Peacekeeping and Post-conflict Maternal Health

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Abstract: Although United Nations Security Council Resolution 1325 highlights the distinct needs of women in security and use of health and education, we have little actual research on how female human security and maternal health in particular evolves in areas with peacekeeping after conflict. We address this gap by exploring how peacekeeping affects maternal health and education. We posit that peacekeepers provide medical facilities and increase the overall level of security, facilitating women's use of medical services and education, which in turn lead to improvements in maternal health. We provide an empirical analysis at the country-level, using a sample of 45 African countries, and as well as a within-country disaggregated analysis across grids, using geo-coded UN operations deployment data and the Demographic Household Survey (DHS) data in 3 sub-Saharan countries. We find strong empirical support for a positive effect of peace keeping on maternal health and women's education.

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1.0. Introduction

The conventional wisdom is that UN peacekeeping is ineffective, yet the review of the existing literature suggests that we not only demand more and more from the blue helmets, but that peacekeepers actually often deliver beyond expectations. So-called integrated (or complex) missions have been given broader mandates encompassing peacebuilding. These missions inevitably have to grapple with what peace and whose peace is to be kept raising questions concerning the contents of 'peace' in peacekeeping, especially for vulnerable groups such as women.

United Nations Security Council Resolution (UNSCR) 1325 highlighted the distinct needs of women in terms of security and access to resources and the gender dimension of how peacekeeping is implemented in terms of improving the protection of women. Most research on women, armed violent conflict, and peacekeeping missions focuses on security and sexual violence. There is very little work on what happens to women's health in post-conflict countries with fragile health systems. Public health, especially maternal health, is an often overlooked area of women's protection from the adverse effects of conflict during peacekeeping missions. Are any policies that can counter the overall negative impact of violent conflict on health outcomes? Can external interventions mitigate the effects of armed violent conflict on women's health? We address this gap by exploring the impact of peacekeeping on maternal health and education.

This study is one of the first attempts to answer these questions by looking at how external interventions such as UN peacekeeping missions (PKOs) impact overall maternal health in fragile post-conflict countries. We argue that the deployment of peacekeepers, especially in integrative PKOs, creates a peacekeeping dividend that generates the necessary space for improving and rebuilding infrastructure, e.g., medical facilities, and provides

improved security so women feel safe to access medical facilities. If our argument is correct, maternal mortality rates should decline faster in post-conflict countries with PKOs and use of health services by women should improve in locations where PKO's are present than in those without PKOs.

To assess the argument, we first use a difference-in-difference estimate for 45 African countries, comparing the change in maternal mortality rates (MMR) in countries with PKOs to countries without PKOs between 1990 and 2013. We then look at variations within countries that have experienced integrative PKOs using disaggregated geo-coded maternal health provision and education indicators from the Demographic and Health Surveys (DHS) in Liberia, Côte D'Ivoire, and the Democratic Republic of Congo. The DHS data are combined with geo-coded data on UN peacekeeping deployment to compare improvements in maternal health provisions and education indicators in grids with UN presence and grids without. The country-level comparisons suggest that UN PKO presence leads to much better improvement in MMR for the period of 1990-2013, while grid cell analysis indicates that women in locations where peacekeepers have been deployed have better access to maternity health services and higher levels of education.[1]

2.0. Maternal Health in post-conflict environments

[1] Complex "integrative missions" have broader mandates and more ambitious goals to sustain peace in post-conflict period. They are also larger in numbers and tend to deploy in conflict areas within a country; 1st generation PKOs which are smaller in size (usually 200-300 personnel) and, thus, have limited deployment capabilities within a country.

Most of the literature on security, gender and conflict tends to focus on sexual and physical violence against women during and after wars and violent armed conflicts (Author1a 2015). The emphasis on sexual and physical violence is partly attributed to the focus of feminist research on the impact of patriarchy and its institutions on conflict and sexual violence in conflict (Cohen, Hoover Green and Wood 2013:12; Hudson et al. 2009; Grey and Shepherd 2013; Leiby 2009; Shepherd 2011). Women's health and, especially, maternal health is a different dimension of women's security during violent armed conflict and post-conflict environments.[2] Liebeling-Kalifani and Baker (2010) and Liebeling-Kalifani et al (2008) argue that men and women experience adverse health conditions --in particular as an outcome of sexual violence-- in gendered ways. While sexual violence is a contributing factor that undermines women's health in conflict environments, it is not the only factor that influences overall women's health. Adverse conditions beyond sexual violence are detrimental to most women, especially for maternal health which is the main focus of this paper.

The literature on maternal mortality primarily focuses on immediate determinants of maternal health that influence the sequence of events increasing the risk of maternal mortality, such as access to health services and trained personnel (McCarthy and Main 1992; Rosmans and Graham 2006). Yet, contextual and distant factors such as social and economic conditions and cultural environment often shape the immediate determinants. The persistence of high relative female mortality rates in areas such as Sub-Saharan Africa

[2] The term conflict and violent armed conflict are used to primarily describe contested incompatibilities between the government and armed groups that result in more than 25 deaths per battlefield (Wallensteen and Sollenberg 2001).

may in part be attributed to the indirect effects of conflict on overall maternal health and female mortality (Guha-Sapir and and D'Aoust 2010; Urdal and and Chi 2013).[3] Maternal death is defined by the World Health Organization (WHO) as the "death of a woman while pregnant or within 42 days of termination of pregnancy… from any cause related to or aggravated by the pregnancy or its mismanagement" (Maternal Mortality Estimates 2004). Most women are in higher risk of dying the third trimester and the first week after childbirth, with the first and second days after childbirth being of higher risk (Ronsmans and Graham 2006: 1193). As the standard definition of maternal mortality indicates women remain at risk more than a month after giving birth. Severe bleeding, hypertensive diseases and infections remain the leading causes of maternal health (Ronsmans and Graham 2006: 1193).[4]

[3] In 1990 Asia had the highest maternal mortality followed by sub-Saharan Africa. By 2008 this trend was reversed and Sub-Saharan African countries have been slower than other regions in improving their MMR. In Asia maternal mortality has been consistently reduced by more than 4% per year whereas in sub-Saharan Africa the annual decline is 1.7% and 5% in Northern Africa (Wilmoth et al. 2012). Sub-Saharan Africa remains the region with the highest percentage of maternal mortality, a staggering 510 deaths out of 100,000 live births. This is quite different from other regions such as Southern Asia and South-East Asia with 190 and 140 deaths in 100,000 live births respectively (WHO, U. UNFPA, The World Bank, United Nations Population Division).

[4] HIV/AIDS and induced abortions lead to complications that are also contributing factors, yet it is hard to assess the impact either HIV or induced abortions have on maternal deaths.

2.1. The impact of conflict on maternal health

Calculating the impact of conflict, especially civil wars, on mortality and health is a minefield due to the difficulty of estimating the baseline mortality in countries that have experienced civil wars, especially protracted wars. Recently researchers have attempted to identify possible pathways through which conflict undermines public health, and differentiate health outcomes between men and women (Ghobarah et al. 2003). The collective conflict, medical and development literature draws attention to several mechanisms such as the destruction of socioeconomic structures, destruction of public health institutions and social disruptions that directly affect maternal health. During violent armed conflict infrastructure is ruined, basic services such as water and transportation are interrupted, there are significant losses of health care personnel, and funds for health care are diverted (Iqbal 2006:637).

During peace time women generally live longer than men but this gap is decreased during conflicts. Disaggregating by gender the impact of conflict on health, Li and Wen (2005) find that conflict has a large impact on men's health and mortality, while in the long run there are no differentiations between men and women. Their study, however, is contradicted by Plümper and Neumayer (2006) who find that both international and civil wars are associated with higher mortality for women, but while wars have a direct impact on male mortality --through combatant casualties-- wars and particularly ethnic civil wars also have a devastating impact on infrastructure, provision of health and economic productivity, and social order undermining security.

The neglect and decline in funding for health care programs commence even before wars actually start, with resources being diverted from health system to military expenditures (Plümper and Neumayer 2006:728; O'Hare and Southall 2007). Services such

as emergency health care, prenatal care, family planning care are destroyed and interrupted, while access to information about services becomes increasingly difficult. Health facilities as well as roads are often destroyed during conflict by bombing attacks, making it difficult to transport people, medicines and equipment (Mansoor and Rees 2012; Plümper and Neumayer 2006:729). Moreover diseases are easily spread through the contamination of water and the increasing difficulty to access clean water (Li and Wen 2005:473).[5] Medical personnel either flee the country or get killed. The destruction of medical equipment during war makes the health care situation even more precarious. According to the World Health Organization (WHO) in Bosnia more than 40% of medical equipment was destroyed or disappeared during the civil war.

Urdal and Chi (2013:490) argue that maternal mortality is the cause of excess overall death that disproportionally kills more women than men in the aftermath of civil wars. They show that a conflict of 2500 battle-related deaths is associated with 10% increase in maternal mortality rate (Urdal and Chi 2013:503). Without adequate access to healthcare and other basic public goods that are linked to public health, women are in a higher risk to develop infections during obstetric care. Puerperal sepsis remains the second major cause of maternal mortality in developing countries (Garg et al. 2006:5). Especially in cases where there is no access to clean water, the chances of getting infections such as sepsis during labour are higher. As a result, the gender gap between men and women decreases and this effect is even more pronounced in "failed" states. Urdal and Chi (2013: 491) emphasize that

[5] In some cases, rival fighting parties target infrastructure in an attempt to destabilize the other side making the access to drinking water, sewage, sanitation and basic health infrastructure unreliable or absent.

"generally women are dying while giving birth because they have no access or limited access to health care, or because the health care is poor."[6]

The effects of conflict on maternal health is the outcome of the combination of four factors that largely increase the risks to maternal health: a deteriorated health care system, higher rates of abortion and pregnancy terminations, shortage of skilled health professionals, and greater risks of contracting infections combined with higher levels of malnutrition during pregnancies and after child birth. Financial hardships and poor access to food in displaced populations further increase the risk of malnutrition and infections (Plümper and Neumayer 2006; Urdal and Chi 2013).[7] These factors can exacerbate the challenges of maternal health in conflict environments when combined with increased levels of fertility.

2.2. Higher fertility rates and conflict

Fertility levels tend to increase in post-conflict countries because families try to replace the children lost during the war and also because of the declining of educational and

[6] The negative impact of conflict on health care exacerbates the dangers of unsafe abortion. More than 50% of pregnancies are unplanned while 25% are unwanted leading to induced abortions (Kehoe et al. 2010: 209).

