A security dividend: Peacekeeping and maternal health outcomes and access

Ismene Gizelis, Department of Government, Essex University

Xun Cao, Department of Political Science, Penn State University

Abstract:

UNSCR 1325 highlights the distinct needs of women in security and access to health and education. Few studies explore how peacekeeping affects women's access to health and education. We argue that PKOs have both a direct and an important indirect impact on maternal health and women's well-being. First, peacekeeping can have a direct effect by providing medical and training facilities. Second, peacekeeping has an indirect effect as improvements in the overall level of security facilitates women's access to medical services and education. We examine the peacekeeping's impact on outcomes at both the country-level, using a sample of 45 African countries, as well as in within country, grid-cell level, using geo-coded data UN deployment and information from the Demographic and Health Surveys in three sub-Saharan countries. We find strong empirical support for a positive relationship between peacekeeping presence and maternal health outcomes and access to services.

Keywords: peacekeeping, maternal health, women's well being

Corresponding author: xuc11@psu.edu

INTRODUCTION

UN peacekeeping missions often have mandates that extend beyond short-term security objectives, aiming at peacebuilding and social transformation. Complex and ambitious UN peacekeeping missions often raise questions about "what" or "whose peace" is to be established, and the distributional consequences for vulnerable groups, e.g. the distinct needs of women for improved protection and well-being.

Existing research offers two different understandings of gender equality. Some researchers take a normative approach, emphasizing a more balanced distribution of resources between men and women as fair and just. Others see gender inequality as an indicator of social capacity, where human and social capital is higher in societies where women are comparatively less disadvantaged to men. Higher social capacity correlates with a more equitable distribution of resources (Forsberg and Olsson 2016). For instance, recent studies suggest that improving female political representation increases the durability and quality of post-conflict peace (Demeritt et al 2014; Shair-Rosenfield and Wood 2017). Women's access to public services such as health and education is a form of gender inequality in post-conflict countries, since adverse conditions often affect women more than men leading to unbalanced distribution of resources (Liebeling-Kalifani and Baker 2010).[1]

We argue that PKOs have both a direct and an important indirect impact on maternal health and women's well-being. The latter, indirect impact posits that PKOs can create a "peacekeeping dividend" through the security brought by peacekeepers in conflict areas. This security signals that fighting has subsided allowing for improved infrastructure such as

[1] Childbirth with limited health care access is a driver of female mortality in post-conflict environments (Urdal and Chi 2013).

medical facilities and schools, safer access to medical facilities and other services such as schools.

We evaluate our argument by combining evidence from different levels of analysis. First, we use a difference-in-difference analysis of 45 African countries with data between 1990 and 2013, comparing the changes in maternal mortality rates (MMR) for countries with and without PKOs. Second, we look at within-country variations across areas with and without UN peacekeeping deployment in three countries with integrative PKOs, combining geo-coded peacekeeping data with individual data on maternal health and education from the Demographic and Health Surveys (DHS) in the Democratic Republic of Congo, Côte D'Ivoire, and Liberia. We find that countries with UN PKOs see much higher improvement in MMR between 1990 and 2013, while women in locations where peacekeepers have been deployed have gained much better access to public services.

UN PEACEKEEPING AND QUALITY OF PEACE

Peacekeeping has become the main method to manage and contain civil wars (Doyle and Sambanis 2000; Fortna 2008; Howard 2008). Although some question the effectiveness of peacekeeping missions pointing to incidents of abuse and sexual exploitation against local populations (Autesserre 2010; Barnett et al. 2014; Beber et al. 2017; Pouligny 2006), other studies suggest that PKOs promote peace and peacebuilding by strengthening the capacity of governments (Doyle and Sambanis 2000; Dorussen and Gizelis 2013). Empirical studies on peacekeeping so far have focused only on "negative"peace, or the absence of armed conflict, rather than "positive" peace including the well-being of civilians (Galtung 1964). The definition of "positive" peace as "the integration of human society" should include not only the protection of civilians and vulnerable groups but also the "quality" of peace in post conflict societies. Crucially, the "quality" of peace has different implications for the well-being of men and women. These differences in outcomes for men and women are linked to post-conflict distribution of resources (Barnett et al 2014; Olsson and Gizelis 2015; Olsson 2009).

The persistence of high female mortality rates in regions such as sub-Saharan Africa is partly attributable to the indirect effects of conflict in the distribution of services such as health and education (Guha-Sapir and D'Aoust 2010). The risks to maternal health and women's well-being increase during conflict because of deteriorating health care, higher rates of abortion and pregnancy terminations, shortage of skilled health professionals, and greater risks of contracting infections combined with more malnutrition during pregnancies and after childbirth. These factors combined with increased fertility and weakened public health institutions further exacerbate conditions for women (McCarthy and Main 1992; Rosmans and Graham 2006).

The neglect and decline in funding and investment for the provision and access of health start before the outbreak of wars, as resources are diverted from public services to military expenditures (O'Hare and Southall 2007). Diseases spread easily through contaminated water and lack of access to clean water, while medical personnel either are killed or flee (Li and Wen 2005:473). Health facilities, schools, and roads are destroyed and may be targeted to increase the cost to opponents (Plümper and Neumayer 2006:729). Resources redirected towards destructive use leave legacies disrupting the provision of basic services such as health in post-conflict countries. In Liberia, for example, the civil wars from 1989-1996 and 1999-2003 killed approximately 250,000 (10% of the population), displaced around a million people, dismantled the national economy, infrastructure, and a reasonably effective state. After 14 years of civil war, only 51 out of 293 pre-war medical facilities remained functional in 2003 (Kruck et al., 2010).

UN PKOS, SECURITY, AND WOMEN'S WELL-BEING

External interventions from UN PKOs improve the provision of public services as a secure environment enables the provision of basic public services in post-conflict countries, an essential component of post-conflict reconstruction. Provision of public services such as health and public education signal the accountability of the government to its citizens and its capacity to provide services and goods (Kruk et al 2010; Southall 2011; Lee 2008). How can UN PKOs make a difference? First, we argue that an inadvertent consequence of PKO presence is "the peacekeeping dividend", associated with higher provision of and access to public services. This is especially the case for maternal health where better access to services can expand to reach more people much faster than other public services requiring more infrastructure and a longer planning horizon. The presence of peacekeepers, especially in integrative missions increases overall levels of security, here defined as absence of violent armed conflict.[2]

Recent empirical studies show that when peacekeepers deploy there are fewer deaths of civilians, fewer military deaths, and conflict is geographically contained. Presence of

