War and Gender Inequalities in Health: The Impact of Armed Conflict on Fertility and Maternal Mortality

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Abstract

Recent studies have found significant excess mortality in women during and immediately after armed conflicts. This article directly assesses one of the most likely explanations, namely that war negatively affects reproductive health. Armed conflicts may contribute to sustain high fertility levels through increased social insecurity, loss of reproductive health services, and lower female education. Further, war's deteriorating impact on health infrastructure is expected to increase the relative risk that women die from complications associated with pregnancy and child birth. These claims are tested in a global time-series cross national study from 1970 through 2005. Three major findings are reported. First, armed conflicts are associated with higher overall fertility in low-income countries only. Second, maternal mortality rates are elevated, albeit moderately, in conflict countries. Third, conflicts in neighboring countries are associated with lower maternal mortality, possibly indicating that health interventions among refugee and host populations are relatively successful. While addressing one of the least successful UN Millennium Development Goals, this study also responds to the UN Security Council Resolution 1325, in which Article 16 specifically calls for the '*Secretary-General to carry out a study on the impact of armed conflict on women and girls*'.

1. Introduction

Generally, males are more likely to be killed in direct conflict events, whether soldiers or civilians (e.g. Brunborg et al. 2003; Verwimp 2006). Looking at reported war deaths in 13 WHO country mortality surveys, Obermeyer et al. (2008) find that 81% of the reported war deaths were in males. However, some recent studies suggest that the overall excess mortality resulting from conflict is greater for women than men (Ghobarah et al. 2003; 2004; Plümper & Neumayer 2006). This implies that women should be significantly more vulnerable than men to indirect health consequences of conflict. We argue that only maternal mortality is a sufficiently important cause of death disproportionally affecting women that it may account for any large-scale female excess war mortality. However, while deteriorated health services has been suggested as one reason for female excess mortality, there has been a striking lack of attention paid to how armed conflict may affect reproductive health and maternal mortality[i]. A recent review (Gil-Gonzales et al. 2006) concludes that most cross-sectional research on maternal mortality focuses on socioeconomic factors, and that there is a lack of published results on the political determinants of maternal mortality. This article emphasizes the study of health consequences from armed conflict on women, and it is hypothesized that the main explanation for female excess war mortality is found in increased maternal mortality.

Three of the eight UN Millennium Development Goals (MDGs) relate to improvements in health conditions. Goal number 5 is to reduce by three quarters the maternal mortality ratio by 2015, and to achieve universal access to reproductive health. A midway review of the MDGs concludes that Sub-Saharan Africa (SSA) is not on track to achieve any of the goals, and that 'maternal health remains a regional and global scandal' (UN, 2007a: 2). According to the review, the odds that a woman in Sub-Saharan Africa will die from complications related to pregnancy and childbirth during her life, otherwise known as the adult lifetime risk of maternal

deaths, is one in 16 compared to one in 3,800 in the developed world. A better understanding of the impact of armed conflict on maternal health could provide important insights to policy-makers, in particular for SSA, where more than half of all countries have experienced armed conflict on their territory since the end of the Cold War (Gleditsch et al., 2002; Thémner & Wallensteen, 2012).

Two proximate determinants of maternal health are proposed as the most important explanations for the observed female excess mortality from armed conflict. First, it is assumed that the availability of obstetrical care is generally much poorer for women in conflict areas, substantially increasing the risk of death for every pregnancy and child delivery. Generally women are dying while giving birth because 'they have no access or limited access to health care, or because the quality of care is poor' (UNICEF, 2008: 2). Second, we hypothesize that protracted armed conflict is associated with higher levels of fertility[ii], both because of increased social insecurity leading to an increasing demand for children, and because of lack of knowledge about and access to reproductive health services, increasing the supply of children. A possible long-term indirect effect of war on fertility may be through the deterioration of female education, possibly enhancing early female marriage. Previous research has identified limited access to health care as one important explanation for excess female mortality in war-torn countries, but not assessed maternal mortality or access to health services directly. Furthermore, high fertility as a cause of excess female mortality has been largely neglected despite the very high fertility levels in many conflict settings. Of the 11 countries in Sub Saharan Africa where total fertility rates (TFR) were above 6.0 in 2005 (UN, 2007b), eight had experienced recent protracted armed conflicts, while low-intensity armed conflicts had happened recently in the other three.[iii]

Testing the impact of armed conflict on maternal mortality and fertility in cross-national time-series models of developing countries, our results only modestly corroborate studies finding large-scale female excess mortality. While the interaction of armed conflict and poverty appears to be linked to high fertility, particularly in Sub-Saharan Africa, there is also some evidence for an effect of armed conflict on maternal mortality rates, possibly working through the impact of war on economic performance. Finally, conflict in a neighboring country is not associated with increased maternal mortality, as expected, but with lower maternal mortality rates. This may be indicative of a relative success among NGOs and the international community in providing health services to refugee populations, often improving health well beyond the refugee camp. In the following, we review prior relevant empirical studies before outlining the causal mechanisms of our theoretical model. We then present and test our empirical models, before discussing interpretations and implications.

2. The impact of war on fertility and maternal health

Violent conflicts come with a baggage of consequences including economic, social, political and environmental (Iqbal, 20006). Apparently all these consequences may have a direct effect on individual and population health. Conflicts may further affect health throughout different phases. Before conflicts break out, military expenditures typically rise and divert scarce resources from health services and medical care. During conflict, combat casualties, both soldiers and civilians, are directly attributable to conflict. In addition, major losses of life and negative health effects stem from indirect consequences of armed conflict. Armed conflicts generate adverse health conditions and weaken societies' capacity for dealing with the increase in morbidity and mortality (Foege 2000). They often destroy agricultural systems and displace populations, causing food shortages. The Human Security Centre (2004: 7) suggests that six out of

seven major recent African famines were caused by conflict. In many conflicts, the warring parties target infrastructure like drinking water supplies, sewage and sanitation facilities, power plants, food supply systems, communication lines, and basic health infrastructure in order to create chaos and social disorder, and to destabilize the opponent. When infrastructure is destroyed, existing health services may be suspended or severely limited. This has devastating direct consequences, and also longer term indirect effects because public health programs that deal with preventive medicine - such as vaccinations or obstetrical care – are often suspended. Following the 2002 conflict in Cote d'Ivoire, Betsi *et al*. (2006) reported that a significant reduction in health staff in both the public and private sectors was observed in the affected areas coupled with a collapse of the health systems and public infrastructure and interruption of basic health services. This was accompanied by a negative reversal in earlier gains made in maternal health (UNICEF, 2009).