[7] Iqbal (206: 633) highlights the destruction of agriculture as a possible mechanism that links armed conflict to maternal health. Disruptions in agriculture, especially in sub-Saharan Africa where most women in rural communities rely on subsistence agriculture for food, result in famines or limited food supplies putting women's lives under more risk if pregnant. Moreover, conflicts "make people more susceptive to diseases or make it harder for people to recover from disease" (Iqbal 2006: 633).

literacy levels for women and the lack of information about the provision of health care and family planning services when these are actually existent (Guha-Sapir and D'Aoust 2010). It is not always the case that conflict leads to higher fertility rates. Research shows a somewhat mixed picture conditional on local and regional contexts.

Exposure to war, the type and duration of war, and women's socio-economic status in a given country shape family planning and decisions leading to variations across countries and conflicts (Agadjanian and Prata 2002). Refugees and displaced populations often are in higher risk of experiencing sexual violence, consequently suffering from higher rates of sexually transmitted infections and HIV that lead to complications in birth (Austin et al 2008). Yet, Howard et al (2008), studying family planning knowledge, attitudes, and practices among Sierra Leonean and Liberian refugees living in Guinea, found that contraceptive knowledge and use in the camps was much higher than for the populations at large in either Liberia, Sierra Leone, or Guinea. Ultimately, the effects of conflict on forced migration and fertility are often mitigated by the stage of the conflict and whether the community practiced family planning prior to conflict (McGinn et al 2004).

3.0. UN and maternal health

As the literature suggests armed conflict has both a direct and an indirect impact on women and maternal health in post-conflict countries with fragile health care systems. The case of Liberia is a characteristic example of the breakdown of the health care system. Liberian Civil Wars (1989–1996 and 1999–2003) led to approximately 250,000 deaths, or nearly 10% of the population, the displacement of around a million people, the dismantling of the national economy and infrastructure, and the destruction of an effective Liberian state. To fill the void, the UN Peacekeeping Mission in Liberia (UNMIL) arrived in 2003 and has remained, but official drawdown started in 2015. After 14 years of civil war out of 293

medical facilities before the war, only 51 remained functional after the end of the conflict in 2003. Only 30 physicians remained in the country to attend an exponentially growing population of over 3 million (Kruck et al., 2010). The destruction of the wars placed the government of Liberia in a position of dependency -- and loss of health sovereignty -- on external medical humanitarian aid. A loose consortium of international organizations (e.g. UNICEF and WHO) led by UNMIL provided primary health care services and run larger medical units and hospitals. International actors flocked to the country effectively substituting the Liberian state in the provision of medical care. In 2007-2008 approximately 80% of the country's health spending was financed by foreign donors (Abramowitz 2014; Abramowitz and and Panter-Brick 2015; Kruck et al., 2010).

Provision of basic public goods to the local populations is an integral component of peacebuilding and sustainable development. A well-structured health system signals the accountability of the government to its citizens and increases its capacity to provide services and goods. However, without security and conditions that allow people to use the services it is difficult to implement most policies that target women and vulnerable populations or develop synergies between local governments and NGOs that support the provision of health (Kruk et al 2010; Southall 2011; Lee 2008). The provision of a secure environment becomes a precondition in order to improve on the provision of health services and rebuild the health system in a post-conflict country.

Peacekeeping has become one of the main methods to manage and contain civil wars (Doyle and Sambanis 2000; Fortna 2008; Howard 2008). There is evidence that the right deployment of peacekeepers within a country can affect local conflict dynamics and improves the overall effectiveness of the mission to contain conflict (Author 1). Despite strong criticism on the effectiveness of peacekeeping missions to facilitate peacebuilding,

cross-sectional studies suggest that peacekeeping promotes peace and possibly can facilitate peacebuilding by strengthening the capacity of governments (Autesserre 2010; Doyle and Sambanis 2000; Fortna 2008; Pouligny 2006). Newer studies using disaggregated information of peacekeeping presence and conflict events have also illustrated that at least integrative peacekeeping missions tend to protect civilians and prevent one-sided massacres. In some cases peacekeeping missions even reduce the probability that conflict will commence in a particular location, controlling for the presence and the size of the peacekeeping mission (Hutlman et al 2013; Hultman et al 2014).

In most of these studies providing "security" and maintaining "peace" signifies the absence of violent conflict while "peace" does not have a specific content; hence, the term of "negative" peace. Effective missions should not only provide "negative" peace by stopping conflict, but also provide "positive" peace. The concept of "positive" peace expands to include the protection of civilians and vulnerable groups of people from residual violence and the "quality" of peace. "Quality" of the peace brings forward questions about governance and ultimately the nature of societies that emerge, since peace has different implications for the security of men and women in post-conflict environments (Olsson 2009).

UN has long underlined its commitment to women's security. The use of gender mainstreaming in redefining security after armed conflict was formalized with the UN Security Council Resolution (UNSCR) 1325 in 2000, which calls for a gender perspective in peace operations (Hafner-Burton and Pollack 2002). UNSCR 1325 and developments initiated during the UN Decade for Women, 1975-1985, increased the pressure on UN peacekeeping missions as well as other organizations and national governments to include a gender perspective in post-conflict reconstruction and to incorporate the rhetoric and

practices of gender mainstreaming in all policies, including those that target security, poverty reduction and development (United Nations 2000). With the adoption of follow-up UNSCR 1820 in 2008 (further enhanced by resolutions 1888, 1960 and 2106), the protection of women and girls from sexual and gender-based violence formalized and enforced a normative development on improving women's security during and after armed conflict. Yet, many researchers, some of them already included in the discussion above, have pointed out that security for women should move beyond the narrow confines of sexual and gender-based violence. A broader view of security should incorporate the lack or low quality of public health as a key dimension of women's wellbeing during and after conflict.

How can UN missions impact women's health? Here, we argue that there are two possible channels through which peacekeeping might improve maternal health. The first pathway is direct -- and often short-term in terms of planning -- focusing on emergency provision and support of local medical facilities. The provision of emergency health care is often performed by both integrative and non-integrative missions. Short-term impact projects target improvement of medical facilities, sanitation and provision of clean water by building latrines or rehabilitating water pumps which is essential for maternal health. UN missions and organizations engage in educational programs or other humanitarian and emergency activities -- for example establishing medical camps to treat local communities -- that support the local provision of public health or provide emergency medical relief in remote communities without regular access to health care. An example of such medical camp was set up for three days in Sass Town, Kley District, 37 kilometres outside the capital of Liberia Monrovia by a Pakistani contingency in January 2004. Often UN organizations and missions are also involved in the training of local communities in hygiene.

Second, the presence of peacekeepers can increase the overall levels of security. Here security is defined as absence of violent armed conflict which indirectly leads to improved health conditions in different pathways. The presence of peacekeepers -- especially in the cases of complex, integrative missions -- maintains "negative" peace and creates a peacekeeping dividend (Hultman et al 2013; Author 1c). This peacekeeping dividend creates conditions where "positive" peace or higher "quality" of peace in the form of the provision for health and education for women can emerge. The absence of conflict allows international organizations such as UNICEF, WHO and NGO's such as Save the Children and International Rescue Committee or private partners -- for example the Bill and and Melinda Gates Foundation, Kiwanis International, Pampers -- to provide not just emergency medical care but also sponsor long-term programs that lead to tangible improvements in the use of medical services, leading to improved outcomes such as reduction in maternal mortality (Luginaah et al 2016). In Liberia even though the loose health care system has faced significant challenges, international-private partnerships were successful in eradicating maternal and neonatal tetanus (MNT), one of the causes of maternal and neonatal death. The presence of such partnerships relies on the provision of "negative" peace and the sense of stability provided by UNMIL (UNMIL 2012).

It is challenging to empirically separate the direct and indirect effects of UN missions in post-conflict countries, we can nonetheless observe if the presence of UN missions leads to improvement in actually outcomes like MMR *all other things being equal*. If UN missions have both a direct and indirect impact on health outcomes then countries with PKOs should outperform in reducing MMR compared to countries without PKOs. To sum up, we expect:

H1: Countries with peacekeeping missions experience greater improvements in maternal mortality than countries without.

Many studies show significant variation in health outcomes within countries (Luginaah et al 2016). Similarly, research on local UN PKOs' deployment suggests that the presence and size of peacekeeping forces impact whether violent armed conflict will continue in conflict-prone locations within a country. In other words peacekeeping missions that are deployed with sufficient forces can reduce and contain armed conflict in conflict areas within countries (Author 1c). If the overall argument that integrative UN PKOs improve health outcomes is correct, then one should expect that in conflict areas where UN peacekeepers are deployed there will be a link between localized peacekeeping presence, maternal health and levels of education.

Education is a driver of improved maternal health linked with higher and more frequent use of resources, as well as the ability to follow sound medical advice. The deterioration of women's education during conflict is one of the key mechanisms through which conflict can increase fertility rates and maternal mortality ratios. Without education women have less autonomy and ability to access information about fertility control and use of health resources (Riyami et al. 2004; Urdal and Chi 2013:495). Ahmed et al. (2009) examine the relationship between women's economic, educational and empowerment status and maternal health service utilization in developing countries. They particularly focused on goals that are linked to the Millennium Development Goals, such as extreme poverty, education and women's empowerment. In areas where women face inequalities in regards to these goals, they are less likely to use health services. In general, more educated women are more likely to have a skilled birth attendant present and also more likely to have access to antenatal care than less educated women. A relatively secure environment allows local women to access schools, educational programs and training essential for good hygiene and maternal health.

Thus, at the sub-national level we examine if the peacekeeping dividend of integrative PKOs expands antenatal care and education which many argue would lead to long-term, overall improvement in maternal health. We develop the following two hypotheses to assess the link between PKO deployment and maternal health and education indicators at the sub-national level:

H2: In regions within countries where the UN peacekeepers are deployed, women should have better access and make better use of health care services.

H3: In regions within countries where the UN peacekeepers are deployed, educational outcomes for women should improve.