[2] There are three indicators that separate an integrative from a traditional mission: (1) range of tasks: integrative missions have included humanitarian assistance, disarmament and re-integration of combatants, security sector reform, promoting human rights and reestablishment of rule-of-law, organizing democratic elections and supporting economic development and social justice, (2) size of the mission: traditional missions have 200-300 members, integrative missions are significantly larger, up to 22,000 staff, and (3) deployment patterns: traditional missions are not deployed in rural areas where fighting often occurs; limiting the provision of security compare to integrative missions (Dorussen and Gizelis 2013; Dorussen and Ruggeri 2017).

peacekeepers is also associated with shorter incidents of violent conflict (Hoeffler 2014; Hultman et al. 2013; 2014; Gleditsch and Beardsley 2015). The halting and containment of violence creates conditions where “positive” peace or higher “quality” of peace materializes. PKO presence acts as a costly signal that rebels and government are converging towards an agreement. Not all governments and rebels agree to be “peace kept”, but demand for peacekeeping by local actors sends a signal of future intentions regarding peace and conflict. Peacekeepers are costly for both governments and rebels because they independently monitor the behaviour of local actors raising the cost of continuing fighting, thus, signalling that peace is achievable (Fortna and Martin 2009; Ruggeri et al 2017).

Countries that have experienced conflict tend to be low-information environments that investors avoid. Signalling that peace prevails in a country allows for development aid to be directed into the country and indicates to a broader audience that the country is “open for business” encouraging future foreign direct investment in key development areas, such as the provision of public services (Garriga and Phillips 2014). The absence of violence makes possible the redirection of resources to productive use and overall investment to improve provision and access to medical services, leading to outcomes like lower maternal mortality.

The absence of violent conflict creates space for international organizations and NGO’s such as UNICEF, WHO, Save the Children and International Rescue Committee or private partners – for example the Bill & Melinda Gates Foundation, Kiwanis International, Pampers – to provide sponsor long-term medical programs leading to tangible improvements in human capital and infrastructure. Beyond fostering NGOs and IGOs to become active in an area, the containment of conflict allows for synergies between government agencies and external partners. In Liberia despite the fragility of the post-conflict health care system, international-private partnerships were successful in eradicating maternal and neonatal tetanus (MNT), one of the causes of maternal and neonatal death. The development of such partnerships relies on maintaining “negative” peace and a sense of stability provided by UNMIL (UNMIL 2012).

Another pathway through which UN presence leads to improvements in the provision of at least health is direct – often short-term and quick in terms of planning projects – focusing on emergency provision, support of local medical facilities, and re-introduction of new resources to replenish what was lost during conflict. UN quick impact projects (QIP) have been designed to win the hearts and mind of local populations. QIPs are not meant to be developmental or long-term but rather aim to build confidence to the mission, build on the peace dividend, support and extend the government’s authority and strengthen ties with local stakeholders (UN DPKO 2007). The QIPs are tools to fulfil the UN Security Council objective of “promoting economic and social rehabilitation and transformation of post-conflict societies” with an emphasis on projects that target health, sanitation, rehabilitation of water pumps or building latrines (UN Security Council 2001).

UN missions often establish medical camps to treat local communities, train local communities in hygiene, or provide emergency medical relief in remote communities.[3] As an example of a QIP, a medical camp was set up for three days in Sass Town, Kley District, 37 kilometres outside the capital of Liberia Monrovia by the Pakistani contingency in January 2004. Other missions such as UNAMID (the partner mission of UN and African Union mission in Darfur) have targeted issues such as hygiene, sanitation, women’s empowerment and education using QIPs. In particular, projects that target sanitation, hygiene and women’s empowerment may have a direct impact on maternal and neonatal health.

---

[3] For examples of QIPs refer to https://peacekeeping.un.org/en/quick-impact-projects-communities.

We can evaluate whether UN missions improve actual health outcomes such as MMR, although separating the relative effects of direct interventions and security provision is hard without more detailed data. Ultimately, both mechanisms can occur simultaneously and are complimentary. If UN missions have any impact on health outcomes such as maternal health, we should observe that countries with PKOs should outperform countries without PKOs in reducing MMR.

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). Research on local PKOs' deployment suggests that the presence and considerable size of peacekeeping forces can reduce and contain armed conflict within countries (Ruggeri et al 2017). If integrative PKOs improve health outcomes and public services, one might expect to observe an association between localized peacekeeping presence and improvements in indicators of maternal health and well-being.

If PKOs have an indirect impact on the quality of peace and the peacekeeping dividend argument is correct, we may observe improvement across other public services besides health. Other indicators of the accrued "benefit" of peace such as years of schooling should also increase over time in areas where peacekeepers are present. Observed changes in levels of education also allow us to tease out the direct and indirect impact of peacekeeping missions. If, however, peacekeeping missions only have direct impact through the quick impact projects, we should only observe improvements in one sector – that of women's health.

Moreover, better education is a driver of improved maternal health linked with more frequent use of resources, access to information about fertility control and availability 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 leads to higher fertility rates and maternal mortality ratios. In areas where women face inequalities, they are less likely to use health services. These effects are compounded in countries and regions that have experienced civil wars (Ahmed et al. 2009; Chamarbagwala and Morán 2011; Riyami et al. 2004).

Thus, at the sub-national level we examine if the dividend of integrative PKOs expands antenatal care and education which many argue would lead to long-term, overall improvement in maternal health. One advantage of looking at sub-national variation is that we look at the same mission per country, keeping mission characteristics such as mandates, leadership, and troop composition constant. Thus, we develop the following two hypotheses on the link between PKO deployment and maternal health and education at the sub-national level:

H2: In regions within countries where the UN peacekeepers are deployed, health outcomes for women should improve.

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

EMPIRICAL ANALYSIS

Difference-in-Difference (DID) between Countries: We first use difference-in-differences (DID) to calculate the effect of peacekeeping presence on maternal mortality ratios at the country-year level. DID compares the average change over time in maternal mortality ratios in the treatment group (countries that had a peacekeeping mission) to the average change in maternal mortality ratios in the control group (countries without peacekeeping operations).

DID is not free from biases such as reversion to the mean and other influences of policies.[4] DID is also based on strong assumptions. E.g., the parallel trend assumption posits that the average change in the control group represents the counterfactual change in the treatment group if there were no treatment.[5]

DID Analysis with Two Time-periods: To assess H1, we first look at 45 African countries using maternal mortality ratio (MMR) from the Global Health Observatory (GHO) by the World Health Organization. GHO covers the time-period of 1990-2013. MMR shows the risk of maternal health relative to the frequency of births. It is included as one of the MDG indicators of maternal health. Figure 1 shows the MMR for the 45 countries included in the country-level analysis in 1990 and 2013. The main 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 between 1990 and 2013; and 0 otherwise. In these 45 countries, eight had integrative 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 (Figure 2(a)).[6] During the same period another six

[4] Other criticisms on DID exist (Abadie 2005). However, it has its advantage such as its simplicity and the ability to compare otherwise heterogeneous individuals (Bertrand, Duflo, and Mullainathan 2004).