Although armed conflict has been identified as an important public health problem (Iqbal, 2010; Murray et al. 2002), systematic data collection has been limited. An exception is Lacina & Gleditsch's (2005) dataset on battle deaths in wars measure the extent of immediate, battle-related deaths. Obermeyer et al. (2008) address direct war deaths reported in WHO surveys. Health effects beyond the war, however, remain largely unknown, as actors such as the Center for Disease Control and Prevention have expressed concern over for many years. While international organizations such as the ICRC, MSF, and the IRC (e.g. Coghlan et al. 2006) have knowledge about the medical needs that typically arise in crisis regions, few studies address the overall health effects of conflict. Moreover, this literature has not been merged to any great extent with the growing armed conflict literature. The immediate health consequences of specific conflicts have partly been analyzed in demographic and medical research. Gustafson et al.

(2001) analyze the spread of tuberculosis during war in Guinea-Bissau. Randall (2005) found a remarkable stability in fertility among Tuaregs in Mali.

Some recent comparative studies have addressed the gendered health consequences of armed conflict, and particular civil wars. Ghobarah et al. (2003; 2004) argue that the effects of civil wars are under-estimated, since wars continue to kill people long after the war itself has stopped. They studied cross-national variation in 1999 WHO data on Disability Adjusted Life Years (DALYs). The authors estimate the long-term effects of civil wars and claim that around 12 million DALYs were lost in 1999 in countries with civil wars, plus perhaps another 3 million DALYs in neighboring countries. This is close to twice the size of the WHO's estimate of direct and immediate loss of DALYs from armed conflicts in 1999. Further, the authors (Ghobarah et al., 2003) fully explore the rich health data by looking at the effect of war by gender, age and different disease categories. Here, they find that of the 54 sub-categories that were affected by war, females constituted 33. This led the authors to conclude that indirect mortality disproportionally affects women. However, the problem about such conclusion is that the disease categories are not similar in size, which means that even though there were more sub-categories involving females that were affected by war it does not necessarily imply that female war mortality adds up to become greater than male war mortality. In fact, when Ghobarah et al. (2003) look at the effect of war across disease categories, men and women appear to be quite equally affected. Out of a total of six age/gender sub groups significantly affected by civil war, three were male and three were female. While some concern has been raised over the vulnerability of girls in conflict situations, Ghobarah et al. (2003) find that boys aged 0-4 are more negatively affected than girls at the same age. Boys and girls aged 5-14 seem to be equally negatively affected by war.

Plümper & Neumayer (2006) analyze international data on life expectancy provided by the US Census Bureau. They find in their study that both interstate conflicts and civil wars decrease the natural gap between female and male life expectancy, and thus on average affect women more adversely than men. The authors further investigate how different conflict types have different effects. For interstate and internationalized civil wars, it does not seem to matter whether the conflict has ethnic roots or whether the central political authority has collapsed. For civil wars, however, they find that ethnic wars and wars in 'failed' states are much more damaging to women than other civil wars. As an example, Plümper and Neumayer estimate that in a state with a life expectancy of 60.0 years for men and 64.8 years for women, an ethnic war combined with state failure would reduce the life expectancy by 2.62 years for women against 2 years for men, which is a very significant gender disparity in conflict mortality. Another comparable study by Li & Wen (2005) finds that men tend to suffer higher mortality immediately from armed conflicts, while the long-term mortality owing to the lingering effects of conflicts are relatively equally distributed between the genders. In an extensive study of the impact of armed conflict on a variety of health measures, Iqbal (2010; 93) finds no negative effect of major armed conflict on female life expectancy, while male life expectancy is significantly negatively affected.

Most of the studies of the above type are conducted at the country level. This is likely to lead to an under-estimation of the health effects of war, since effects on neighboring countries are ignored and since the local impact of war only shows up as a change in nation-wide averages. The recent research has improved our knowledge of the health consequences of wars, but these studies also conclude that much more needs to be done. Social and medical scientists as yet have not been able to clearly and unequivocally identify the various causal mechanisms. In particular, none of the above cross-sectional studies directly address the issue of reproductive

health and maternal mortality. Plümper & Neumayer (2007) mention maternal mortality as one contributing factor, but do not test the proposition directly. They assert that 'future research should provide a better understanding and a more detailed account on the relative importance of specific channels through which armed conflict harms women more than men' (ibid.: 38). This article fills that gap.

According to the WHO 'the number of maternal deaths in a population is essentially the product of two factors: the risk of mortality associated with a single pregnancy or a single live birth, and the number of pregnancies or births that are experienced by women of reproductive age' (WHO, 2005: 4). Armed conflicts may affect maternal health through severing the availability of basic reproductive health services, including accessibility to family planning and obstetrical care.

Fertility: High fertility levels implicates that women are put at risk multiple times. So far, relatively little systematic research has been done on how conflict affects fertility. But there is a body of literature (reviewed in Caldwell, 2004) showing that economic shocks generally have a negative short-term effect on fertility. Outbreaks of armed conflict may be expected to have a similar short-term effect on fertility. Wars may reduce the supply of children, particularly where large numbers of young men are mobilized for warfare, possibly leading to both delayed marriages and declines in marital fertility. Demand for children may also temporarily decline as conflict may be expected to have a negative impact on the economy. Lindstrom & Berhanu (1999) reported a short-term decline in conceptions in Ethiopia in years of major social and economic upheaval. Agadjanian & Prata (2002) found a drop in fertility following a major outbreak of war in Angola as well as a postwar increase while Woldemicael (2008) reports that the 1998-2000 border conflict between Eritrea and Ethiopia is likely to have contributed to the significant decline in TFR in Eritrea between 1995 and 2002. Using the 2005 Rwanda

Demographic and Health Survey data to study effects of the 1994 genocide, Jayaraman *et al*. (2009) found that women who lived in conflict-affected clusters married and had children later compared with clusters with less or no conflict.