4.0. Empirical Analysis

4.1. Difference-in-Difference between Countries

The hypotheses correspond to two different levels-of-analysis. The first level is at the country level where we use difference-in-differences to calculate the effect of peacekeeping presence on maternal mortality ratios. Difference-in-differences (DID) is a technique that compares the average change over time in maternal mortality ratios in the treatment group (countries that have had an integrative peacekeeping mission) to the average change in maternal mortality ratios in the control group (countries without peacekeeping operations and countries with first generation peacekeeping missions, see Card and Krueger 1994). The main assumption in DID is that any change such as a secular trend towards lower maternal mortality will be a common trend in all countries before the treatment. Difference-in-difference measures the difference in the differences between the treatment and the control group, rather than measuring the variation within and between subjects. The

method is not free from biases such as reversion to the mean and other influences of policies that cannot be accounted.

In the current analysis, the assumption is that maternal mortality rates should decline during the time period covered by this study: the initial point (t1) is 1990 and the second point (t2) for both the treatment and the control group is 2013. The year 1990 was the beginning of the MDG and since then significant progress along most of the indicators of maternal health has been recorded. Despite the global decline in maternal mortality, sub-Saharan countries are lagging behind and will not be able to reach the desired goal: 75% reduction in maternal mortality from 1990 until 2015. 75% decline over a period of 25 years translates in a change in the region of 5.5% per year. Even though the sub-Saharan countries are not reaching the MDG-5 target the overall trend is one of continuous decline (Hill et al 2007; Wilmoth et al 2012; Zureick-Brown et al. 2013). Moreover, many of the sub-Saharan countries experienced prolonged and devastating civil wars during the same period that should have negatively impacted the decline of MMR.

Thus, to assess H1 we are looking at 45 African countries using maternal mortality ratio (MMR) from the Global Health Observatory (GHO) by the World Health Organization (WHO). GHO covers the time period 1990-2013. We use MMR which shows the risk of maternal health relative to the frequency of births and it is included as one of the MDG indicators of maternal health (Maternal Mortality Estimates 2004; Wilmoth et al 2012). Figure 1 shows the maternal mortality rates (MMR) for the 45 countries included in the country-level analysis in 1990 and 2013.

Insert Figures 1 and 2 here

The main explanatory variable or treatment is the presence of peacekeeping forces in a country within the period of 1990-2013. The variable takes a value of 1 if there was a peacekeeping at some point in the country and 0 otherwise. Following the definitions of "integrative" missions used in Author 1 and and Author 2 (2013 and 2015), we separate UN missions into two types depending on their mandates. The "integrative" missions are second and third generation UN missions that engage in multi-dimensional peacebuilding activities, as these are identified in the Marrack Goulding classification, the Brahimi report and the Capstone Doctrine (Goulding 1993; Brahimi 2000; UN PKO 2008). In the 45 countries that are included in the analysis, 8 countries had "integrative" peacekeeping missions: Angola, Central African Republic, Chad, Ivory Coast, Liberia, Sierra Leone, Democratic Republic of Congo, and Burundi at least for a few years during the specified time period (see Figure 2(a)). One country missing from the current analysis is Sudan (Author 1c 2015). During the same period another six countries had "first" generation of peacekeeping missions with minimal mandate to peacebuilding and establish interactions with local populations: Chad, Rwanda, Namibia, Mozambique, Uganda, Eritrea and Ethiopia (Figure 2(b)): Chad is the only country in our sample that had both 1st generation and integrative type of PKO between 1990 and 2013. "First" generation PKOs tend to be rather small in size (around 300 military personnel) with very limited capacity to deploy in remote parts of country or engage in any type of peacebuilding policies, including guaranteeing security.

Table 1 shows the results of comparing countries with multi-dimensional PKOs to countries without using the DID method. In countries without PKOs, the mean and median reduction in maternal mortality ratio is lower than countries with "integrative" PKOs. In fact, even when comparing the third quartile, the value of the reduction in maternal mortality ratio is significantly lower in countries without PKOs compared to the mean value

of the reduction in maternal mortality ratio in countries with PKOs.[8] A further step is to compare the mean value of the rate of reduction in MMR in countries with PKOs to those without PKOs. The mean value of the rate of reduction in MMR in countries with PKOs is 741.67 versus 369.65 in countries without PKOs. This difference is statistically significant using a one-tail t-test at the 95% confidence level. The value of t-test is 2.172 (df = 5.959 and p-value = 0.037).

Insert Table 1 here

In addition to this difference in means test, we also test the significance of a difference in differences estimator in a regression analysis: this is captured by an interaction term of a dummy variable for the treatment (PKO) and a dummy variable for the post-treatment period (Post-PKO, which equals to 1 for year 2103 and 0 for year 1990). The regression set-up also allows us to control for other predictors of maternal health as suggested by recent studies (Iqbal 2006): GDP per capita (constant 2005 US dollars),[9] population size (logged),[10] trade openness (sum of imports and exports as a percentage of

[8] The value of -3 indicates that MMR has increased.

[9] It is often accepted that poverty and disease are closely related as poorer states and communities do not have the means to improve public health as in their richer counterparts.

[10] Population pressure often exacerbates the issue of resource scarcity which might negatively affects health conditions of the population.

GDP),[11] and the percentage of urban population.[12] We have also added a dummy variable for armed conflicts to indicate whether there was at least one armed conflict during a year according to the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al 2002; Pettersson and and Wallensteen 2014).

One complication when we define the treatment PKO variable is the fact both the 1st generation type and the integrative type of PKO existed between 1990 and 2013. In order to provide a more comprehensive test, we define three types of treatment group (and control group accordingly): 1), 1st generation PKO and integrative PKO vs. no PKO; 2), 1st generation PKO vs. no PKO; 3), integrative PKO vs. no PKO. The results are presented in Table 2 in three model specifications respectively. Note that in the second model specification, we essentially leave out countries that have received the integrative type of PKO in order to compare the difference in differences between 1st generation PKO "treated" countries and countries without PKOs; in last model specification, we leave out countries that have received the 1st generation PKOs to compare the difference in differences between countries with integrative PKOs and countries without PKOs.

Insert Table 2 here

In Table 2, the coefficients of the treatment variable PKO is the estimated mean difference in maternal mortality ratio (MMR) between the treatment and control groups

[11] Trade openness is not only associated with economic prosperity, but better chances to access foreign technologies and knowhow which can help to improve public health.

[12] All four variables are from the World Development Indicators of the World Bank.

prior to the treatment intervention: it represents the baseline differences that existed between the groups before the PKO treatment was applied. The positive and statistically significant coefficients in the first and the last model specifications suggest that before the PKO was applied to the treatment group of countries (year 1990), countries in the treatment group were associated with a higher level of MMR when we define treatment as either integrative and 1st generation PKO or integrative PKO alone. The lack of statistical significance of this variable in the second model specification suggests that *prior* to the treatment, that is, in 1990, there was no difference in MMR between countries that received 1st generation PKO and countries without PKO between 1990 and 2013. Furthermore, the coefficients of the post-treatment period variable (Post-PKO) captures the expected mean change in outcome (MMR) from before to after the onset of the treatment period among the control group. This is the pure effect of the passage of time in the absence of the treatment. The negative and statistically significant coefficients in all three model specifications here reveal negative baseline time trends in MMR without PKO treatment after taking into account of control variables included.

The coefficients for the interaction term (PKO × Post-PKO) are the difference in differences estimators. They are the focus of interest which tells us whether the expected mean change in MMR from before to after treatment is different between the treatment and the control groups. In all three model specifications, regardless of ways of defining treatment group, we find negative and statistically significant coefficient estimates (at least at the .10 level given a relatively small number of observations), suggesting an effective intervention by PKO in reducing maternal mortality rates (MMR). In sum, using difference-in-differences to compare between countries in sub-Saharan region for the period 1990-

2013, the evidence suggests that sub-Saharan Africa countries with PKOs tend to improve MMR much faster than countries without.

In robustness checks not reported in the paper, we have included more control variables, for instance, a dummy variable for whether there was at least one armed conflict during 1991-2012 (years in between the pre- and post-treatment year) and a dummy variable for pre-1990 conflict history: whether there was at least one armed conflict between 1947 and 1989 for a given country.[13] Including both dummy variables did not change the main results.[14] Moreover, the only country that has PKO but no conflict according to the UCDP/PRIO data is Namibia. Removing Namibia from the analysis reduces two observations, but does not change the results. In the next section, we model variation within countries, in particular Liberia, Côte d'Ivoire and DRC, using DHS data on maternal health indicators and disaggregated data on within-country PKO deployment.

4.2. Explaining Within-country Variation

While the analysis at the country level indicates that peacekeeping presence has a positive impact in reducing MMR, it is better to assess if this link between peacekeeping presence and maternal health exists within countries. Looking within countries maintains a similar contextual environment while allowing for subnational/regional variation in health outcomes to be modelled. We often see significant within country spatial variation in public health outcomes, for example, the average percentage of women who have received at least one tetanus injection at the grid (size about 55km by 55km) level in Liberia 2007 ranges from 24.31 to 98.15 with a standard deviation of 18.80. It is difficult to have data on

[13] 1947 is the earliest year that the UCDP/PRIO Armed Conflict Dataset has data for Africa.

[14] Regression results available upon request.

maternal mortality ratios at the sub-national level. Nevertheless, the existence of demographic and health surveys (DHS) for some of the countries included in the previous analysis offers an opportunity to empirically examine whether the presence of UN peacekeepers in a location within a country has an impact on antenatal care and women's education. The expectation is that if women have better access to antenatal care and education then mortality rates should also be reduced.

At the sub-national level, we use data on maternal heath indicators based on the DHS data for Liberia, Côte d'Ivoire, and Democratic Republic of Congo. We use PRIO grids as the unit of analysis in the following matching analysis: these are grid-cells with 0.5 × 0.5 decimal degree cell resolution of the world (Tollefsen et al 2012).[15] Recent waves of Demographic and Health Surveys (DHS) often come with GPS files that give the longitudes and latitudes of survey clusters so that we can locate these clusters to specific grid-cells; this enables us to calculate, for grid-cells that have DHS clusters, average measures of public health indicators.[16]

We use four different indicators that are included in the various DHS surveys and are comparable across surveys and countries. The first two are public health variables. The first variable includes (m1_n) tetanus injections before birth;[17] we make this binary so it is

[15] This corresponds to a cell of roughly 55 × 55 kilometers at the equator. Cell area decreases at higher latitudes.

[16] If there are more than one DHS clusters in a grid cell, we take the mean of each cluster, then take the mean of all the cluster means.

