tuberculosis	Female	15_44	0.1089	**2.33**	0.58
Tuberculosis	Male	15_44	0.1198	**2.00**	0.61
Tuberculosis	Female	45_59	0.0996	**1.70**	0.58
Tuberculosis	Male	45_59	0.1387	**1.81**	0.69
Respiratory diseases, infectious	Female	5_14	0.1196	**2.20**	0.65
Respiratory diseases, infectious	Male	5_14	0.1196	**2.31**	0.63
Respiratory diseases, infectious	Female	15_44	0.1012	**2.69**	0.58
Respiratory diseases, infectious	Male	15_44	0.1024	**2.10**	0.54
Respiratory diseases, infectious	Female	45_59	0.1081	**2.37**	0.57
Respiratory diseases, infectious	Male	45_59	0.1040	**2.09**	0.61
Other infectious	Male	0_4	1.8168	**1.79**	0.72
Other infectious	Female	5_14	0.4344	**2.94**	0.64
Other infectious	Male	5_14	0.3374	**2.43**	0.66
Other infectious	Female	15_44	0.3803	**2.43**	0.65
Other infectious	Male	15_44	0.3615	**1.88**	0.60
Other infectious	Female	45_59	0.2681	**2.29**	0.62
Other infectious	Male	45_59	0.2127	**1.91**	0.65
Transportation accidents	Female	5_14	0.0695	**4.08**	0.28
Transportation accidents	Female	15_44	0.0492	**3.78**	0.23
Transportation accidents	Male	15_44	0.1523	**2.12**	0.34
Transportation accidents	Female	45_59	0.0609	**1.99**	0.17
Transportation accidents	Male	45_59	0.0962	**1.76**	0.19
Homicide	Female	5_14	0.0256	**5.30**	0.33
Homicide	Male	15_44	0.1414	**2.23**	0.41
Other unintentional injuries	Male	15_44	0.1913	**1.79**	0.33
Other unintentional injuries	Female	45_59	0.1068	**1.70**	0.11
Suicide	Female	15_44	0.0316	**2.26**	0.10
Maternal conditions	Female	15_44	0.6577	**2.82**	0.64
Maternal conditions	Female	45_59	0.0509	**2.26**	0.53
Respiratory disease, chronic	Female	5_14	0.0340	**1.80**	0.03
Cervix cancer	Female	5_14	0.0001	**1.86**	0.46
Cervix cancer	Female	45_59	0.0389	**2.15**	0.65
Cervix cancer	Female	60plus	0.0618	**2.01**	0.60
Breast cancer	Female	0_4	0.0007	**1.95**	0.33
Liver cancer	Female	45_59	0.0170	**1.83**	0.54
Liver cancer	Female	60plus	0.0301	**1.70**	0.55
Other malignant neoplasms	Male	5_14	0.0174	**2.78**	0.45
Cardiovascular disease	Female	5_14	0.0362	**2.83**	0.54
Digestive disease	Female	5_14	0.0121	**2.25**	0.30

Table 3: The long-term impact of contiguous civil wars: DALYs lost by disease categories

Cause Name	Gender	Age Group	Contiguous civil war Coefficient	Contiguous civil war t-ratio	Adjusted R-square
AIDS	Female	0_4	3.624	3.69	0.29
AIDS	Male	0_4	3.531	3.78	0.30
AIDS	Female	5_14	0.200	3.90	0.30
AIDS	Male	5_14	0.204	4.03	0.30
AIDS	Female	15_44	9.275	3.51	0.24
AIDS	Male	15_44	6.839	3.35	0.25
AIDS	Female	45_59	1.960	3.35	0.27
AIDS	Male	45_59	3.837	3.65	0.27
AIDS	Female	60plus	0.113	3.53	0.27
AIDS	Male	60plus	0.267	3.59	0.27
Homicide	Male	0_4	0.141	1.67	0.03
Homicide	Female	5_14	0.019	1.76	0.33
Homicide	Male	5_14	0.020	2.36	0.45
Homicide	Male	15_44	0.248	1.72	0.41
Homicide	Male	45_59	0.137	2.03	0.17
Other unintentional injuries	Female	0_4	0.494	2.01	0.21
Other unintentional injuries	Male	0_4	1.100	2.27	0.05
Other unintentional injuries	Female	5_14	0.229	2.06	0.37
Other unintentional injuries	Male	5_14	0.271	2.43	0.50
Digestive disease	Female	0_4	0.611	1.85	0.05
Digestive disease	Male	0_4	0.780	1.79	0.08
Digestive disease	Female	5_14	0.038	3.09	0.30
Digestive disease	Female	15_44	0.091	2.21	0.31
Cervix cancer	Female	0_4	0.056	1.67	-0.01
Lung cancer	Female	0_4	0.012	1.78	-0.02
Lung cancer	Male	0_4	0.031	1.74	0.00
Cancer of mouth, esophagus	Female	0_4	0.016	1.85	-0.02
Stomach cancer	Male	0_4	0.034	1.90	0.03
Other malignant neoplasms	Male	0_4	0.162	1.68	0.05
Other malignant neoplasms	Female	5_14	0.025	1.86	0.23
Liver cancer	Female	5_14	0.001	2.20	0.50
All other diseases	Female	5_14	0.187	1.99	0.07