[5] We test this assumption at the end of next section of a panel DID.

[6] We do not include Sudan (which became Sudan and South Sudan in 2011) in our analysis.

countries had first generation missions: Chad, Rwanda, Namibia, Mozambique, Uganda, Eritrea and Ethiopia (Figure 2(b)).[7]

Insert Figure 1 and 2 here.

Traditional PKOs aim to monitor a cease-fire or peace agreement and make it more difficult for the parties to return to violence (Fortna 2008). By contrast, integrative missions combine security, political reform, and development concerns to support comprehensive treaty agreements (Dorussen and Gizelis 2013; Durch et al., 2003; Goulding 1993; Brahimi 2000). Traditional PKOs are smaller in size (usually 200-300 personnel) with limited deployment capabilities primarily concentrating in the capital or very localized urban areas. Integrative missions have broader mandates and more ambitious goals aiming to protect civilians and support the peacebuilding process (Di Salvatore 2017; Hultman et al 2013 and 2014). The deployment of troops follows the conflict where fighting occurs, usually in the periphery of a country. These missions are significantly larger responding to demands posed by complex emergencies (Eide et al. 2005; Dorussen and Gizelis 2013).[8]

Based on a simple regression analysis of only two cross-sections of data (1990 and 2013), we test the significance of a DID estimator, $D_{i,t}$, which is captured by an interaction

---

[7] Chad is the only country in our sample that had both 1st generation and integrative PKOs. The UN Mission in Central African Republic and Chad was a unique mission aimed to protect civilians without a political mandate capturing elements of both 1st generation and integrative type of mission. In other cases, such as Liberia and Sierra Leone the integrative missions superseded and replaced the 1st generation PKOs.

[8] The "presence" of peacekeepers consists of maintaining a sizeable security presence, training local police units, engaging with security sector reform, and conducting daily patrols and discussions with local community leaders (Karim and Gorman 2016).

term of a dummy variable for the treatment group (*PKO countries*) and a dummy variable for the post-treatment period (*Post-PKO period*, equal to 1 for year 2103; 0 for 1990). The regression set-up allows us to control for other predictors such as GDP per capita (constant 2005 $), population size (logged), trade openness (sum of imports and exports as a percentage of GDP), and the percentage of urban population.[9] Because the status of conflict is often central to women's health, we have added a dummy variable to indicate whether there was at least one *ongoing* armed conflict during the year included in the analysis (i.e., 1990 and 2013) according to the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al 2002; Pettersson and Wallensteen 2014). Finally, we control for regime type by including a polity variable (Marshall, Gurr, and Jaggers 2017).

One complication when defining the PKO treatment is that both 1st generation and the integrative PKO existed between 1990 and 2013. To provide a more comprehensive test, we define three types of treatment group (and control group accordingly):

1) 1st generation and integrative PKO (i.e., all PKO) vs. no PKO;

2) 1st generation PKO vs. no PKO;

3) integrative PKO vs. no PKO.

The regression results are in Table 1: in the model specification 3 and 4, we leave out countries with 1st generation PKOs to compare the difference in differences between countries with integrative PKOs and countries without PKOs; in model specification 5 and 6, we leave out countries with integrative PKOs to compare the difference in differences between 1st generation PKO "treated" countries and countries without PKOs.[10]

---

[9] Iqbal (2006). All four variables are from the World Development Indicators.

[10] We lose observations because of missing values from control variables.

In this DID, the coefficients of the treatment group dummy variables $PKO^{all}_{countries}$/ $PKO^{integrative}_{countries}$/$PKO^{first\ gen}_{countries}$ is the estimated mean difference in MMR between the treatment and control groups *prior* to the treatment intervention. The positive and statistically significant coefficients in model 1-4 suggest that before the PKO was applied, countries in the treatment group were associated with a higher level of MMR when we define treatment group as either "integrative & 1st generation PKO" ($PKO^{all}_{countries}$) or "integrative PKO" alone ($PKO^{integrative}_{countries}$). The lack of statistical significance of this variable in model specification 5-6 suggests that *prior* to the treatment, that is, in 1990, there was no difference in MMR between countries that later received 1st generation PKO ($PKO^{first\ gen}_{countries}$) and countries without PKO.

The coefficients of the post-treatment period variable (*Post-PKO period*) captures the expected mean change in MMR from before to after the onset of the treatment period in the absence of the treatment. In model specification 1, 3, and 5, we do not include the polity variable: the coefficients of the *Post-PKO period* variable are negative and statistically significant, suggesting negative baseline time trends in MMR without PKO treatment. However, once the polity score is included in model specifications 2, 4, and 6, the coefficients are not statistically different from zero. At the same time, polity score has a negative and highly statistically significant association with MMR: between 1990 and 2013, polity scores for many of the 45 countries included in our analysis increased significantly; it seems that negative baseline time trends in MMR are explained largely by improvements in polity scores.

Insert Table 1 here.

What interests us the most is the DID estimator, $D_{i,t}$, which is an interaction term of *PKO countries* and *Post-PKO period*. It tells us whether the expected mean change in MMR from before to after treatment is different between the PKO treated group and the control group. In all but the 5th model specifications, regardless of ways of defining PKO treatment group, we find negative and statistically significant coefficient estimates, suggesting an effective intervention by PKO in reducing maternal mortality rates. Even in the fifth model specification, the p-value for $D_{i,t}$ is almost exactly 0.10: this is the case in which we do not control for the polity score; when we do (model specification 6), $D_{i,t}$ is statistically significant at 0.05 level.

Online appendix B reports robustness checks with more control variables: a dummy variable *Conflict 1991-2012* for whether there was at least one armed conflict during 1991-2012 (years between the pre- and post-treatment year), a dummy variable *Pre-1990 conflict* for whether there was at least one armed conflict before 1990,[11] a *Pre-1990 battle death variable* to account for pre-treatment period severity of conflicts. Including these additional variables does not change the main results (Table B-1 in online appendices).[12] Peacekeeping might co-occur with other international assistance. Using data from AidData (Tierney et al. 2011), we included foreign aid variables in robustness checks. Adding these variables does not change the results, either (Table B-3).[13]

A Panel DID Analysis: We have shown that even for a simple DID with only two cross-sections of fewer than 80 observations (Table 1), there is empirical support for PKO's effect on MMR. Here, we extend the analysis to a DID using all years of 1990-2013 for the same group of countries. We follow the typical way to estimate a panel DID:

[11] 1947 is the earliest year that UCDP/PRIO Dataset has data for Africa.