But long-lasting and high intensity armed conflicts could be expected to exert an opposite effect on fertility (Iqbal, 2010). While this may primarily work through affecting the socioeconomic determinants of fertility, there could also be important direct effects. On the supply side, access to contraception and abortions may be severed if health clinics have to be shut down or provide only limited services. With the prevailing state of insecurity, basic supplies to health facilities might be disrupted. For instance, in the Maoist insurgency in Nepal incidents of destruction of health posts, intimidation of health personnel and disruption of transport of medical supplies have been reported (Ghimire & Pun, 2006). On the demand side, closed schools may mean that the cost of children declines at the same time as their value as labor increases. Declines in the formal economy decreases the opportunity cost of parents, but may encourage the use of children for generating additional income. Long-lasting wars and instability may lead parents to choose short-term income from many children over long-term return from fewer and educated children. Finally, high child mortality during conflict may lead parents to replace lost children. In a recent analysis of the Rwandan conflict on fertility, Schindler & Brück (2011) found a strong replacement effect. Indirectly, there may also be an effect on fertility via education and labor force participation. If the educational infrastructure disintegrates, declines in educational levels may increase fertility possibly through early marriage for young girls and poor knowledge on family planning and birth control. DeRose & Kravdal (2006) find that educational reversals in sub-Saharan Africa increase fertility beyond individual effects. Long-lasting wars may generally decrease the alternative cost of women by offering

contracting economic opportunities. In a rare study of war and aggregate fertility, Iqbal (2010: 82-83) finds no significant effect of major armed conflict on fertility rates.

Maternal mortality: Conditions may severely deteriorate for women of reproductive age during war due to destruction of health infrastructure where maternal health care is normally provided, killing and fleeing of senior health personnel, and a complete cut-off from other basic amenities as was the case with the conflict in Sarajevo (Carballo *et al*. 1996). As observed during the Bosnian war in the 1990s 'health services, especially those supporting women and children, were severely disrupted, with over 35% of facilities destroyed or heavily damaged' (Kinra et al., 2002: 76). This resulted in a steep increase in maternal mortality per delivery, a situation that was rapidly reversed following the end of the war (Fatusic et al., 2005). Armed conflicts and post-war conditions produce an increase in risks to maternal health through several mechanisms: a) higher rates of dangerous abortions and pregnancy terminations due to non-functional/poorly functional health services and acute shortage of skilled medical personnel, b) greater risk of infectious diseases during pregnancies or following birth due in part to women being larger percentage of displaced populations and shortage of medical professionals/clinics, c) possibly higher malnutrition levels during pregnancies and after birth due to family economic crises, higher rates of being in displaced populations with poor access to food.

In countries where maternal deaths have been significantly brought down, this has largely been associated with the effectiveness of skilled birth attendance and advances in and diffusion of medical technology like caesarian section, blood transfusion, institutional delivery, and antenatal care (Hogan *et al*. 2010; Prata *et al*. 2010, see also Khan *et al*. 2006), practices and procedures that are all vulnerable to conflict activity. In a recent review, O'Hare and South-all (2007) found an association between a recent armed conflict and higher rates of maternal mortality. They observed that the median adjusted maternal mortality in countries that have

experienced a recent conflict (from 1990 upwards) was 1,000/100,000 births versus 690/ 100,000 births in countries without recent conflict. Their findings also revealed that the median reported MMR was also significantly higher in countries with recent conflict.

Arguably, the single-most important factor implicated in maternal deaths in conflict and post-conflict settings is poor quality or the complete absence of emergency obstetric care (EmOC) services. Studies in Uganda (Mbonye *et al*. 2007) have revealed that the availability of basic services such as a midwife in a health facility can reduce case fatality rate by up to 80%. Unfortunately such services are largely absent in lot of conflict settings. A study by Bartlett *et al*. (2002) among Afghan refugees in Pakistan revealed that 41% of deaths among reproductive-age women were pregnancy-related, due to inaccessibility of emergency obstetric care. The United Nations Populations Fund (UNFPA) suggests that one third of maternal deaths could be prevented if unmet need for family planning were to be eliminated, and wars and other violent conflicts can contribute to make access to these basic services much harder.

A 2010 review (Hogan *et al*. 2010) of maternal mortality in 181 countries, spanning 1980-2008 revealed that 50% of all maternal deaths were in only six countries in 2008 (India, Nigeria, Pakistan, Afghanistan, Ethiopia, and the Democratic Republic of the Congo), all of which are countries with ongoing or recent armed conflicts. Furthermore, for over a decade, the bottom 10 countries on the *Save the Children's* 'state of the world's mothers' index ranking have primarily been conflict or post-conflict countries, further highlighting the challenged health and wellbeing of women in conflict areas globally. This is an index that is determined by considering the health, educational, economic and political status of women in each of the countries considered. The 2011 mothers' index featured the following countries on the bottom 10: Central African Republic, Sudan, Mali, Eritrea, DR Congo, Chad, Yemen, Guinea-Bissau, Niger and Afghanistan. According to the report "war, violence and lawlessness also do great harm to the well-being of mothers and children, and often affect certain segments of the population disproportionately" (Save

the Children State of the World's Mothers 2011: 27). Similarly, the bottom 10 countries featuring on the UN Human Development index for the last decade are either in conflict or emerging from one, a further indication of the destructive effects of conflicts on overall human development.

Refugee populations: During conflicts, women and children are typically overrepresented among refugee and IDP populations, and for various social and biological reasons they are the most vulnerable to the indirect and direct consequences of war (Carballo et al. 1996). When many people are displaced, diseases break out more easily, with deadly effects. People live under precarious conditions, with poor access to fresh water, heating, sanitation facilities, contraception, etc. resulting in weakening of the body's natural defenses against disease and infection. Diseases that are more easily transmitted under such conditions are HIV/AIDS, cholera, tuberculosis, malaria and various other infections. Iqbal & Zorn (2010) working with HIV prevalence data from 43 African countries from 1997 – 2005 found that both domestic and international conflicts are positively associated with increasing HIV/AIDS prevalence. They suggest that conflicts could enhance the transmission and prevalence of HIV/AIDS through increase contact between uninfected and infected populations as a result of massive population displacement, and 'increase probability that HIV-transmitting events will occur'(p. 150). However, the evidence for conflict as a main driver of HIV is mixed. Gizelis (2009) assesses the impact of war on the rate of new infections on an annual basis for the 1982-2000 period. She finds no effect of internal conflict or refugee movements on the spread of AIDS. In a study reviewing existing evidence on conflict and HIV prevalence in seven countries in Sub-Saharan Africa, Spiegel et al. (2007) found insufficient data to support the claim that conflict, forced displacement, and wide-scale rape increase prevalence on the population level, nor for the assumption that refugees spread HIV infection in host communities.