[1] Estimates run as high as 90 percent of all war deaths in the late twentieth century being civilians (Ahlstram 1991), but such estimates are not reliable (Goldstein 2001: 399-402). Davis and Kuritsky 2002 report that severe military conflict in sub-Saharan Africa cut life expectancy by more than 2 years and raised infant mortality by 12 per thousand.

[2] The one-year impact of infectious disease and health system breakdowns associated with refugees is well-established (Toole 1997). War-related deaths from tuberculosis during the war in Guinea-Bissau are documented by Gustafson et al. 2001; Roberts et al. 2001 report war-derived disease deaths in Congo during the war as 6 times greater than those from direct violence. Effects beyond the war period are less clear, though the longer-term risk from tuberculosis, respiratory infections, and malaria is well-recognized (Centers for Disease Control and Prevention 1992).

[3] See Williams (1999), Murray et al. (2000), and Filmer and Pritchett (1999:1312).

[4] More information on the procedures can be found in WHO (2000: 145-46), and DALYs are displayed by disease category, gender, and region in WHO (2000: 170-75). DALE and life expectancy correlate highly (r = .99); DALE's attractiveness is its breakdown, in DALY's, of specific disease effects by age, and gender.

[5] Though our civil war data stop at the end of 1997, in 10 of the 34 cases the civil war did continue as late as 1999, and our analysis takes it into account.

[6] Duration and severity are moderately correlated (r = .41). Further research might look for a difference in effects between long but smoldering conflicts and short but intense ones.

[7] We ran several sensitivity checks for the results reported in the section below on data analysis. As expected, very long lag structures such as 1977-90 produce much weaker findings in which the coefficient for the civil war variable is only about one-fourth as large as for 91-97, and not statistically significant. A break between 1991-95 and 1996-97 shows greater impact for the latter period, but the standard error is higher. Eliminating all countries whose civil wars extended

past 1997 reduces the impact of wars in 1996-97, but not that of earlier wars. It is also possible that victorious rebels may redistribute health care resources so as to repair previous inequalities in the system, ultimately producing lower death and disability rates. These effects, however, are likely to be "long term and cumulative" (Dixon and Moon 1989: 187), with lags approaching 20 years. With our shorter lags we found no significant beneficial effects from civil wars in any of our estimations.

[8] A better measure, difficult to compile but useful in future research, might include measure the proportion of a country's borders occupied by states experiencing civil war, the severity of those wars, and the permeability of borders (Starr and Thomas 2002).

[9] Note that this comes after the time for which civil wars are measured. Since it picks up the indirect effect of civil war in reducing income and health spending it probably contributes to understating the full effect of our civil war variable.

[10] Some observations were estimated by multiple imputation from other data on educational attainment. For sources and methods see Evans et al. (2000b).

[11] WHO (2000: 164) reports that, among infectious disease categories, the major causes of deaths in Africa are, in descending order, HIV/AIDS, respiratory infections, malaria, diarrheal diseases, measles, and tuberculosis.

[12] Conflict involving a neighbor is a strong predictor of subsequent conflict at home (Ward and Gleditsch 2002). Nevertheless, this analysis shows the effect of an adjacent civil war whether or not the country itself had a civil war. Previous analysis (Ghobarah et al. 2001) found the effect is robust to inclusion or exclusion of countries that themselves experienced civil war.

[13] Twenty three disease or condition groups, times five age groupings and two genders, would give 230 equations. Some categories, however, are empty: for males, five each for maternal conditions, breast cancer, and cervical cancer; three for maternal conditions for females

under 15 and over 44; two for suicide by children under 5 years. The equations are too space-consuming to print here, but are available with the data on the website noted in the credits.

[14] Research in Sub-Saharan Africa suggests that the human papilloma virus (HPV) is linked to cancer of the cervix (Feachem, Jamison, and Bos 1991:17). HPV infection is necessary for development of low-grade squamous intra-epithelial lesions (LSIL), which in turn may develop into cervical cancer. Every new sexual partner greatly increases the risk of HPV, with the risk of developing LSIL in the first three years after HPV infection (Moscicki et al. 2001); however further progression to cancer is slower.

[15] One third of all DALYs lost from communicable disease in Africa are due to HIV/AIDS (WHO 2000: 170). Of course not all such losses stem from civil war. Conditions of urbanization, and income and ethnic inequality—included in our model—may be causally related to both AIDS and civil war.