[12] We have further limited the sample of countries to those that had ever experienced conflicts. The result stays the same (Table B-2).

[13] The only country that has PKO but no conflict according to the UCDP/PRIO data is Namibia. Removing Namibia does not change the results.

$$MMR_{i,t} = \alpha + \beta \times (country\ dummies_i) + \gamma \times (year\ dummies_t) + \delta \times D_{i,t} + \theta \times X_{i,t} + \epsilon_{i,t} \quad (1)$$

$MMR_{i,t}$ is MMR for country i and at year t. $\theta \times X_{i,t}$ estimates the effects of the same set of control variables as in Table 1. Again, the DID estimator, $D_{i,t}$, is a dummy variable which equals 1 for treatment units *i* and in the post-treatment period (0 otherwise). This is the same interaction term between the treatment group dummy variable and the post-treatment period dummy variable in last section's simple DID with only two time-periods. The difference here is that because we have all years of 1990-2013 and countries' initial year of PKO deployment varies by time, for countries in the treatment group, $D_{i,t}$ is a time-variant variable now. The first year of PKO deployment varies by country: e.g., for Liberia, first year of deployment is 1993; for Burundi, 2004.

Another significant difference is that the model in Equation (1) does not include a dummy variable for the post-treatment period, because it is absorbed by the year fixed effects ($\gamma \times (year\ dummies_t)$); it does not include a dummy variable indicating the treatment group, either, because this is absorbed by the country fixed effects ($\beta \times (country\ dummies_i)$). Table 2 presents several model specifications from this panel DID. Following Table 1, in model specification 1 and 2, we define $D_{i,t}$ using both types of PKO – therefore we use $D_{i,t}^{all}$ as the variable name; in the model specification 3 and 4, we leave out countries with 1st generation PKOs to compare the difference in differences between countries with integrative PKOs and countries without PKOs – therefore $D_{i,t}^{integrative}$; in model specification 5 and 6, we leave out countries with integrative PKOs to compare the difference in differences between 1st generation PKO "treated" countries and countries without PKOs ($D_{i,t}^{first\ gen}$). Here, we find that regardless of our definition of the DID estimator ($D_{i,t}$) – by both types or by one type alone – $D_{i,t}$ is always associated with lower level of MMR.

Insert Table 2 here.

One advantage of a panel DID is that it allows a statistical test for the parallel trend assumption (e.g., Autor 2003). More specifically, this is to interact the DID treatment variable with time dummies: here one set of dummy variables indicate whether for a country-year included in the analysis, this year is one year (*t-1*) before the PKO started, two year (*t-2*) before PKO, three year (*t-3*), …, so on and so forth, for years before PKO – their interactions with the DID indicator are often called *leads*; another set of dummy variables indicate for years after PKO, whether this is one year (*t+1*) after a PKO started, two year (*t+2*) after PKO, three year (*t+3*) after, …, – their interactions with the DID indicator are called *lags*.

The idea is that one can include the interactions of the time dummies and the treatment indicator for all the periods except one (due to the dummy variable trap). Now all the other interactions are expressed relative to the omitted period which serves as the baseline. If the outcome trends between treatment and control group before treatment are the same, that is, the parallel trend assumption holds, the coefficients associated with the *leads* should all be statistically insignificant, i.e., the difference in differences is not significantly different between the two groups in the pre-treatment periods. This is indeed what we find in Table B-4 of the online appendices, which lends strong empirical support that the parallel trend assumption holds.[14]

Explaining Within-country Variation with Matching: We often see significant within country variation in public health outcomes. e.g., grid-level (55km by 55km) average percentages of women who received at least one tetanus injection in Liberia 2007 range from 24.3 to 98.15 with a standard deviation of 18.80.[15] Direct measures of maternal mortality rate

---

[14] Because of space limit, we only discuss the test briefly here, our online appendices have more detailed discussion.

[15] Moreover, some of the PKO missions are small, with no plan to cover the entire country.

are not always available from the DHS.[16] When they do, there is often too much noise in this measure. Indeed, an official report from the DHS (Stanton et al. 1997) concludes that "The sampling errors associated with maternal mortality ratios are substantially larger than those associated with other frequently used DHS indicators. This lack of precision precludes the use of these data for trend analysis and has led to the recommendation that this DHS module not be used more than once every ten years in the same country." Therefore, we use indirect measures of women's health from the DHS – two indicators on women's access to antenatal care and two indicators on women's education: if women have better access to antenatal care and education, mortality rates would be lower.

At the sub-national level, we use data on maternal heath indicators from DHS for Liberia, Côte d'Ivoire, and Democratic Republic of Congo. We use PRIO grids as the unit of analysis: these are grid-cells with 0.5 × 0.5 decimal degree cell resolution of the world (Tollefsen et al 2012).[17] We use GPS files from the DHS, which give the longitudes and latitudes of survey clusters, to locate surveys to specific grid-cells;[18] this enables us to calculate, for grid-cells that have DHS clusters, average measures of public health indicators.[19]

---

[16] From the DHS: "The maternal mortality module is not always included in DHS surveys due to the difficulty of collecting the information." (https://dhsprogram.com/Topics/Maternal-Mortality.cfm, accessed February 22, 2018).

[17] This corresponds to a cell of 55 × 55 kilometers at the equator.

[18] The coordinates provided are longitudes and latitudes of the survey location (often a village in rural areas and a neighborhood in urban areas).

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

We use four indicators that are comparable across surveys and countries. The first variable measures (m1_n) tetanus injections before birth;[20] we make this binary, that is, whether 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 before giving birth. The second dependent variable is antenatal care (m14_1n): similarly, we calculate the grid-cell level percentage of women who have had at least one antenatal visit.[21] The other two dependent variables are human capital variables that are linked to maternal health. The first one, based on the v106n variable from the DHS, captures the grid-level average of women's level 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.

We do not choose to use DID at the grid level for these countries because first, Democratic Republic of Congo has no DHS prior to the initiation of the United Nations Missions in the DRC in 1999; it cannot be included in a DID analysis because there is no pre-treatment period. Second, even though Liberia and Côte d'Ivoire have DHS data before and

---

[20] The tetanus vaccination is required to prevent maternal and neonatal tetanus (MNT).