Toole (2000) reports mortality rates from refugee camps that are up to 100 times higher than the normal mortality rate in the affected country. Internally Displaced Persons (IDP) camps can be particularly severely hit when geographically close to ongoing conflicts, as people are either directly affected by the fighting or it delays and impedes assistance. Under such conditions people could die from direct combat activities, develop injuries that eventually kill them, or die from pre-existing conditions that could be exacerbated by the conflict and/or weakened health system.

There are some studies providing gendered mortality data for refugee populations. In a Burmese refugee camp in Bangladesh female infants were reported to be twice as likely to die as male infants (Toole, 2000: 204). The mortality rates of females above the age of five were also 3.5 times higher than that of males. Verwimp & Van Bavel (2005) report higher infant mortality levels, particularly for newborn girls, and increased fertility levels among Rwandan refugees. Health conditions are likely to be worse for refugees that concentrate outside camps as these may not benefit from public services or international aid. Ethnic cleansing policies particularly increase the likelihood of forced displacements which will put pregnant women at higher risk as a result of disease, malnutrition, and lack of competent care. Finally, the impact of displacement on maternal mortality may not be limited to the countries directly as we could expect to see cross-border refugee movements causing negative spill-over effects on maternal health indicators in neighboring countries.

Resilience and post conflict recovery: As should be expected, countries will react to shocks such as conflicts in different ways. In this regard, previously poor countries with weak health systems will be more severely affected compared to rich countries with better health systems. This will undoubtedly be reflected in the performance of important health indicators like maternal mortality ratio, access to contraceptives and unmet need for family planning post-

conflict. For instance, due to the strong health system that existed in Bosnia before the conflict of the 1992-1995, the poor maternal mortality ratio experienced during the conflict sharply improved following the end of the war as the pre-war health system was quite resilient and could better withstand the shocks from the conflict. This might not be the case with many conflicts in Sub-Saharan Africa. In analyzing the public health impact of violent conflict, Iqbal (2006), shows that although the impact is generally devastating, the degree of devastation varies across countries based on their levels of wealth, trade and democracy. As such the public health impact of conflict on states with higher levels of wealth, trade and democracy tend to be less severe in the short and long term post-conflict compared with those with lower ratings on these parameters. Therefore, a better appreciation of the effect of war on health indicators should be done taking these factors into consideration.

Based on a review of the existing literature, the following hypotheses are proposed:

H_1: Armed conflicts are associated with higher fertility rates.

H_2: Neighboring conflicts are associated with higher fertility rates.

H_3: Armed conflicts are associated with higher maternal mortality rates.

H_4: Neighboring conflicts are associated with higher maternal mortality rates.

H_5: The poorer the country, the stronger is the effect of conflict on maternal health.

3. Research design, data

The relationship between armed conflict and maternal health is assessed in two cross-national time-series studies covering the 1970-2005 (fertility rates) and 1990-2005 (maternal mortality rates) periods. Both outcome variables are measured in five-year intervals, and the units of

observation in the datasets used are five-year periods. The first dependent variable, the total fertility rate (TFR), is defined as 'the average number of children a hypothetical cohort of women would have at the end of their reproductive period if they were subject during their whole lives to the fertility rates of a given period and if they were not subject to mortality'. The measure is expressed in number of children per woman, and estimates are provided by the United Nations Population Division (UN 2007b).

The second dependent variable, the Maternal Mortality Rate (MMR) is defined as 'the death of a woman while pregnant or within 42 days of completion of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes' (WHO, 2007). It is expressed as maternal deaths per 100,000 live births, and is logtransformed for the purpose of this analysis. We are using WHO panel data on national annual maternal death estimates, covering the years 1990- 2005. Vital registration is arguably the most useful resource to measure maternal mortality (Hogan *et al*. 2010) unfortunately such services tend to be disrupted or even closed down during conflicts, hindering reliable means of measuring such an important parameter. In many conflict areas especially in Africa, data on maternity mortality in conflict settings is of poor quality or largely unavailable. The MMR estimates used for our analysis primarily make use of data from vital registration systems, however where such data was not available a multilevel regression model was developed to derive estimates and projections of maternal deaths at specific time points (WHO, 2010). While such data sets are not without some concerns, these appear to be the best and most comprehensive current estimates.

As illustrated in Table I, not accounting for any other factors that may affect both conflict and health, countries with recent conflict have on average considerably higher levels of both fertility and maternal mortality rates. In Sub-Saharan Africa, the average maternal

mortality rate in a country with recent conflict is more than three times that of a non-conflict country, the average TFR is 1.2 children higher in conflict countries than in non-conflict states. Table I further shows the lower averages of contraceptive prevalence and skilled attended births in conflict compared to non-conflict countries.

We follow the approach taken by Gates et al. (2012) in their analysis of the effect of armed conflict on the progress of several Millennium Development Goals.[iv] The main independent variable, armed conflict, is a logtransformed measure of the aggregate number of casualties in conflict (battle-related deaths) in the preceding five-year period.[v] As the measure includes both prior and, in many cases, current conflict, it arguably captures both immediate and lingering health effects of conflict. In addition, a separate variable is coded measuring the number of conflict-years in neighboring states in the previous five-year period, with 'neighboring state' being defined as any country within 500 km of the borders of the country in question.

Like Gates et al. (2012) we exclude developed countries[vi] and use fixed-effects regression models, removing between country-differences and focusing on within-country effects.[vii] We are further including period dummies to account for the general improvement in maternal health over time, assumed to also affect conflict countries. The design resembles recent studies of aggregate fertility by Lutz et al. (2006) and Doces (2011), and of aggregate maternal mortality by Hogan et al (2010), including many of the same control variables as these three studies. While both the TFR and MMR basic models include only the conflict variables in addition to the time period dummies and a control for logtransformed total population (in thousands) (UN, 2007b), the expanded models include major drivers of fertility and maternal mortality rates identified by previous studies (in particular Doces, 2011; Hogan et al., 2010; Lutz et al., 2006), some of which are also proxies for factors affecting the risk of armed conflict.