[17] The tetanus vaccination (tetanus toxoid (TT or Td)) is required to prevent maternal and neonatal tetanus (MNT).

whether or not one has received tetanus injection. We then calculate, as our first dependent variable, the grid level average percentage of women who have received at least one tetanus injection. The second dependent variable is antenatal care (m14_1n). According to the MDGs pregnant women should have 4 antenatal visits. Here we only look if pregnant women had any antenatal care at all. So we create a binary variable that is whether or not a woman had antenatal visits. Aggregated to the grid cell level, this is the percentage of women who have had at least one antenatal visit.

The second group of dependent variables are human capital variables that are linked to maternal health. The first one, based on the v106n variable of the DHS survey, captures the grid level average of women's levels of education where we define no education as 0, primary education as 1, secondary education as 2, and higher education as 3. The second variable (v107n) measures the grid average of women's years of education.

Note that we do not choose to use DID at the grid level for these countries because first, DRC has no DHS surveys prior to the initiation of the United Nations Missions in the Democratic Republic of Congo (MONUC) in 1999, it cannot be included in the analysis. Second, even though Liberia and Côte d'Ivoire have DHS data before and after the civil wars and the presence of UN missions,[18] using only information from Liberia and Côte d'Ivoire,

[18] Liberia was included in the first DHS surveys in 1986 (DHS-I) followed by surveys in 2007 (DHS-V) and in 2013 (DHS-VI). Liberia experienced two civil wars from 1989 to 2003. It also experienced two UN missions; the UN Mission in Liberia (UNMIL) (2003-current) is one of the largest and most comprehensive, integrative missions in the recent history of peacekeeping. Côte d'Ivoire had its first DHS survey in 1994 (DHS-III), followed by surveys in 1998-1999 and DHS-VI in 2011-12. The first Ivorian civil war started in 2002 and lasted until

and selecting grids that have been included in the initial and the more recent DHS surveys, we only have in total 172 observations. Moreover, DID is based on strong assumptions such as the parallel trend assumption which posits that the average change in the control group represents the counterfactual change in the treatment group if there were no treatment. By construction, that assumption is untestable.[19] This also relates to the problem of selection bias. In the context of peacekeeping, Author 2 (2015) have shown that UN peacekeepers tend to be deployed in urban centers: it is likely the time trends between urban and rural areas, without the treatment of peacekeeping operations, are different.

To deal with potential selection bias of PKO locations, we use a matching model which approximates randomized experiments. The basic idea is to select a subset of the observational data wherein the treatment and control units are matched so that they have same characteristics, that is, the same distributions for pre-treatment covariates X. In this way, the link between pre-treatment covariates X and treatment assignment T (peace keeping) might be broken (approximately) in a way that brings us much closer to the ideal

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2007; while the second Ivorian civil war last for 4 months from November 2010 until April 2011. The United Nations Operation in Côte d'Ivoire (ONUCI) started in 2004 and remains active after being extended several times following the second civil war. The Democratic Republic of Congo, on the other hand, have had only two DHS surveys, one in 2007 (DHS-V) and the second in 2013-14 (DHS-VI).

[19] When data on several pre-treatment periods exist, one can check the validity of this assumption by testing for differences in the pre-treatment trends of the treatment and control groups. Equality of pre-treatment trends lends confidence, but this does not directly test the identifying assumption.

situation where the treatment and control units had been assigned randomly from a single population. Imai and van Dyk (2004) have developed the broad notion of using propensity scores as a means of managing sample matching in parametric studies. Ho, Imai, King and Stuart (2004) have developed the *MatchIt* R library that implements these procedures to produce matched subsamples. Once the matched subsamples are produced, one can simply calculate the average treatment effect (E(Y|T=1)-E(Y|T=0)); one can also proceed with normal parametric model fitting as we will do in the following analysis.

We follow Ho, Imai, King and Stuart (2004) and use *MatchIt* to find subsamples of the data where the assignment of treatments is not correlated with pre-treatment covariates X. Whether there were peacekeeping operations within a grid cell is used to decide whether it has received a treatment (see Figure 3 for the distribution of PKOs within the three countries). We use original peacekeeping deployment data from Author 2 (2015). Deployment data are estimates based on UN information provided in the reports of the Secretary General. The location of the deployment of peacekeeping forces is based on UN information and deployment maps.[20] The pre-treatment covariates X or conditions include distance to capital city, travel time to the nearest urban area, proportion of mountain area,

[20] The deployment maps are included regularly in the reports of the UN Secretary General that provide further information on the location of bases, the nature of the contingent deployed and the nationality of the peacekeepers deployed at the bases. Making use of this additional information, PKO size estimates the number of peacekeepers deployed in a certain area in any given year (for more details on the construction of the PKO data please see Author 1c 2015). The PKO data included in the analysis incorporate the UN missions in Liberia, Côte d' Ivoire, and Democratic Republic of Congo.

GDP per capita, population, and (whether a grid cell is in a) conflict zone, all measured at the grid-cell level.[21]

Unlike DID, we do not need pre-treatment periods from the DHS data. (Thus, we can include DRC to our analysis.) Because of our matching model set up, we only use DHS surveys after peace keeping operations so that the public health and human capital measures can be considered as post-treatment outcomes. These post-treatment country-years are therefore Democratic Republic of Congo (DRC) 2007 and 2013, Cote d'Ivoire (CDI) 2011, and Liberia (LIB) 2007 and 2013. The total number of grid cells for DRC is 762, LIB 37, and CDI 113. The total grid-cell-years for these 5 country years should be 1711. However, not every grid cell is covered by the DHS though. Only 656 grid cells from these 5 country years are covered by DHS (about 38% of the grid-cell-years).[22] Among these 656 grids, 152 had within grid PKOs: these are the 152 treatment units.[23] We use nearest neighbourhood

[21] All six variables are from the PRIO grids (Tollefsen et al. 2012).

[22] In DHS, households were sampled using stratified two-stage cluster sampling to make sure a nationally representative sample was achieved. The strata used in the first stage for the sample often are provinces and whether the cluster is in an urban or rural area.

[23] A potential problem is if PKO forces move from one location to the next one during their deployment. Beardsley and Gleditsch (2014) show that once a mission has fully deployed in conflict areas it tends to spatially contain the area of conflict. Author 1c (2015) also show that peacekeepers tend to go to conflict areas with a time lag but once present then they can stop fighting. In all three cases included in our analysis the missions have been deployed for several years the patterns of deployment remain relatively stable in terms of locations but not size.

matching to identify 152 control units. We run OLS regressions on the matched data on four dependent variables (Ho et al 2004).

Table 3 reports the empirical findings regarding maternal health based on the matched subsample of the data. Note that for each maternal health variable, we presented two model specifications, one with and one without an urbanization variable. Urban areas are often associated with better health outcomes and peace keepers are also more likely to be stationed in urban area. We calculate the percentage of urban area within a grid cell using the Urban Extents Grid, v1 (1995) shape file data from the Global Rural-Urban Mapping Project (GRUMP).[24] Note this variable is time-invariant and based on 1995 data. Being the only data source on urbanization at the grid-cell level that we are aware of, this data, however, is outdated, especially given rapid urbanization in at least some parts of Africa. Moreover, this variable is highly correlated with the population variable (at 0.74). These are the reasons why we choose to present both model specifications, that is, with and without this variable.

Insert Table 3 here

[24] The urban extent grids distinguish urban and rural areas based on population counts, settlement points, and the presence of night time lights. Areas are defined as urban where contiguous lighted cells from the night time lights or approximated urban extents based on buffered settlement points for which the total population is greater than 5,000 persons (Balk et al. 2006; CIESIN 2011); http://sedac.ciesin.columbia.edu/data/set/grump-v1-urban-extents, accessed July 2014.

We find strong effects of PKO on both maternal health indicators in all four model specifications. For the first model specification, everything else equal, the percentage of women who had at least one tetanus injection is about 6.4% higher in grid cells with PKO than in grid cells without PKO. The third model specification reveals an even stronger effect of PKO on antenatal care: having PKO increases the percentage of women who have received antenatal care by almost 8.5%. All model specifications present strong causal effects of PKO on maternal health indicators at the grid cell level.

Insert Table 4 here

We further test whether PKO also affects women's education. The first two model specifications in Table 4 suggest that PKO is associated with higher grid cell level average in education levels for women. Having a PKO within a grid is associated with an increase in education levels by about 0.18 to 0.23, depending whether we add in the urbanization variable. It is hard to get a concrete sense of how big is the substantive effect since these are levels of education (no education: 0; primary: 1; secondary: 2; higher: 3) for women. The last 2 model specifications in Table 4 provide a much more intuitive sense of the substantive effect of PKO on years of education. After matching, a grid with a PKO is associated with an increase in women's education of almost one year.

Note that up to this point, we have defined treatment units as those grid cells that include at least one peace keeping station. One problem associated with the strategy is that it ignores the fact people might be able to travel, from other grid cells, to a PKO location to seek help. PKO might affect maternal health conditions of locations outside the grid cell where it is in. Therefore, as a robustness check, we redefine treatment units as those grid cells that are within a 25 kilometers radius of a PKO location: 25 kilometers is often the maximum travel distance by foot within a day. Figure 3 shows the newly defined treatment units (grid-cells in blue) when we use the 25 kilometers buffers.

Insert Figure 3 here

We repeat our regression analysis based on newly matched sample and the results are reported in Table 5 and 6. In Table 5, the effect of PKO on tetanus injection is still positive, but the significance level drops to 0.12-0.14. PKO's effect on antenatal care is significant; however, the magnitude of the substantive effect, compared to Table 3, is almost reduced by half. This makes sense because one PKO operation now "treats" a much larger area --- all grid cells within a buffer zone of 25 km radius. In Table 6, we find strong support that PKOs are associated with better education for women: for example, the last two model specifications suggest that grids within 25 km of a PKO location are associated with a higher level in women's education of as much as close to 0.9 years.

Insert Table 5 and 6 here

Finally, we have conducted further robustness checks. There are two motivations. The first concern has to do with bordering grids: grids on national borders. Up to this point,

we have included a grid cell into our sample as long as a part of the grid is in one of the three countries. This is different from the original PRIO-GRID which classifies a grid as belonging to one country using the following rules: each cell can be assigned to one and only one country in each yearly file; to determine country ownership, PRIO-GRID draws on the cShapes dataset (Weidmann et al 2008);[25] grid cells that fall completely within the territory of an independent state are assigned the corresponding country code; grid cells that cover the territory of two or more independent states (i.e. the cell intersects with multiple country polygons) are assigned to the country that covers the largest share of the cell's area. The difference in inclusion criterion affects grid cells at the national border. Now, we follow the PRIO-GRID rule to test whether this change affects our results.