[21] The DHS data we use are recall data: the DHS sampled mothers age 15-49 and with at least a live birth in the *five years* preceding the survey, asking the number of tetanus toxoid injections and the number of antenatal visits during the pregnancy for the last live birth. There is a concern for recall bias: whether the subjects were able to provide accurate information. Past studies have shown that overall biases in recall data are low (Valadez and Weld 1992). In our empirical analysis, we binarized both variables (m1_n and m14_1n) partly to prevent a potential recall bias: one would expect a higher bias in the exact number of visits recalled, but a lower bias if it is about whether there was at least a visit at all.

after the civil wars and the presence of UN missions, using only information from Liberia and Côte d'Ivoire, and selecting grids that have been included in the initial and the more recent DHS surveys, we would only have in total 172 observations.

Finally, in the context of peacekeeping, UN peacekeepers tend to locate 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 such a potential selection bias of PKO locations, we use a matching model to approximate 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. In this way, the link between pre-treatment covariates and treatment assignment (peace keeping) might be broken (approximately) in a way that brings us much closer to the ideal 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. However, it is important to note that matching cannot replace randomized experiments because there may be unobserved variables related to both treatment assignment and the outcome; matching (and other non-experimental study) can only match on the observables, which might result in biased treatment effect estimates (Stuart 2010).

We follow Ho et al. (2004) and use *MatchIt* to find subsamples of the data where the assignment of treatments is not correlated with pre-treatment covariates. Whether there were peacekeeping operations within a grid cell is used to decide whether it has received a treatment (Figure 3 shows PKO distribution within the three countries). We use peacekeeping deployment data from Ruggeri et al (2017). The location of the deployment of peacekeeping forces is based on UN information and deployment maps. We consulted with recent literature that suggests important predictors for within-country peacekeeping locations. These pre-treatment covariates or conditions include distance to capital city, travel time to the nearest urban area, proportion of mountain area, GDP per capita, population, and (whether a grid cell is in a) conflict zone, level of urbanization, all measured at the grid-cell level.[22]

Unlike DID, we do not need pre-treatment periods from the DHS: we are comparing the post-treatment outcome of the treated group with the outcome of the control group at the same time period after the treatment (Stuart 2010; Ho et al. 2004). Because of the matching model set up, we only use DHS surveys after PKOs so that the public health and human capital measures can be considered as post-treatment outcomes. The post-treatment country-years are 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, only 656 grid cells from these 5 country-years are covered by DHS (about 38% of the grid-cell-years).[23] Among these 656 grids, 152 had within-grid PKOs: these are the 152 treatment units.[24] We use nearest neighbourhood matching to identify 152 control units. We run OLS regressions on the matched data.

[22] Other than urbanization, all variables are from the PRIO grids.

[23] In DHS, households were sampled using stratified two-stage cluster sampling to make sure a nationally representative sample. The strata used in the first stage for the sample often are provinces and urban-rural difference.

[24] What if PKO forces move from one location to another during their deployment? Beardsley and Gleditsch (2014) show that once a mission has fully deployed, it tends to spatially contain the area of conflict. In all three countries, the patterns of deployment remain relatively stable regarding locations.

Model specification 1-4 from Table 3 report the empirical findings regarding maternal health access. For each maternal health variable (m1 and m14), we present two model specifications, one with and one without an urbanization variable. Urban areas are often associated with better health outcomes and peacekeepers are more likely to station in urban area. We calculate the percentage of urban area within a grid-cell using the Urban Extents Grid data from the Global Rural-Urban Mapping Project (GRUMP). (This variable is time-invariant, 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. Moreover, this variable is highly correlated with the population variable (at 0.74). These are the reasons why we choose to present model specifications with and without this urbanization variable.

Insert Table 3 here.

We find strong effects of PKO on both maternal health indicators in model specifications 1-4 in Table 3. For the first model specification, everything else equal, the percentage of women who had at least one tetanus injection is about 6.421% 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 8.419%.

We further test whether PKO also affects women’s education. Model specifications 5-6 of Table 3 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 0.179 to 0.225, depending whether we add in the urbanization variable. It is hard to get a concrete sense of the substantive effect since these are levels of education (no education: 0; primary: 1; secondary: 2; higher: 3). The last two model specifications in Table 3 provide a much more intuitive sense of the substantive effect. After matching, a grid with a PKO is associated with an increase in women’s education of almost one year.

Insert Figure 3 here.

Up to this point, we have defined treatment units as those grid cells that include at least one peacekeeping station. However, 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 in which 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.

We repeat our analysis based on newly matched sample in Table 4. In the first model specifications, 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 (model specifications 3 and 4); 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 model specifications 5-8, 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 4 here.

We have conducted further robustness checks. The first motivation has to do with grids on national borders. Up to this point, we have included a grid cell into our sample if a part of the grid is in one of the three countries. This is different from the original PRIO-GRID rule that 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 second motivation 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. 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. Because of space limit, we choose to only present the 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 treatment effect becomes more significant even though we have lower number of observations. For example, the treatment effect on tetanus injections (m1_n) from Table 4 is less than borderline significant; now, its 95% confidence interval does not include zero (see higher left plot of Figure 4).

Insert Figure 4 here.

Finally, in online Appendix C, we report regression results based on matched samples after including grid-cell level foreign aid as a pre-treatment covariate and a control variable. This partly addresses the concern that PKOs co-occur with other international assistance efforts. After controlling for grid-cell level pre-peace keeping cumulative aid, we still find that PKOs increase maternal health services and women's education.

CONCLUSION

We suggest that peacekeeping has an effect, beyond containing conflict, on maternal health and women's education in areas with deployment. Peacekeepers might contribute to a surge in resources that improve the provision of medical services. Furthermore, the presence of peacekeepers can increase the overall levels of security within a country indirectly leading to an improvement of maternal health access and women's education. We conduct analysis at both country and within country levels, with the latter using geo-referenced UN deployment data and the DHS data in three sub-Saharan countries. We find strong empirical support for a positive effect of peacekeeping presence on maternal health in national-level maternal mortality rates and subnational maternal health service indicators (such as antenatal care and vaccination), as well as levels and years of women's education.

However, our empirical results need to be interpreted with caution because of built-in limitations of the DID and matching methods. For instance, DID is based on assumptions, such as parallel trend, postulating that the average change in the control group represents the counterfactual change in the treatment group if there were no treatment. For the matching method, one major limitation is that we can only match on observables. Our hope is that by using different empirical methods (DID and matching) and by conducting analysis at both national and subnational levels, we can increase our confidence that peacekeeping improves women's access to health services and improve education outcomes.

Our study is one of the first to explore the impact of peacekeeping missions on women's well-being in the aftermath of conflicts. Thus, it moves beyond concepts of "negative" peace and absence of violent conflict to "quality" of peace (Wallensteen 2015). Despite challenges, PKOs might lead to tangible improvements in the quality of life for women at least in health and education. Both health and education are linked to long-term sustainable developmental goals and women's empowerment. Our study also suggests that provision of security can lead to significant dividends by creating the necessary space for improving health and education in post-conflict countries.