The expanded TFR models include *infant mortality rates* (logtransformed), defined as the number of children who survive to the age of at least 1 per 1,000 live-born children (UN, 2007b); per capita income (GDP) (logtransformed) (from Gates et al., 2012); the proportion of the total population living in urban areas (UN, 2007b), and the proportion of females aged 15-24 years with completed secondary or higher education (Lutz et al., 2007). The expanded MMR models include per capita income, share of population that is urban, and HIV prevalence estimates, defined as the estimated number of adults aged 15-49 years with HIV infection, whether or not they have developed symptoms of AIDS, expressed as per cent of total population in that age group. The HIV prevalence data is obtained from the WHO Global Health Observatory Data Repository (WHO, n.d.). While we ideally would have liked to include estimates for the proportion of births attended by skilled health personnel, antenatal care coverage, and contraceptive prevalence rates, such data are too sparsely available that they could be used in a cross-national analysis.

4. Results

Armed conflict and fertility

Table II presents the results from fixed-effects models assessing the impact of conflict intensity (measured as battle-related deaths) and conflict in neighboring countries on fertility levels (TFR). The expectation was that both armed conflict and neighboring conflict would be positively associated with fertility. In addition to the conflict measures, Model 1 includes period dummy variables accounting for changes in average levels of TFR over time, as well as a control for total population size (log-transformed) as larger countries are likely to have higher battle-death counts. The statistically significant period indicators in Model 1 underscore the strong, general decline in fertility over the 1970 to 2005 period. These time trends are to a large extent

accounted for when introducing controls for major drivers of fertility in Model 2; both infant mortality and the proportion of the population living in urban areas are strongly related to fertility levels. These two measures are highly correlated with the GDP per capita measure, and similar to what Lutz et al. (2006) find, per capita income does not exert a statistically significant impact on fertility when infant mortality and urban population are accounted for.

- Table II here -

Contrary to our expectation, conflict does not appear to affect overall fertility, whether it takes place in the country in question or across a neighboring border. However, as discussed above, individual fertility behavior may differ across contexts, and there are reports in the literature both about increased and reduced fertility during conflict. In Model 3, we include an interaction term between battle-related deaths and poverty (the inverted income per capita variable)[viii], assuming that while individuals in relatively higher income settings may offset fertility in the context of the increased insecurity that conflict represents, individuals in relatively poorer countries may maintain a high level of fertility as a strategy to cope with insecurity if having a large family is a dominant form of economic and social security. The interaction effect of conflict and poverty is indeed clearly statistically significant, suggesting that conflict may act as a deterrent to the demographic transition in poor countries.

As an additional test including the percentage of females aged 15-24 with secondary or higher education is provided in Model 4. While the education data has limited coverage, thus significantly reducing the units of observation, female education stands out as an important factor reducing overall fertility, consistent with the overwhelming evidence in fertility research.

Armed conflict and maternal mortality

In Table III, four models assessing the relationship between armed conflict and maternal mortality are presented. In Model 5, the strong improvement in maternal mortality over time is captured in the negative and strong period dummy variables. As hypothesized, armed conflict does seem to be associated with increased maternal mortality rates, albeit the effect is relatively moderate. An armed conflict of median intensity level (2500 battle-related deaths) is associated with a 10% increase in the Maternal Mortality Rate. Neighboring conflict, on the other hand, appears to be associated with lower levels of maternal mortality, and this finding is consistent across model specifications (including Models 5 through 7). While conflicts may have significant negative spillover effects on development, this result may be suggestive of the relative success of NGOs and the international community in providing basic health services to refugee populations in neighboring countries. Such improvements are often also provided to the host population in the area of arrival, contributing to significant overall health improvements. This interpretation is discussed further in the next section.

- Table III here –

In Model 6 we control for level of income, which is strongly associated with reductions in maternal mortality. Its inclusion in the basic model washes out the effect of armed conflict on MMR, suggesting that the effect identified in Model 1 may be indirect, working through reduced levels of income possibly affecting the provision of health care. In Model 7, the interaction between battle-related deaths and poverty is statistically insignificant, suggesting that the effect of conflict on maternal mortality is not conditioned on level of poverty. The share of

population living in urban areas is not associated with maternal mortality rates, while HIV prevalence (Model 8) is, consistent with the findings of Hogan et al. (2010). Another factor typically associated with maternal mortality rates, female education, is not statistically significant in our models and not shown here.

5. Discussion and conclusion

Recent studies have reported finding equally high, or higher, female to male war mortality rates. The highly gendered nature of dying in relation to pregnancy and childbirth makes maternal mortality rates, but also fertility levels, obvious suspects in the search for sources of excess female war mortality. Arguably, only maternal mortality leads to sufficiently many deaths – estimated at 342,900 globally in 2008 – with such disproportional gender distribution that it could explain a significant mortality disadvantage for women compared to men during conflict. While the results reported in this study may not fully account for the strong impact of war on female life expectancy reported in earlier studies, the impact of conflict on maternal health is discernible. In particular, armed conflicts appear to delay the fertility transition in the poorest countries, and are associated with higher levels of maternal mortality. These findings are consistent with the empirical observation that many of the countries in sub-Saharan Africa with the highest current fertility and maternal mortality rates have experienced recent wars.