Insert Figure 4 here

The second reason is to try additional radius for the buffer around PKO locations: 0, 5km, 15km, and 25 km --- to identify treatment grids which are those intersecting or falling within the buffer accordingly defined.[26] We want to see whether the treatment effects are sensitive to the size of buffer zones. We repeat the same matching procedure and run regression analysis based on matched samples using the model specification that includes the urbanization variable (the second and fourth model specifications in Table 3-6). Because of space limit, we do not present detailed regression results. We choose to only present the

[25] cShapes contains geographic data on the outline of countries since 1946, based on the Gleditsch and and Ward (1999) list of independent states.

[26] 0 km essentially captures grids cells that have PKO locations within.

95% confidence intervals of the estimated coefficients for the PKO variable which is the treatment effect on the maternal health and education variables. Figure 4 presents these treatment effects: as we change the size of the buffer zones from 0 to 25 km, more grids would intersect or fall within the buffer zones and be considered as treatment units. It seems that the treatment effects on all four variables are robust to the changes in buffer size around PKO locations. Moreover, after we followed the PRIO-GRID rule, which is more stringent, to decide which bordering grids belong to those three countries, the results regarding the treatment effect become more significant even though we have lower number of observations. For example, the treatment effect on m1 from Table 5 is less than borderline significant; now, its 95% confidence interval does not include 0 (higher left plot of Figure 4).

5.0. Conclusion

In this article, we argue and show that peacekeeping has an effect beyond traditional security concerns and affect maternal health and women's education in areas with deployment. We have argued that there are two possible channels through which peacekeeping might make an improvement. First, peacekeepers might contribute to an improvement and the provision of medical facilities. Second, the presence of peacekeepers can increase the overall levels of security, facilitating use of medical services and educational facilities; thus, indirectly leading to an improvement of maternal health. We conduct our empirical analysis at both country and within country with the latter using geo-referenced UN operations deployment data and the Demographic Household Survey (DHS) data in three sub-Saharan countries. We find strong empirical support for a positive effect of peacekeeping on maternal health both in terms of indicators such as antenatal care and

vaccination. We also find strong evidence that levels and years of education improve for women leading to positive feedback loops on maternal health outcomes.

Our study is one of the first to explore the impact of peacekeeping missions on women's well-being and health in the aftermath of violent armed conflict. Thus, it moves beyond concepts of "negative" peace and absence of violent conflict to "quality" of peace (Wallensteen 2015). Despite challenges PKOs seem to lead to tangible improvements in the quality of life of women at least when it comes to health and education. Both health and education are linked to long-term sustainable developmental goals and women's empowerment. Our study also reinforces the view that minimal provision of security can lead to significant dividends when it comes to developmental goals by creating the necessary space for development agencies and actors, but also locals, to become active.

Generating opportunities for improving health and education in post-conflict countries does not imply that the emerging structures are also sustainable long-term or more equitable. There is a risk that the peacekeeping dividend can be lost if countries either lack the capacity or the will to invest sufficiently in health and education. Moreover, peacekeeping efforts can fail if they do not manage to adapt to challenges arising. Still, given the low amount of resources invested to peacekeeping, our analysis suggests remarkable payoffs.

References

Abramowitz, Sharon A. (2014). How the Liberian Health Sector Became a Vector for Ebola. Hot Spots. Cultural Anthropology website. October 07, 2014. http://www.culanth.org/fieldsights/598-how-the-liberian-health-sector-became-a-vector-for-ebola.

Abramowitz, Sharon A. and Panter-Brick, Catherine. eds., 2015. Medical Humanitarianism: Ethnographies of Practice. University of Pennsylvania Press.

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

Ahmed, Saifuddin, Andrea A. Creanga, Duff G. Gillespie, and Amy Tsui. (2010). Economic status, education and empowerment: implications for maternal health service utilization in developing countries. *PloS one* 5(6): e11190.

Austin, Judy, Samantha Guy, Louise Lee-Jones, Therese McGinn, and Jennifer Schlecht. (2008). Reproductive health: a right for refugees and internally displaced persons. *Reproductive Health Matters* 16(31): 10-21.

Autesserre, Séverine. (2010). *The trouble with the Congo*. Cambridge: Cambridge University Press.

Beardsley, Kyle C. and Kristian Skrede Gleditsch. (2015). Peacekeeping as conflict containment. *International Studies Review* 17(1): 67-89.

Brahimi, Lakdhar. (2000). Report of the Panel on United Nations Peace Operations. http://www.un.org/en/ga/search/view_doc.asp?symbol=A/55/305 (Accessed on 22-07-2016).

Card, David and Alan B Krueger. (1994). Minimum wages andemployment: A case study of the fast-food industry in New Jersey and Pennsylvania. *American Economic Review* 84 (4): 772–793.

CIESIN, FAO. (2011). "CIAT.(2005)." Gridded population of the world [dataset] 23(07).

Cohen, Dara Kay, Amelia Hoover Green, and Elisabeth Jean Wood. (2013). Wartime Sexual Violence. USIP Special Report. Available at http://s3.amazonaws.com/academia.edu.documents/40184836/Cohen-Green-Wood_Wartime_Sexual_Violence_-_USIP_Feb_2013__1_.pdf?AWSAccessKeyId=AKIAJ56TQJRTWSMTNPEA&Expires=1469194337&Signature=Zh%2FVkJG4endq9U0mrNbzSsGRYq0%3D&response-content-disposition=inline%3B%20filename%3DCohen_Green_Wood_Wartime_Sexual_Violence.pdf (Accessed on 22-07-2016).

Doyle, Michael and Nicholas Sambanis. (2000). International peace-building: A theoretical and quantitative analysis. *American Political Science Review* 94(4): 779–801.

Fortna, Virginia P. (2008). Does peacekeeping work? Shaping belligerents' choices after civil war. Princeton: Princeton University Press.

Garg, Bishan S., Shakuntala Chhabra, and Shahnaz M. Zothanzami. (2006). Safe motherhood: social, economic, and medical determinants of maternal mortality. Women and Health Learning Package, The Network: TUFH Women and Health Taskforce. Karachi: The Network: 1132.

Gleditsch, Kristian S., and Michael D. Ward. (1999). Interstate system membership: A revised list of the independent states since 1816. International Interactions 25(4): 393-413.

Gleditsch, Nils Petter; Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg and Håvard Strand. (2002). Armed Conflict 1946–2001: A New Dataset. Journal of Peace Research 39(5): 615–637.

Goulding, Marrack. (1993). The evolution of United Nations peacekeeping. International Affairs (Royal Institute of International Affairs 1944-): 451-464.

Ghobarah, H. Adam, Huth, Paul Huth, and Bruce Russett. (2003). Civil wars kill and maim people—long after the shooting stops. *American Political Science Review* 97(02): 189-202.

Grey, Rosemary and Laura Shepherd. (2013). Stop rape now? Masculinity, responsibility, and conflict-related sexual violence. *Men and Masculinities* 16(1): 115 – 135.

Guha-Sapir, Debarati and Olivia D'Aoust. (2011). Demographic and health consequences of civil conflict. Washington, DC: World Bank.

Hafner-Burton, Emilie, and Mark A. Pollack. (2002). Mainstreaming gender in global governance. *European Journal of International Relations* 8(3): 339-373.

Hill, Kenneth, Kevin Thomas, Carla AbouZahr, Neff Walker, Lale Say, Mie Inoue, Emi Suzuki, and Maternal Mortality Working Group. (2007). Estimates of maternal mortality worldwide between 1990 and 2005: an assessment of available data. *The Lancet*. 370(9595):1311-1319.

Ho, Daniel E., Kosuke Imai, Gary King, and Elizabeth A. Stuart. (2004). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. Working paper at http://Gking.Harvard.Edu/matchit.

Howard, Lise M. (2008). UN Peacekeeping in Civil Wars. Cambridge: Cambridge University Press.

Howard, Natasha, Sarah Kollie, Yaya Souare, Anna von Roenne, David Blankhart, Claire Newey, Mark I. Chen, and Matthias Borchert. (2008). Reproductive health services for refugees by refugees in Guinea I: family planning. *Conflict and Health* 2(1): 1.

Hudson, Valerie M., Mary Caprioli, Bonnie Ballif-Spanvill, Rose McDermott, and Chad F. Emmett. (2009). The heart of the matter: The security of women and the security of states. *International Security* 33(3): 7–45.

Hultman, Lisa, Jacob Kathman, and Megan Shannon. (2013). United Nations Peacekeeping and civilian protection in civil war. *American Journal of Political Science* 57(4):875-891.

----- (2014). Beyond keeping peace: United Nations effectiveness in the midst of fighting. *American Political Science Review* 108(4): 737-753.

Imai, Kosuke, and David A. van Dyk. (2004) Causal inference with general treatment regimes: Generalizing the propensity score. *Journal of the American Statistical Association* 99 (467): 854–866.

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

Kehoe, Sean, James Neilson, and Jane Norman (Eds.). (2010). Maternal and infant deaths: chasing millennium development goals 4 and 5. RCOG.

Kruk, Margaret E., Lynn P. Freedman, and Grace A. Anglin. (2010). Rebuilding health systems to improve health and promote statebuilding in post-conflict countries: A theoretical framework and research agenda. *Social Science and Medicine* 70(1): 89-97.

Lee, Romeo B. (2008). Delivering maternal health care services in an internal conflict setting in Maguindanao, Philippines. *Reproductive Health Matters*. 16(31): 65-74.

Leiby, Michele. (2009). Wartime sexual violence in Guatemala and Peru. *International Studies Quarterly* 53(2): 445-468.

Li, Quan and Ming 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):47l-92.

Liebling-Kalifani, Helen J., Ruth Ojiambo-Ochieng, Angela Marshall, Juliet Were-Oguttu, Seggane Musisi, and Eugene Kinyanda. (2008) Violence against women in Northern Uganda: The neglected health consequences of war. *Journal of International Women's Studies* 9(3): 174-192.