Our findings do not imply that the emerging structures are 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 when peacekeeping forces start the drawdown process or pull out altogether. The devastation of the recent Ebola epidemic in Liberia and Sierra Leone highlighted the perils of weak and over-dependent health care systems for the population and especially pregnant women. Still, given the low amount of resources invested to peacekeeping, our analysis suggests remarkable payoffs.

REFERENCES

Abadie, Alberto. (2005). Semiparametric Difference-in-Differences Estimators. *The Review of Economic Studies* 72(1): 1–19.

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

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

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

Barnett, Michael, Songying Fang, and Christoph Zürcher. (2014). Compromised peacebuilding. *International Studies Quarterly* 58(3): 608-620.

Beber, Bernd, Michael Gilligan, Jenny Guardado, and Sabrina Karim. (2017) Peacekeeping, compliance with international norms, and transactional sex in Monrovia, Liberia. *International Organization* 71(1): 1-30.

Bertrand, Marianne, Duflo, Esther, and Mullainathan, Sendhil. (2004). How much should we trust Differences-In-Differences estimates? *The Quarterly Journal of Economics* 119(1): 249-275.

Brahimi, Lakhdar. (2000). Report of the Panel on United Nations Peace Operations. http://www.un.org/en/events/pastevents/brahimi_report.shtml, accessed 20-01-2019.

Chamarbagwala, Rubiana and Hilcías Morán. (2011). Human capital consequences of civil war: Evidence from Guatemala. *Journal of Development Economics* 94(1): 41-61.

Di Salvatore, Jessica. (2017). "Peacekeepers against ethnic and criminal violence: Unintended consequences of UN peacekeeping." Typescript University of Amsterdam.

Demeritt, Jacqueline, Angela D. Nichols, and Eliza G. Kelly. (2014). Female participation and civil war relapse. *Civil Wars* 16(3): 346-368.

Dorussen, Han, and Theodora-Ismene Gizelis. (2013). Into the lion's den: Local responses to UN peacekeeping. *Journal of Peace Research* 50(6): 691-706.

Dorussen, Han, and Andrea Ruggeri. (2017). Peacekeeping Event Data: Determining the Place and Space of Peacekeeping. *International Peacekeeping* 24: 32-38.

Doyle, Michael, and Nicholas Sambanis. (2000). International Peace-building: A Theoretical and Quantitative Analysis. American Political Science Review 94(4): 779–801.

Durch, William, Victoria Holt, Caroline Earle & Moira Shanahan. (2003). *The Brahimi Report and the Future of UN Peace Operations.* Washington D.C.: The Henry J. Stimson Center.

Eide, Espen, Anja Kaspersen, Randolph Kent, and Karen von Hippel. 2005. Report on Integrated Missions: Practical Perspectives and Recommendations. Independent Study for the Expanded UN ECHA Core Group.

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

Fortna, V. Page and Lisa Martin. (2009). Peacekeepers as signals: The demand for international peacekeeping in civil wars. In Helen Milner and Andrew Moravcsik (eds) *Power, interdependence, and nonstate actors in world politics*. Princeton University Press: Princeton: 87-107.

Galtung, Johan. (1964). An Editorial: What is Peace Research. *Journal of Peace Research* 1(1):1-4.

Garriga, Ana Carolina, and Brian J. Phillips. (2014). Foreign aid as a signal to investors: Predicting FDI in post-conflict countries. *Journal of Conflict Resolution* 58(2): 280-306.

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

Gleditsch, Nils Petter; Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg & 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, Adam, Huth, Paul, and Bruce Russett. (2003). Civil wars kill and maim people long after the shooting stops. American Political Science Review 97(02): 189-202.

Guha-Sapir, Debarati and Olivia D'Aoust. (2011). Demographic and Health Consequences of Civil Conflict. Washington, DC: World Bank.

Ho, Daniel, Kosuke Imai, Gary King, and Elizabeth Stuart. (2004) Matching as nonparametric pre-processing for reducing model dependence in parametric causal inference. Working paper.

Hoeffler, Anke. (2014). Can international interventions secure the peace?. *International Area Studies Review* 17(1): 75-94.

Howard, Lise. (2008). UN peacekeeping in civil wars. Cambridge University Press.

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. (2014). United Nations peacekeeping and civilian protection in civil war. *American Journal of Political Science* 57(4): 875 – 891.

Hultman, Lisa, Jacob Kathman, and Megan Shannon. 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.

Karim, Sabrina, and Ryan Gorman. (2016). Building a more competent security sector: The case of UNMIL and the Liberian National Police. *International Peacekeeping* 23(1):158-191.

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

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

Li, Quan, and Ming Wen. (2005). The immediate and lingering effects of armed conflict on adult mortality. *Journal of Peace Research* 42(4):47l-92.

Liebling-Kalifani, Helen J., Ojiambo-Ochieng, R., Marshall, A., Were-Oguttu, J., Musisi, S., and Kinyanda, E. (2008) Violence against women in Northern Uganda. *Journal of International Women's Studies* 9(3): 174-192.

Liebling-Kalifani, Helen, and Baker, B. (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, 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.

Marshall, Monty G., Ted R. Gurr, and Keith Jaggers. (2017). Polity IV project: dataset user's manual. Severn: Center for Systemic Peace, 2017.

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

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

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, and Theodora-Ismene Gizelis, eds. (2015). *Gender, Peace and Security: Implementing UN Security Council Resolution 1325*. New York: Routledge.

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

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

Ruggeri, Andrea, Han Dorussen & Theodora-Ismene Gizelis. (2017) On the frontline every day? Subnational deployment of United Nations peacekeepers. *British Journal of Political Science* 48(4):1005-1025.

Ruggeri, Andrea, Han Dorussen & Theodora-Ismene Gizelis. (2017). Winning the peace locally: UN peacekeeping and local conflict. *International Organization* 71(1):163-185.

Ruggeri, Andrea, Theodora-Ismene Gizelis, and Han Dorussen. (2013). Managing mistrust: An analysis of cooperation with UN peacekeeping in Africa. *Journal of Conflict Resolution* 57(3): 387-409.

Shair-Rosenfield, Sarah, and Reed M. Wood. (2017). Governing well after war: How improving female representation prolongs post-conflict peace. *The Journal of Politics* 79(3): 995-1009.

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.

Stanton C, Abderrahim N, and Hill K. 1997. DHS Maternal Mortality Indicators: An Assessment of Data Quality and Implications for Data Use. Calverton, MD: Demographic and Health Surveys, Macro International, Inc.

Stuart, Elizabeth A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical science: a review journal of the Institute of Mathematical Statistics* 25(1): 1–21.