While conflict in the neighborhood does not appear to impact total fertility rates, there is an effect of conflicts in neighboring countries on maternal mortality. However, conflicts are not associated with negative maternal health externalities in neighbor countries as expected; rather maternal mortality is lower in countries with neighbors at war everything else being

equal. We speculate that this finding may be driven by the relative success of NGOs and other international actors in targeting refugee populations in host countries and providing basic health services. Refugee populations living in recognized refugee camps are relatively easy to reach, and women of reproductive age are typically overrepresented, so that maternal health interventions may be highly effective. A number of studies (Orach and De Brouwere, 2004; Van Damme et al.,1998) focusing on access to basic healthcare for refugees vis-a-vis the host populations have found that refugees tend to have better access to health care services including major obstetric interventions than members of the host communities. In some cases, maternal mortality was even found to be 2.5 times higher in the host population than in the refugee population of the same area. McGinn (2000) reports that in the study of refugee populations negative maternal health outcomes are generally less commonly reported. UNHCR estimates of maternal mortality rates from eight refugee camps in 1998 showed an MMR between 65 and 526 per 100,000 live births, considerably lower than national estimates for both host and home countries. In a comparative study of more than 600,000 displaced people living in 52 post-emergency phase camps in seven countries, Hynes et al. (2002) find that refugees and internally displaced had better reproductive health outcomes – including lower fertility, lower neonatal mortality, lower maternal mortality, and higher birth weight – than both the host country population and the population in the country of origin. With concerns over inequity in access to health care potentially becoming a source of tension between refugees and the host populations, Orach and De Brouwere (2006) have called for an integration of health services for refugees and host communities. When successful, such integration allows host populations to benefit greatly from the delivery of health services to refugees. In rural areas in Guinea receiving refugees from Liberia and Sierra Leone in the early 1990s, maternal health in the host population improved substantially in the areas where the refugees had settled (McGinn, 2000).

Deaths associated with maternal conditions is the second leading cause of mortality among women in reproductive ages globally, and the sixth most important cause of female deaths overall in low-income countries (WHO, 2009). 99 per cent of all maternal deaths occur in developing countries, many of these in conflict-affected countries. Like previous studies concluding that armed conflicts have a negative effect on public health, this study finds that maternal health is impacted. The relatively weak results and seemingly positive impact of targeted interventions in refugee populations appear to attest to the possibilities for health interventions in conflict and post-conflict situations, targeting vulnerable populations. Additional research on the conditions under which national and external provision of health services may be successful in conflict and post-conflict settings could be crucial in order to achieve further reduction in maternal mortality leading towards the MDG target.

6. Literature

Agadjanian V & N Prata, 2002. War, peace, and fertility in Angola, *Demography* 39 (2): 215-231.

Bartlett LA; DJ Jamieson, T Kahn, M Sultana, HG Wilson & A Duerr, 2002. Maternal mortality among Afghan refugees in Pakistan, 1999-2000, *Lancet* 359: 643-649.

Betsi NA; BG Koudou, G Cissé, et al., 2006. Effect of an armed conflict on human resources and health systems in Côte d'Ivoire: Prevention of and care for people with HIV/AIDS, *Aids Care* 18(4): 356-365.

Brunborg H; T Lyngstad & H Urdal, 2003. Accounting for genocide: How many were killed in Srebrenica?, *European Journal of Population* 19 (3): 229–248.

Caldwell JC, 2004. Social upheaval and fertility decline, *Journal of Family History* 29(4): 382–406.

Carballo M; S Simic & D Zeric, 1996. Health in countries torn by conflict: Lessons from Sarajevo, *Lancet* 348: 872-875.

Coghlan B; RJ Brennan, P Ngoy et al., 2006. Mortality in the Democratic Republic of Congo: A nationwide survey, *Lancet* 367: 44–51.

DeRose LF & Ø Kravdal, 2006. Educational reversals and first-birth timing in sub-Saharan Africa: A dynamic multilevel perspective, *Demography* 44(1): 59-77.

Doces JA, 2011. Globalization and population: International trade and the demographic transition, *International Interactions* 37(2): 127-146.

Fatusic Z; A Kurjak, G Grgic & A Tulumovic, 2005. The influence of the war on perinatal and maternal mortality in Bosnia and Herzegovina, *Journal of Maternal - Fetal & Neonatal Medicine* 18(4): 259-263.

Foege WH, 2000. 'Arms and public health: A global perspective', in BS Levy & VW Sidel, eds, *War and Public Health.* Pp. 3–11. New York: Oxford University Press.

Gates S; H Hegre, HM Nygård & H Strand, 2012. Development consequences of armed conflict, *World Development* 40(9): 1713–1722.

Ghimire L & M Pun, 2006. Health effect of Maoist insurgency in Nepal, *Lancet* 368: 1494.

Ghobarah HA; P Huth & B Russett. 2003. Civil wars kill and maim people – Long after the shooting stops, *American Political Science Review* 97(2): 189-202.

Ghobarah HA; P Huth & B Russett. 2004. The postwar public health effects of civil conflict, *Social Science & Medicine* 59: 869-884.

Gil-Gonzales D; M Carrasco-Portino & MT Ruiz, 2006. Knowledge gaps in the scientific literature on maternal mortality: A systematic review, *Bulletin of the World Health Organization* 84(11): 903-909.

Gizelis TI, 2009. 'Wealth alone does not buy health: Political capacity, democracy, and the spread of AIDS', *Political Geography* 28(2): 121–131.

Gleditsch NP; P Wallensteen, M Eriksson, M Sollenberg & H Strand, 2002. Armed conflict 1946–2001: A new dataset, *Journal of Peace Research* 39(5): 615-637.

Gustafson P, VF Gomes, CS Vieira, et al., 2001. Tuberculosis mortality during a civil war in Guinea-Bissau, *Journal of the American Medical Association* 286: 599-560.

Hogan MC; KJ Foreman, M Naghavi, et al, 2010**.** Maternal mortality for 181 countries, 1980-2008: A systematic analysis of progress towards Millennium Development Goal 5, *Lancet* 375**:** 1609-1623.

Human Security Centre, 2004. *Deadly Connections: The War/Disease Nexus Workshop Report*, March 22–23, Vancouver.

Hynes M et al, 2004. A determination of the prevalence of gender-based violence among conflict-affected populations in East Timor, *Disasters* 28(3): 294-321.

Iqbal Z, 2006. Health and human security: The public health impact of violent conflict, *International Studies Quarterly* 50(3): 631–649.

Iqbal, Z, 2010. *War and the Health of Nations*. Stanford, CA: Stanford University Press.

Iqbal Z & C Zorn, 2010. Violent conflict and the spread of HIV/AIDS in Africa, *Journal of Politics* 72 (1): 149-162.

Jayaraman A; T Gebreselassie, & S Chandrasekhar, 2009. Effect of conflict on age at marriage and age at first birth in Rwanda, *Population Research and Policy Review* 28(5): 551-567.