Liebling-Kalifani, Helen J. and B. Baker. (2010). Women war survivors of sexual violence in Liberia: inequalities in health, resilience and justice. *Journal of International Social Research* 3(13): 188-199.

Luginaah, Isaac N., Joseph Kangmennaang, Mosoka Fallah, Bernice Dahn, Francis Kateh, and Tolbert Nyenswah. (2016). Timing and utilization of antenatal care services in Liberia: Understanding the pre-Ebola epidemic context. *Social Science & Medicine* 160: 75-86.

Mansour, Hani and Daniel I. Rees. (2012). Armed conflict and birth weight: Evidence from the al-Aqsa Intifada. *Journal of Development Economics* 99(1): 190-99.

Maternal Mortality Estimates developed by WHO, UNICEF and UNFPA. (2004). Geneva, World Health Organization.

McCarthy, James and Deborah Maine. (1992). A framework for analyzing the determinants of maternal mortality. *Studies in Family Planning* 23(1): 23–33.

McGinn Therese, Sara Casey, Susan Purdin, and Mendy Marsh. (2004). Reproductive health for conflict-affected people: policies research and programmes. Overseas

Development Institute, Humanitarian Practice Network, Apr. [35] p. (Network Paper No. 45).

O'Hare, Bernadette AM, and David P. 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.

Olsson, Louise. (2009). Gender equality and United Nations Peace Operations in Timor Leste. Leiden: Martinus Nijhoff Publishers.

Palmer, Celis A. and Zwi, Anthony B. (1998). Women, health and humanitarian aid in conflict. *Disasters* 22(3): 236-249.

Pettersson, Therése and Peter Wallensteen. (2014). Armed conflict, 1946-2014. *Journal of Peace Research* 52(4): 541-554.

Plümper, Thomas and Eric 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.

Pouligny, Beatrice. (2006). Peace operations seen from below. Kumarian Press.

Riyami, Asya, Mustafa Afifi, and Ruth M. Mabry. (2004) Women's autonomy, education and employment in Oman and their influence on contraceptive use. *Reproductive Health Matters* 12(23):144-154.

Ronsmans Carine and Wendy J. Graham. (2006) Maternal mortality: Who, when, where and why. On Behalf of the Lancet Maternal Survivors Series steering groups 368: 1189-200.

Shepherd, Laura J. (2011). Sex, security and superhero(in)es: From 1325 to 1820 and beyond. *International Feminist Journal of Politics* 13(4): 504-21.

Southall, David (2011). Armed conflict women and girls who are pregnant, infants and children; a neglected public health challenge. What can health professionals do? *Early Human Development* 87(11): 735-742.

Tollefsen, Andreas F., Haavard Strand and Halvard Buhaug. (2012). PRIO-GRID: A unified spatial data structure. *Journal of Peace Research* 49(2): 363-374.

UN DPKO (2008). Capstone Doctrine: United Nations Peacekeeping Operations: Principles and Guidelines. New York: United Nations.

UNMIL. (2012). Liberia eliminates maternal and neonatal tetanus. Available at: https://unmil.unmissions.org/liberia-eliminates-maternal-and-neonatal-tetanus. (Accessed on 22-07-2016).

United Nations Security Council. (2000). Resolution 1325. S /RES/1325. New York: United Nations. Available at: http://www.un.org/events/res_1325e.pdf (Accessed 22-07-2016).

Urdal, Henrik; and Chi, Primus Che. (2013). War and gender inequalities in health: The impact of armed conflict on fertility and maternal mortality. *International Interactions* 39(4): 489–510.

Zureick-Brown, Sarah, Holly Newby, Doris Chou, Nobuko Mizoguchi, Lale Say, Emi Suzuki, and John Wilmoth. (2013). Understanding global trends in maternal mortality.International perspectives on sexual and reproductive health 39(1).Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3886625/ (Accessed on 22-07-2016).

Wallensteen, Peter. (2015). Quality of peace: peacebuilding, victory, and world order. Oxford: Oxford University Press.

Wallensteen, Peter and Margareta Sollenberg. (2001). Armed Conflict, 1989-2000. *Journal of Peace Research* 38(5): 629-644.

Weidmann, Nils B., Doreen Kuse, and Kristian Skrede Gleditsch. (2010). The geography of the international system: The CShapes dataset. *International Interactions* 36(1): 86-106.

WHO, U. UNFPA, The World Bank, United Nations Population Division. (2014). Trends in maternal mortality: 1990 to 2013. WHO. World Health Organization, Geneva.

Wilmoth John R., Mizoguchi Nobuko, Oestergaard Mikkel Z., Say Lale, Mathers Colin D., Zureick-Brown Sarah, Inoue Mie and Chou Doris (2012). A new method for deriving global estimates of maternal mortality. Statistics, Politics and Policy, 3(2).

Table 1: MMR Reduction in Countries with and without PKO.

Countries with Integrative PKO					
Min	1st Qu.	Median	Mean	3rd Qu.	Max
20	307.5	560	573.8	775	1200
Countries without Integrative PKO					
Min	1st Qu.	Median	Mean	3rd Qu.	Max
-3	190	280	385.8	450	1320
Countries with PKO					
Min	1st Qu.	Median	Mean	3rd Qu.	Max
20	320	560	640	940	1320
Countries without PKO					
Min	1st Qu.	Median	Mean	3rd Qu.	Max
-3	186.8	270	329.5	372.5	1310

Note: Maternal mortality is measured in deaths per million.

Table 2: Estimated Interactive Effects of PKO (Treatment) and Post-PKO Period.

	integrative and 1st gen. PKO vs. no PKO		1st gen. PKO vs. no PKO		integrative PKO vs. no PKO	
	Coef.	ˆσ (*p*>|t|)	*Coef*.	ˆσ (*p*>|t|)	*Coef*.	ˆσ (*p*>|t|)
Intercept	951.832	512.176 (0.07)	802.859	472.648 (0.09)	974.000	471.981 (0.04)
PKO	446.763	111.683 (0.00)	15.289	149.795 (0.92)	587.961	122.119 (0.00)
Post-PKO	-248.403	90.529 (0.01)	-244.443	77.518 (0.00)	-239.021	82.190 (0.01)
PKO × Post-PKO	-347.209	154.954 (0.03)	-313.607	188.163 (0.10)	-344.547	180.534 (0.06)
GDP per capita	-0.058	0.020 (0.01)	-0.039	0.018 (0.03)	-0.043	0.019 (0.03)
Population	-7.208	29.358 (0.81)	4.741	26.585 (0.86)	-7.283	27.069 (0.79)
Trade openness	0.610	1.208 (0.62)	0.857	1.076 (0.43)	1.006	1.115 (0.37)
Urbanization	-3.580	2.658 (0.18)	-6.300	2.527 (0.02)	-6.020	2.545 (0.02)
Conflicts	85.962	98.673 (0.39)	217.230	102.364 (0.04)	197.510	106.893 (0.07)
Adjusted R^2		0.49		0.50		0.55
N. observations		78		65		68

Table 3: OLS estimates on the matched sample for maternal health variables.

	m1: tetanus injection				m14: antenatal care			
	Coef.	ˆσ (*p*>|t|)	*Coef.*	ˆσ (*p*>|t|)	*Coef.*	ˆσ (*p*>|t|)	*Coef.*	ˆσ (*p*>|t|)
Intercept	87.539	4.008 (0.00)	87.296	3.792 (0.00)	94.223	3.182 (0.00)	92.882	3.091 (0.00)
PKO	6.421	2.326 (0.01)	3.762	2.096 (0.07)	8.419	1.847 (0.00)	6.293	1.709 (0.00)
Distance to capital	-0.009	0.002 (0.00)	-0.008	0.002 (0.00)	-0.006	0.002 (0.00)	-0.006	0.002 (0.00)
Urbanization			0.284	0.351 (0.42)			0.238	0.286 (0.41)
Time to urban	-0.018	0.008 (0.03)	-0.019	0.008 (0.01)	-0.008	0.006 (0.20)	-0.005	0.006 (0.45)
Mountain area	-2.886	4.037 (0.48)	-3.610	3.645 (0.32)	1.359	3.204 (0.67)	3.211	2.971 (0.28)
Conflict zone	-9.097	2.597 (0.00)	-5.793	2.353 (0.01)	-4.955	2.061 (0.02)	-3.009	1.918 (0.12)
Population	0.000	0.000 (0.80)	-0.000	0.000 (0.46)	-0.000	0.000 (0.87)	-0.000	0.000 (0.42)
GDP per capita	0.000	0.003 (0.96)	0.002	0.003 (0.47)	0.002	0.002 (0.34)	0.003	0.002 (0.27)
Adjusted R^2		0.18		0.18		0.13		0.11
N. observations		304		304		304		304

Note: Country and year fixed effects estimated not reported because of space limit.

Table 4: OLS estimates on the matched sample for education outcome variables.

	v106n: education levels				v107n: years of education			
	Coef.	ˆσ (*p*>|t|)	*Coef*.	ˆσ (*p*>|t|)	*Coef*.	ˆσ (*p*>|t|)	*Coef*.	ˆσ (*p*>|t|)
Intercept	1.386	0.085 (0.00)	1.238	0.087 (0.00)	5.923	0.443 (0.00)	5.378	0.443 (0.00)
PKO	0.225	0.049 (0.00)	0.179	0.048 (0.00)	0.958	0.252 (0.00)	0.830	0.245 (0.00)
Distance to capital	-0.000	0.000 (0.00)	-0.000	0.000 (0.00)	-0.001	0.000 (0.00)	-0.001	0.000 (0.00)
Urbanization			0.037	0.008 (0.00)			0.193	0.041 (0.00)
Time to urban	-0.000	0.000 (0.05)	-0.000	0.000 (0.49)	-0.001	0.001 (0.19)	-0.000	0.001 (0.67)
Mountain area	-0.352	0.085 (0.00)	-0.319	0.084 (0.00)	-1.832	0.439 (0.00)	-1.635	0.426 (0.00)
Conflict zone	-0.076	0.055 (0.16)	-0.018	0.054 (0.75)	-0.286	0.280 (0.31)	-0.080	0.274 (0.77)
Population	0.000	0.000 (0.13)	-0.000	0.000 (0.03)	0.000	0.000 (0.07)	-0.000	0.000 (0.08)
GDP per capita	0.000	0.000 (0.54)	0.000	0.000 (0.06)	0.000	0.000 (0.28)	0.001	0.000 (0.10)
Adjusted R^2		0.47		0.49		0.40		0.44
N. observations		304		304		304		304

Note: Country and year fixed effects estimated not reported because of space limit.