Tierney, Michael, Daniel Nielson, Darren Hawkins, Timmons Roberts, Michael Findley, Ryan Powers, Bradley Parks, Sven Wilson, and Robert Hicks. (2011). More dollars than sense:

Refining our knowledge of development finance using AidData. World Development 39 (11): 1891-1906.

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

UN DPKO (2007). DPKO Policy Directive: Quick Impact Projects (QIPs). https://www.regjeringen.no/globalassets/upload/ud/vedlegg/fn/multidimensional-and-integrated/quick-impact-guidelines.pdf. Accessed 03/03/2018.

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

UNMIL. (2012). Liberia eliminates maternal and neonatal tetanus: https://unmil.unmissions.org/liberia-eliminates-maternal-and-neonatal-tetanus.

UN Security Council (2001). No exit without strategy: Security Council decision-making and the closure or transition of United Nations peacekeeping operations: Report of the Secretary-General, S /2001/394. http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/PKO%20S%202001%20394.pdf. Accessed on 03/03/2018.

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

Valadez JJ and Weld LH. (1992). Maternal recall error of child vaccination status in a developing nation. American Journal of Public Health 82(1):120-122.

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

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

Table 1: DID with two time periods, 1990 and 2013.

	Maternal Mortality Rates (MMR)					
	(1)	(2)	(3)	(4)	(5)	(6)
$PKO_{countries}^{all}$	446.763***	430.072***				
	(111.683)	(104.993)				
$PKO_{countries}^{integrative}$			587.961***	540.986***		
			(122.119)	(118.288)		
$PKO_{countries}^{first\ gen}$					15.289	71.506
					(149.795)	(139.886)
Post-PKO period	−248.403***	−76.163	−239.021***	−106.525	−244.443***	−115.685
	(90.529)	(99.793)	(82.190)	(93.627)	(77.518)	(83.269)
$D_{i,t}^{all}$: $PKO_{countries}^{all}\times$ *Post-PKO period*	−347.209**	−349.798**				
	(154.954)	(145.750)				
$D_{i,t}^{integrative}$: $PKO_{countries}^{integrative}\times$ *Post-PKO period*			−344.547*	−309.898*		
			(180.534)	(174.134)		
$D_{i,t}^{first\ gen}$: $PKO_{countries}^{first\ gen}\times$ *Post-PKO period*					−313.607	−353.111**
					(188.163)	(174.708)
GDP per capita	−0.058***	−0.058***	−0.043**	−0.043**	−0.039**	−0.038**
	(0.020)	(0.020)	(0.019)	(0.019)	(0.018)	(0.017)
Population	−7.208	−19.537	−7.283	−12.472	4.741	3.645
	(29.358)	(30.074)	(27.069)	(28.415)	(26.585)	(27.163)
Trade openness	0.610	0.803	1.006	1.141	0.857	1.256
	(1.209)	(1.178)	(1.115)	(1.108)	(1.076)	(1.046)
Ongoing conflict	85.962	78.583	197.510*	192.192*	217.230**	191.490**
	(98.673)	(92.639)	(106.893)	(102.488)	(102.363)	(95.133)
Urbanization	−3.580	−2.225	−6.020**	−4.979*	−6.300**	−4.599*
	(2.658)	(2.555)	(2.545)	(2.510)	(2.527)	(2.428)
Polity		−23.164***		−18.346***		−20.079***
		(7.006)		(6.830)		(5.984)
Constant	951.831*	986.338*	974.000**	934.423*	802.859*	654.329
	(512.176)	(519.257)	(471.981)	(490.788)	(472.648)	(478.900)
Observations	78	77	68	67	65	64
Adjusted R^2	0.499	0.558	0.554	0.591	0.503	0.573

Note: The treatment is whether there was any peacekeeping operation (both first generation and integrative) between 1990 and 2013 for model 1 and 2; in model 3 and 4, the treatment is integrative type of PKO and the control group are countries without PKO; in model 5 and 6, the treatment is first generation PKO and the control group are countries without PKO. *p<0.1; **p<0.05; ***p<0.01.

Table 2: DID models with a panel data, 1990-2013.

	Maternal Mortality Rates (MMR)					
	(1)	(2)	(3)	(4)	(5)	(6)
$D_{i,t}^{all}$	−136.149***	−127.973***				
	(16.403)	(16.301)				
$D_{i,t}^{integrative}$			−149.948***	−139.763***		
			(21.102)	(21.452)		
$D_{i,t}^{first\ gen}$					−180.213***	−169.008***
					(21.431)	(21.274)
GDP per capita	−0.038***	−0.039***	−0.039***	−0.040***	−0.043***	−0.043***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Population	−1,012.721***	−1,031.750***	−1,021.835***	−1,035.110***	−987.599***	−1,010.017***
	(64.673)	(64.152)	(68.765)	(68.905)	(58.888)	(58.071)
Trade openness	−0.232	−0.206	−0.209	−0.185	−0.461***	−0.445***
	(0.156)	(0.154)	(0.163)	(0.164)	(0.139)	(0.137)
Urbanization	−0.590	−1.009	−0.522	−1.004	−1.985	−2.447*
	(1.602)	(1.590)	(1.649)	(1.657)	(1.449)	(1.432)
Ongoing conflict	13.037	12.362	49.323***	39.145**	−16.093	−8.499
	(17.834)	(17.945)	(18.969)	(19.349)	(17.698)	(17.750)
Polity		−3.810***		−3.328***		−2.484**
		(1.131)		(1.199)		(1.008)
Constant	17,639.680***	17,964.600***	17,764.560***	18,006.150***	17,341.370***	17,727.100***
	(1,112.527)	(1,103.384)	(1,174.798)	(1,177.340)	(1,013.619)	(999.582)
Fixed-country effects	yes	yes	yes	yes	yes	yes
Fixed-year effects	yes	yes	yes	yes	yes	yes
Observations	1,021	1,006	883	869	848	833
Adjusted R^2	0.941	0.942	0.943	0.943	0.921	0.922

Note: The treatment is whether there was all peacekeeping operation (both first generation and integrative types) for model 1 and 2; in model 3 and 4, the treatment is integrative type of PKO and the control group are countries without PKO; in model 5 and 6, the treatment is first generation PKO and the control group are countries without PKO. *p<0.1; **p<0.05; ***p<0.01.