Kinra S; ME Black, S Mandic & N Selimovic, 2002. Impact of the Bosnian conflict on the health of women and children, *Bulletin of the World Health Organization* 80(1): 75-76.

Khan KS; D Wojdyla, L Say, AM Gulmezoglu & PF Van Look, 2006. WHO analysis of causes of maternal death: A systematic review, *Lancet* 367(9516): 1066-1074.

Lacina B & NP Gleditsch, 2005. Monitoring trends in global combat: A new dataset of battle deaths, *European Journal of Population* 21 (2–3): 145–166.

Li Q & M Wen, 2005. The immediate and lingering effects of armed conflict on adult mortality: A time-series cross-national analysis, *Journal of Peace Research* 42(4): 471–492.

Lindstrom DP & B Berhanu, 1999. The impact of war, famine, and economic decline on marital fertility in Ethiopia, *Demography* 36 (2): 247–261.

Lutz, W; MR Testa & DJ Penn, 2006. Population density is a key factor in declining human fertility, *Population and Environment* 28: 69–81.

Lutz W; A Goujon, KC Samir & W Sanderson, 2007. *Reconstruction of Population by Age, Sex and Level of Educational Attainment for 120 Countries 1970–2000*. Laxenburg, Austria: IIASA.

McGinn T, 2000. Reproductive health of war-affected populations: What do we know?, *International Family Planning Perspectives* 26 (4): 174–180.

Murray CJL; G King, AD Lopez, N Tomijima & EG Krug, 2002. Armed conflict as a public health problem, *British Medical Journal* 324: 346-349.

Obermeyer Z; CJL Murray & E Gakidou, 2008. Fifty years of violent deaths from Vietnam to Bosnia: Analysis of data from the world health survey programme, *British Medical Journal* 336: 1482–1486.

O'Hare B & DP Southall, 2007. First do no harm: The impact of recent armed conflict on maternal and child health in sub-Saharan Africa, *Journal of the Royal Society of Medicine* 100(12): 564–570.

Orach GC & V De Brouwere, 2004. Postemergency health services for refugee and host populations in Uganda, 1999-2002, *Lancet* 364**:** 611-612.

Orach GC & V De Brouwere, 2006. Integrating refugee and host health services in West Nile districts, Uganda, *Health Policy and Planning* 21: 53-64.

Plümper T & E Neumayer, 2006. The unequal burden of war: The effect of armed conflict on the gender gap in life expectancy, *International Organization* 60 (3): 723–754.

Prata N; P Passano, A Sreenivas & CE Gerdts, 2010. Maternal mortality in developing countries: challenges in scaling-up priority interventions, *Women's Health* 6(2): 311–327.

Randall S, 2005. The demographic consequences of conflict, exile and repatriation: A case study of Malian Tuareg, *European Journal of Population* 21 (2–3): 291–320.

Save the Children, 2011. *State of the World's Mothers 2011*. Available at: http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/SOWM2011_INDEX.PDF

Schindler K & T Brück, 2011. The effects of conflict on fertility in Rwanda. *World Bank Policy Research Working Paper* 5715. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2011/08/22/000158349_20110822090814/Rendered/PDF/WPS5715.pdf.

Spiegel, PB et al., 2007. 'Prevalence of HIV infection in conflict-affected and displaced people in seven Sub-Saharan African countries: A systematic review', *Lancet* 369(June): 2187–2195.

Themnér, L & P Wallensteen, 2012. Armed conflict, 1946–2011. *Journal of Peace Research* 49(4): 565–575.

Toole MJ, 2000. 'Displaced persons and war', in BS Levy & VW Sidel, eds, *War and Public Health*, pp. 197–211. New York: Oxford University Press.

UN, 2007a. *Africa and the Millennium Development Goals: A 2007 Update*. New York: United Nations. http://www.un.org/millenniumgoals/docs/MDGafrica07.pdf.

UN, 2007b. *World Population Prospects: The 2006 Revision*. New York: United Nations Population Division.

UNICEF, 2008. *Progress for Children: A Report Card on Maternal Mortality*. Number 7, September 2008. Available at: http://www.unicef.org/childsurvival/files/Progress_for_Children-No._7_Lo-Res_082008.pdf

UNICEF, 2009. *CÔTE D'IVOIRE: 2009-2013*. Available at: http://www.unicef.org/cotedivoire/UNICEF_Briefing_Pack_2009_2013_En.pdf

Van Damme W; V De Brouwere, M Boelaert & W Van Lerberghe, 1998. Effects of a refugee-assistance programme on host population in Guinea as measured by obstetric interventions, *Lancet* 351:1609-1613.

Verwimp P, 2006. Machetes and firearms: The organization of massacres in Rwanda, *Journal of Peace Research* 43 (1): 5–22.

Verwimp, P & J van Bavel, 2005. Child survival and fertility of refugees in Rwanda, *European Journal of Population* 21 (2–3): 271–290.

WHO, 2005. *Maternal Mortality in 2005*. Available at: http://www.who.int/whosis/mme_2005.pdf

WHO, 2007. *International Statistical Classification of Diseases and Related Health Problems 10th Revision*. World Health Organization.

WHO, 2009. *Women's Health*. Fact sheet N°334, November 2009. Available at: http://www.who.int/mediacentre/factsheets/fs334/en/index.html.

WHO, 2010. *Trends in Maternal Mortality: 1990 to 2008*. Available at: http://whqlibdoc.who.int/publications/2010/9789241500265_eng.pdf

WHO, n.d. *WHO Global Health Observatory Data Repository*. Available at http://apps.who.int/ghodata/?vid=22600.

Woldemicael, G, 2008. Recent fertility decline in Eritrea: Is it a conflict-led transition?, *Demographic Research* 18(2): 27–58.