Table 5: OLS estimates on the matched sample for maternal health variables: using 25KM buffer zone to define treatment grids.

	m1: tetanus injection				m14: antenatal care			
	Coef.	^σ (*p*>|t|)	*Coef.*	^σ (*p*>|t|)	*Coef.*	^σ (*p*>|t|)	*Coef.*	^σ (*p*>|t|)
Intercept	88.422	3.266 (0.00)	86.736	3.320 (0.00)	93.453	2.635 (0.00)	92.645	2.687 (0.00)
PKO	2.764	1.879 (0.14)	2.887	1.865 (0.12)	4.623	1.516 (0.00)	4.736	1.510 (0.00)
Distance to capital	-0.010	0.002 (0.00)	-0.009	0.002 (0.00)	-0.005	0.002 (0.00)	-0.006	0.002 (0.00)
Urbanization			0.568	0.370 (0.13)			0.461	0.300 (0.12)
Time to urban	-0.026	0.005 (0.00)	-0.024	0.005 (0.00)	-0.011	0.004 (0.01)	-0.009	0.004 (0.03)
Mountain area	-3.284	3.466 (0.34)	-3.200	3.446 (0.35)	2.083	2.797 (0.46)	2.272	2.790 (0.42)
Conflict zone	-4.282	2.011 (0.03)	-3.871	2.019 (0.06)	-1.962	1.622 (0.23)	-1.571	1.635 (0.34)
Population	-0.000	0.000 (0.76)	-0.000	0.000 (0.22)	0.000	0.000 (0.98)	-0.000	0.000 (0.32)
GDP per capita	0.003	0.002 (0.18)	0.003	0.002 (0.17)	0.002	0.002 (0.27)	0.002	0.002 (0.28)
Adjusted R^2		0.15		0.15		0.08		0.09
N. observations		518		518		518		518

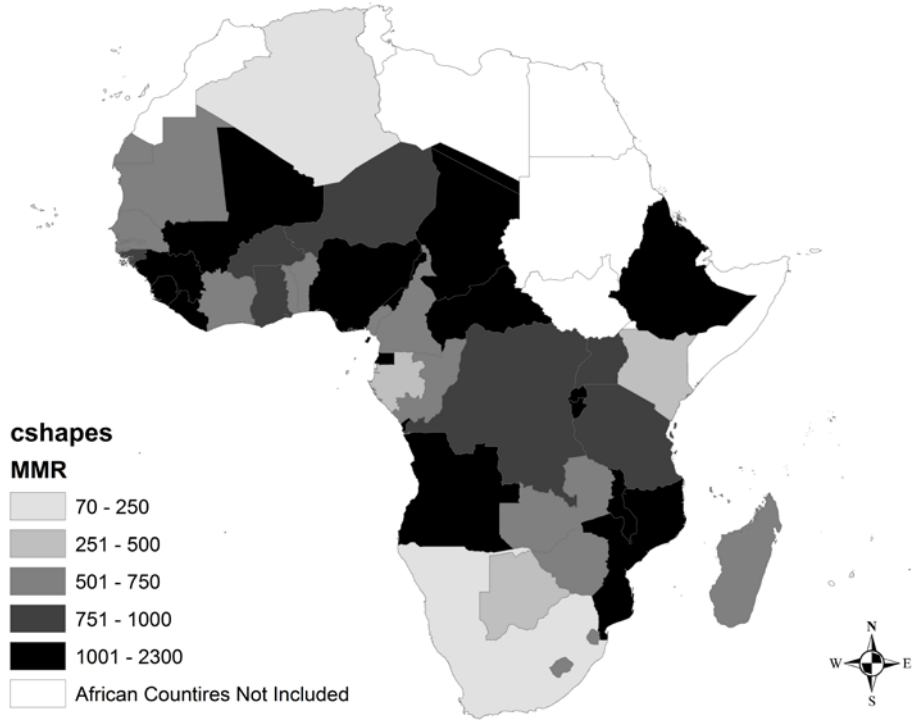
Note: Country and year fixed effects estimated not reported because of space limit.

Table 6: OLS estimates on the matched sample for education variables: using 25KM buffer zone to define treatment grids.

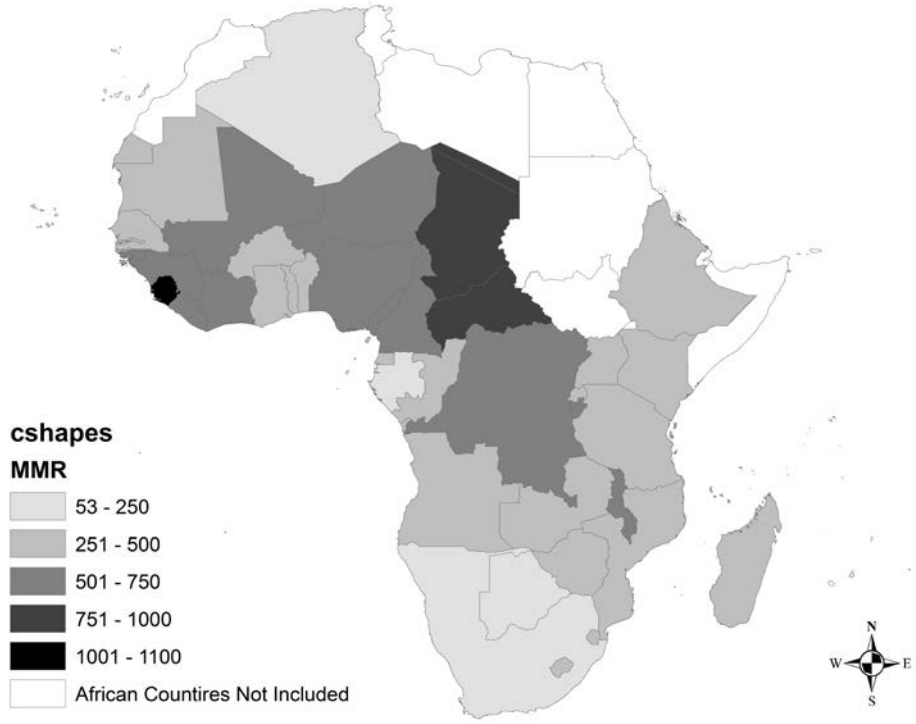
	v106n: education levels				v107n: years of education			
	Coef.	ˆσ (*p*>|t|)	*Coef.*	ˆσ (*p*>|t|)	*Coef.*	ˆσ (*p*>|t|)	*Coef.*	ˆσ (*p*>|t|)
Intercept	1.269	0.069 (0.00)	1.179	0.068 (0.00)	5.595	0.353 (0.00)	5.125	0.347 (0.00)
PKO	0.159	0.040 (0.00)	0.164	0.038 (0.00)	0.854	0.203 (0.00)	0.883	0.195 (0.00)
Distance to capital	-0.000	0.000 (0.00)	-0.000	0.000 (0.00)	-0.001	0.000 (0.00)	-0.001	0.000 (0.00)
Urbanization			0.045	0.008 (0.00)			0.238	0.039 (0.00)
Time to urban	-0.000	0.000 (0.06)	-0.000	0.000 (0.50)	-0.001	0.001 (0.02)	-0.001	0.001 (0.30)
Mountain area	-0.293	0.074 (0.00)	-0.281	0.071 (0.00)	-1.370	0.375 (0.00)	-1.293	0.361 (0.00)
Conflict zone	-0.008	0.043 (0.86)	0.029	0.042 (0.48)	-0.014	0.218 (0.95)	0.177	0.211 (0.40)
Population	0.000	0.000 (0.09)	-0.000	0.000 (0.01)	0.000	0.000 (0.03)	-0.000	0.000 (0.01)
GDP per capita	0.000	0.000 (0.09)	0.000	0.000 (0.04)	0.000	0.000 (0.16)	0.000	0.000 (0.08)
Adjusted R^2		0.43		0.47		0.37		0.42
N. observations		518		518		518		518

Note: Country and year fixed effects estimated not reported because of space limit.

Figure 1: Maternal Mortality Rates (MMR) in 45 African Countries in the DID Analysis.



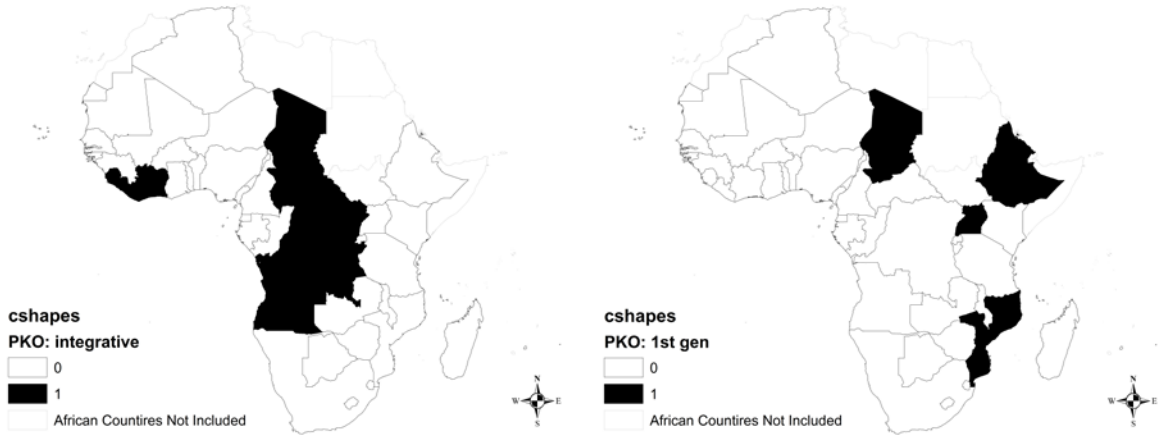
(a): 1990



(b): 2013

Note: countries not included in the DID ("African Countries Not Included") are also shown, but with no information on their MMR, therefore no color for their polygons.

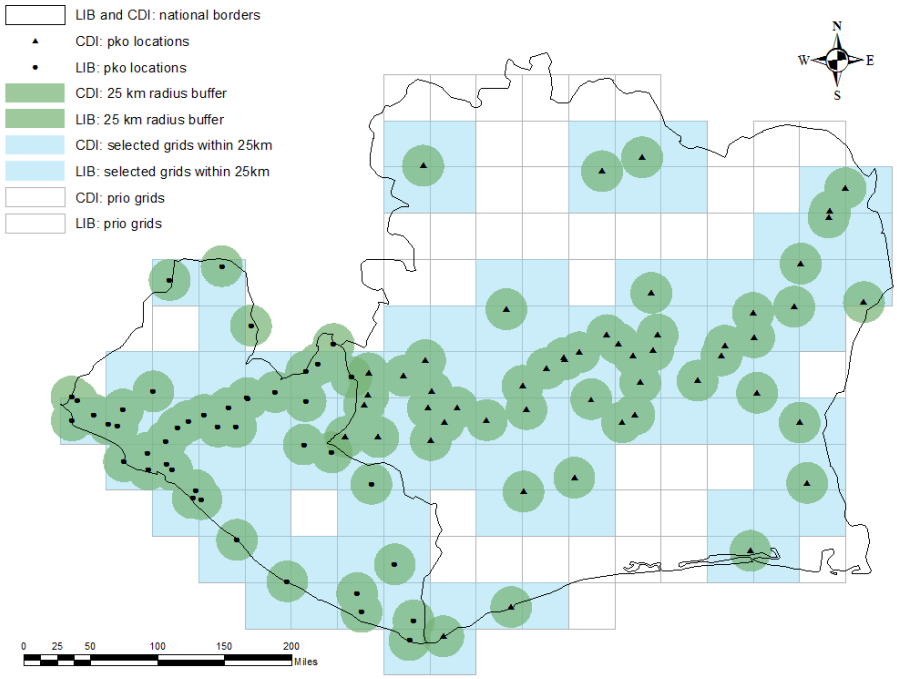
Figure 2: Integrative and 1st Generation PKOs.



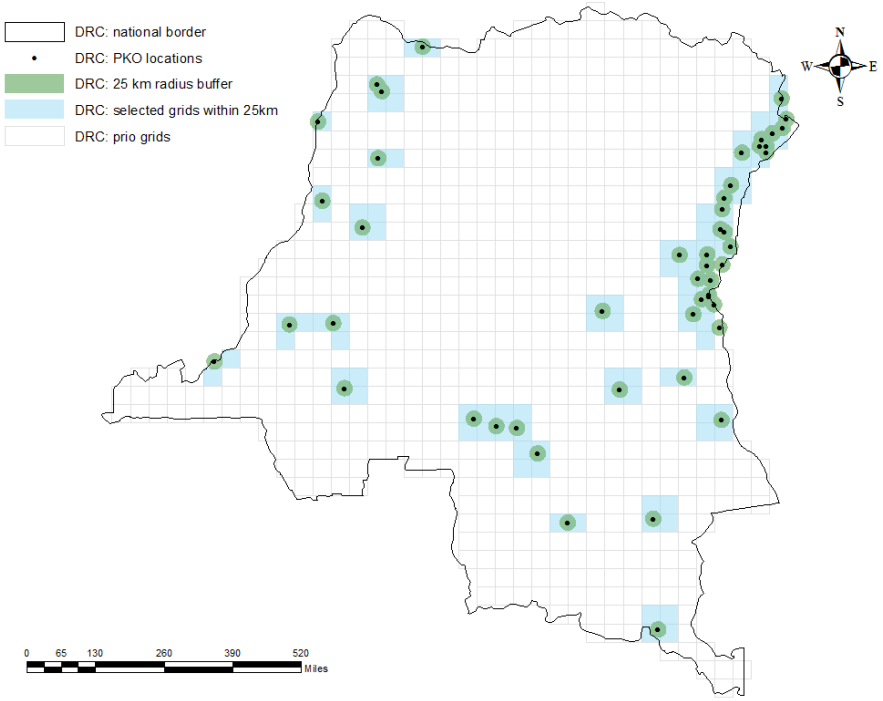
a): integrative PKOs b): 1st generation PKOs

Note: countries not included in the DID ("African Countries Not Included") are also shown, but with lighter gray borders for their polygons.

Figure 3: Distribution of PKOs, Buffer Zones, and Grids "Treated."



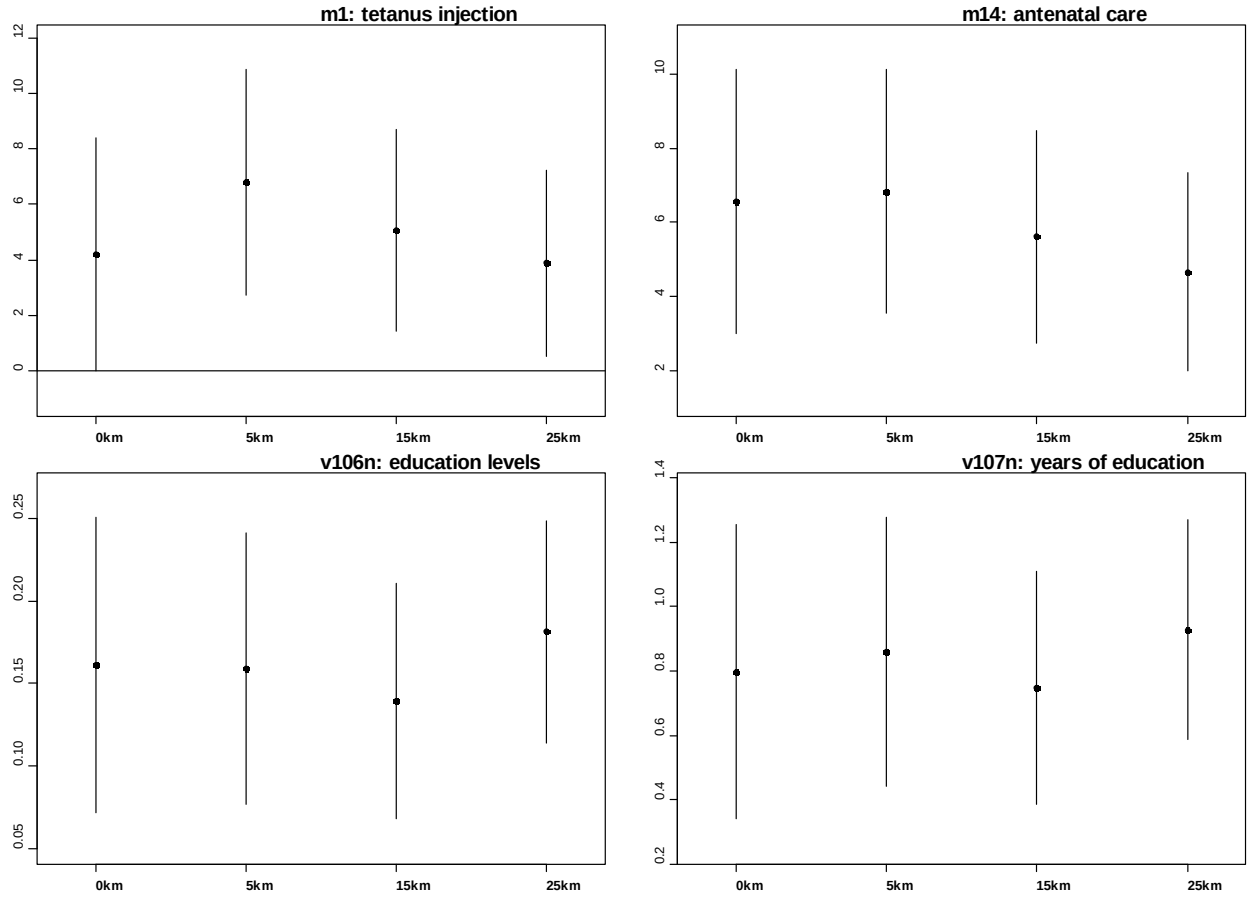
(a): Liberia (LIB) (left) and Cote d'Ivoire (CDI).



(b): Democratic Republic of Congo (DRC).

Note: Figure 3(a) and (b) use different scale because of different country size. The grids in both figures, in grey, are PRIO grid (the unit of analysis in matching regressions). 25 km buffers from PKO locations are indicated by solid green circles. Blue grids are grids selected as treatment units using 25 km buffer zones.

Figure 4: PKO Treatment Effects as a Function of the Size of Buffer Zones.



Appendix: Countries Included in the DID Analysis.

Table A-1: countries included in the DID and descriptive statistics.

country	MMR 1990	MMR 2013	Reducation in MMR	Intergrative PKO	1st generation PKO
Algeria	160	89	71	0	0
Angola	1400	460	940	1	0
Benin	600	340	260	0	0
Botswana	360	170	190	0	0
Burkina Faso	770	400	370	0	0
Burundi	1300	740	560	1	0
Cabo Verde	230	53	177	0	0
Cameroon	720	590	130	0	0
Central African Republic	1200	880	320	1	0
Chad	1700	980	720	1	1
Comoros	630	350	280	0	0
Congo	670	410	260	0	0
Côte d'Ivoire	740	720	20	1	0
Democratic Republic of the Congo	1000	730	270	1	0
Equatorial Guinea	1600	290	1310	0	0
Eritrea	1700	380	1320	0	1
Ethiopia	1400	420	980	0	1
Gabon	380	240	140	0	0
Gambia	710	430	280	0	0
Ghana	760	380	380	0	0
Guinea	1100	650	450	0	0
Guinea-Bissau	930	560	370	0	0
Kenya	490	400	90	0	0
Lesotho	720	490	230	0	0
Liberia	1200	640	560	1	0
Madagascar	740	440	300	0	0
Malawi	1100	510	590	0	0
Mali	1100	550	550	0	0
Mauritania	630	320	310	0	0
Mauritius	70	73	-3	0	0
Mozambique	1300	480	820	0	1
Namibia	320	130	190	0	1
Niger	1000	630	370	0	0
Nigeria	1200	560	640	0	0
Rwanda	1400	320	1080	0	0
São Tome and Principe	410	210	200	0	0
Senegal	530	320	210	0	0
Sierra Leone	2300	1100	1200	1	0
South Africa	150	140	10	0	0
Swaziland	550	310	240	0	0
Togo	660	450	210	0	0
Uganda	780	360	420	0	1
United Republic of Tanzania	910	410	500	0	0
Zambia	580	280	300	0	0
Zimbabwe	520	470	50	0	0