Table I: Mean value of some study variables between countries that experienced a conflict in the past 5 years and those that did not from 2000 – 2008[$]

Variables	**All countries**		**Sub-Sahara African countries**	
	Had conflict in the past 5 years	No conflict in the past 5 years	Had conflict in the past 5 years	No Conflict in the past 5 years
TFR	4.13 (401)	2.69 (1117)	5.86 (168)	4.64 (237)
MMR	459.18 (127)	159.65 (379)	787.59 (54)	241.77 (81)
Contraceptive prevalence	40.38% (112)	53.62 (175)	17.61% (39)	29.17 (46)
Skilled attended births	62.98% (114)	87.14% (306)	43.48% (42)	59.86% (49)

$. Figures in brackets refer to the number of data points

Table II: Armed conflict and total fertility rates, 1970-2005

*******: statistically significant at 0.001; ******: statistically significant at 0.01; *****: statistically significant at 0.05.

	Model 1	Model 2	Model 3	Model 4
Battle-related deaths (ln)	0.008 (0.007)	-0.008 (0.006)	-0.031*** (0.007)	-0.001 (0.007)
Neighboring conflict	0.009 (0.008)	0.006 (0.007)	0.004 (0.007)	-0.015 (0.008)
Battledeaths (ln)* Poverty			0.035*** (0.006)	
1970-74 (reference category)				
1975-79	-0.208** (0.070)	0.154* (0.074)	0.134 (0.072)	0.045 (0.080)
1980-84	-0.345*** (0.070)	0.287** (0.088)	0.231** (0.087)	0.197* (0.098)
1985-89	-0.556*** (0.083)	0.324** (0.107)	0.270* (0.105)	0.256* (0.122)
1990-94	-0.829*** (0.092)	0.292* (0.125)	0.213 (0.123)	0.243 (0.147)
1995-99	-1.143*** (0.101)	0.206 (0.101)	0.096 (0.142)	0.168 (0.170)
2000-04	-1.342*** (0.109)	0.215 (0.162)	0.069 (0.160)	0.183 (0.194)
2005-09	-1.456*** (0.115)	0.267 (0.177)	0.093 (0.175)	0.178 (0.212)
Infant mortality (ln)		0.955*** (0.088)	0.943*** (0.086)	0.624*** (0.108)
GDP per capita (ln)		-0.107 (0.064)		0.238** (0.085)
Poverty (GDP pc (ln) inverted)			0.041 (0.063)	
Urban population share		-1.343** (0.422)	-1.415** (0.413)	-0.525 (0.518)
Female secondary education (15-24)				-1.824*** (0.303)
Population (ln)	-1.294*** (0.121)	-1.730*** (0.150)	-1.588*** (0.149)	-1.796*** (0.176)
Constant	16.51*** (1.018)	17.33*** (1.420)	15.33*** (1.185)	17.55*** (1.794)
N	1,124	1,018	1,018	668
R sq, overall	0.03	0.15	0.16	0.10

Table III: Armed conflict and maternal mortality rates, 1990-2005

*******: statistically significant at 0.001; ******: statistically significant at 0.01; *****: statistically significant at 0.05.

	Model 5	**Model 6**	**Model 7**	**Model 8**
Battle-related deaths (ln)	0.012* (0.005)	0.007 (0.005)	0.007 (0.006)	0.003 (0.006)
Neighboring conflict	-0.014** (0.005)	-0.013** (0.005)	-0.013** (0.005)	0.006 (0.007)
Battledeaths (ln)* Poverty			-0.0003 (0.004)	
1990-94 (reference category)				
1995-99	-0.155*** (0.032)	-0.133*** (0.032)	-0.133*** (0.032)	0.169** (0.059)
2000-04	-0.280*** (0.109)	-0.238*** (0.043)	-0.238*** (0.044)	0.076* (0.035)
2005-09 (reference category Model 8)	-0.464*** (0.115)	-0.381*** (0.057)	-0.380*** (0.058)	
GDP per capita (ln)		-0.246*** (0.050)		-0.331*** (0.063)
Poverty (GDP pc (ln) inverted)			0.041 (0.063)	
Urban population share		-0.165 (0.518)	-0.167 (0.520)	-1.450 (0.775)
HIV prevalence				0.052*** (0.008)
Population (ln)	0.256 (0.132)	0.245 (0.142)	0.243 (0.143)	0.247 (0.245)
Constant	2.882* (1.149)	5.060*** (1.341)	3.068* (1.244)	5.832* (2.286)
N	561	532	532	354
R sq, overall	0.05	0.40	0.40	0.54

Appendix A: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Total fertility rate	8,127	4.36	2.08	1.15	8.70
Maternal mortality rate	824	266.68	351.70	2	1800
Maternal mortality rate (ln)	824	4.469	1.69	.6931472	7.495
Infant mortality (ln)	8,211	3.82	1.06	1.08	5.62
GDP pc (ln)	7,084	8.22	1.29	4.76	11.92
Urban population share	7,851	0.46	0.24	0.02	1
Population (ln)	8,211	8.87	1.67	4.69	14.11
Female secondary education (15-24)	980	0.57	0.33	0	1
HIV prevalence	2,788	1.75	4.11	0	26.5
Battle deaths (ln)	1,286	1.98	3.49	0	13.67
Neighboring conflict	1,133	5.04	3.81	0	20

[i] Maternal health refers to the health of women before, during, and after pregnancy. Reproductive health is defined more broadly by WHO as a state of physical, mental, and social well-being in all matters relating to the reproductive system at all stages of life. A maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

[ii] Extensive female mortality that is caused by high fertility rates is not reflected in the Maternal Mortality Ratio (MMR), since the MMR is normalized over births. The MMR is defined as the number of maternal deaths per 100,000 live births.

[iii] Countries with high TFR and recent protracted high-intensity conflicts (at least 1,000 battledeaths annually) include Angola, Burundi, Chad, Democratic Republic of Congo, Liberia, Sierra Leone, Somalia and Uganda. High-TFR countries with minor recent conflicts (less than 1,000 casualties annually) include Guinea-Bissau, Mali and Niger.

[iv] Their study was restricted to using indicators from the World Development Indicators, and does not cover maternal mortality.

[v] Periods with no battledeaths are coded '0' on the logtransformed variable.

[vi] The industrial countries excluded are Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

[vii] Such effects are of paramount importance, since they correspond to time-invariant or almost time-invariant factors such as genetic and climatic differences, countries' historical legacy, culturally influenced beliefs and customs toward health practices, and the ethnic composition of the population.

[viii] The purpose of inverting the income variable is solely to ease interpretation, as a high value on the interaction term indicates high TFR and low income.