Table 3: OLS estimates on the matched sample for maternal health access and women education variables.

	m1: tetanus injection		m14: antenatal care		v106n: education levels		v107n: years of education	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	87.539***	87.296***	94.223***	92.882***	1.386***	1.238***	5.923***	5.378***
	(4.008)	(3.792)	(3.182)	(3.091)	(0.0851)	(0.087)	(0.443)	(0.443)
PKO	6.421**	3.762*	8.419***	6.293***	0.225***	0.179***	0.958***	0.830***
	(2.326)	(2.096)	(1.847)	(1.709)	(0.0494)	(0.048)	(0.252)	(0.245)
Distance to capital	-0.009***	-0.008***	-0.006***	-0.006***	-0.0002***	-0.000***	-0.001***	-0.001***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.0000)	(0.000)	(0.000)	(0.000)
Urbanization		0.284		0.238		0.037***		0.193***
		(0.351)		(0.286)		(0.008)		(0.041)
Time to urban	-0.018**	-0.019**	-0.008	-0.005	-0.0003*	-0.000	-0.001	-0.000
	(0.008)	(0.008)	(0.006)	(0.006)	(0.0002	(0.000)	(0.001)	(0.001)
Mountain area	-2.886	-3.610	1.359	3.211	-0.352***	-0.319***	-1.832***	-1.635***
	(4.037)	(3.645)	(3.204)	(2.971)	(0.0856	(0.084)	(0.439)	(0.426)
Conflict zone	-9.097***	-5.793**	-4.955**	-3.009	-0.0768	-0.018	-0.286	-0.080
	(2.597)	(2.353)	(2.061)	(1.918)	(0.0551	(0.054)	(0.280)	(0.274)
Population	0.000	-0.000	-0.000	-0.000	0.0000	-0.000**	0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000	(0.0000)	(0.000)	(0.000)	(0.000)
GDP per capita	0.000	0.002	0.002	0.003	0.0000	0.000*	0.000	0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.0001)	(0.000)	(0.000)	(0.000)
Fixed-country effects	yes	yes	yes	yes	yes	yes	yes	yes
Fixed-year effects	yes	yes	yes	yes	yes	yes	yes	yes
N. of observations	304	304	304	304	304	304	304	304
Adjusted R^2	0.18	0.18	0.13	0.11	0.47	0.49	0.40	0.44

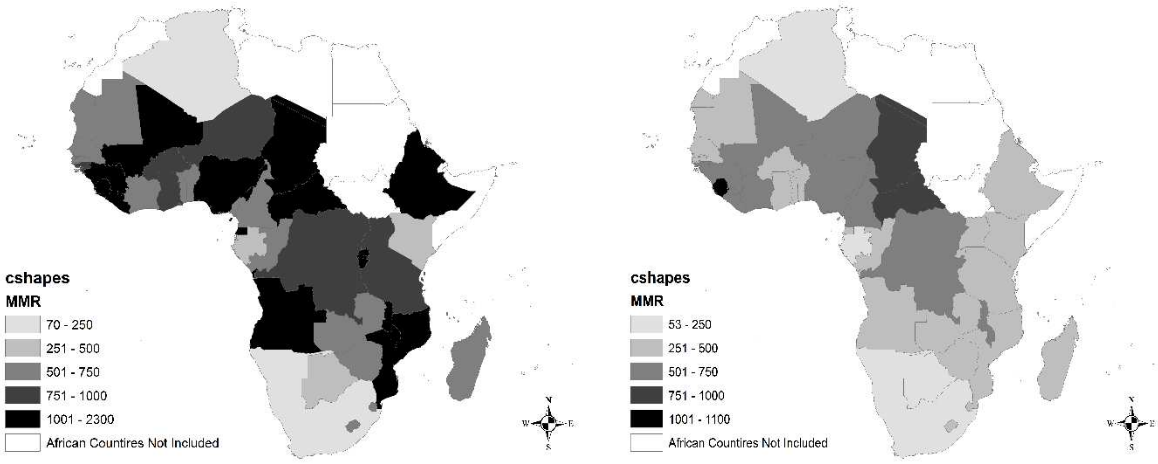
Note: regression analysis based on mateched grid-cell level observations from Democratic Republic of Congo of 2007 and 2013, Liberia 2007 and 2013, and Cote d'Ivoire 2011. Whether there were peacekeeping operations within a grid cell is used to decide whether it has received a PKO "treatment". *p<0.1; **p<0.05; ***p<0.01.

Table 4: OLS estimates on the matched sample for maternal health access and women education variables, using 25km buffer zone.

	m1: tetanus injection		m14: antenatal care		v106n: education levels		v107n: years of education	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	88.422***	86.736***	93.453***	92.645***	1.269***	1.179***	5.595***	5.125***
	(3.266)	(3.320)	(2.635)	(2.687)	(0.069)	(0.068)	(0.353)	(0.347)
PKO_{25KM}	2.764[a]	2.887[b]	4.623***	4.736***	0.159***	0.164***	0.854***	0.883***
	(1.879)	(1.865)	(1.516)	(1.510)	(0.040)	(0.038)	(0.203)	(0.195)
Distance to capital	-0.010***	-0.009***	-0.005***	-0.006***	-0.000***	-0.000***	-0.001***	-0.001***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Urbanization		0.568		0.461		0.045***		0.238***
		(0.370)		(0.300)		(0.008)		(0.039)
Time to urban	-0.026***	-0.024***	-0.011**	-0.009**	-0.000*	-0.000	-0.001**	-0.001
	(0.005)	(0.005)	(0.004)	(0.004)	(0.000)	(0.000)	(0.001)	(0.001)
Mountain area	-3.284	-3.200	2.083	2.272	-0.293***	-0.281***	-1.370***	-1.293***
	(3.466)	(3.446)	(2.797)	(2.790)	(0.074)	(0.071)	(0.375)	(0.361)
Conflict zone	-4.282**	-3.871*	-1.962	-1.571	-0.008	0.029	-0.014	0.177
	(2.011)	(2.019)	(1.622)	(1.635)	(0.043)	(0.042)	(0.218)	(0.211)
Population	-0.000	-0.000	0.000	-0.000	0.000*	-0.000**	0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP per capita	0.003	0.003	0.002	0.002	0.000*	0.000**	0.000	0.000*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Fixed-country effects	yes	yes	yes	yes	yes	yes	yes	yes
Fixed-year effects	yes	yes	yes	yes	yes	yes	yes	yes
N. of observations	518	518	518	518	518	518	518	518
Adjusted R^2	0.15	0.15	0.08	0.09	0.43	0.47	0.37	0.42

Note: regression analysis based on mateched grid-cell level observations from Democratic Republic of Congo of 2007 and 2013, Liberia 2007 and 2013, and Cote d'Ivoire 2011. Whether a grid cell grid cells is within a 25 kilometers radius of a PKO location is used to decide whether it has received a PKO_{25KM} "treatment". a: p-value is 0.14; b: p-value is 0.12. *p<0.1; **p<0.05; ***p<0.01.

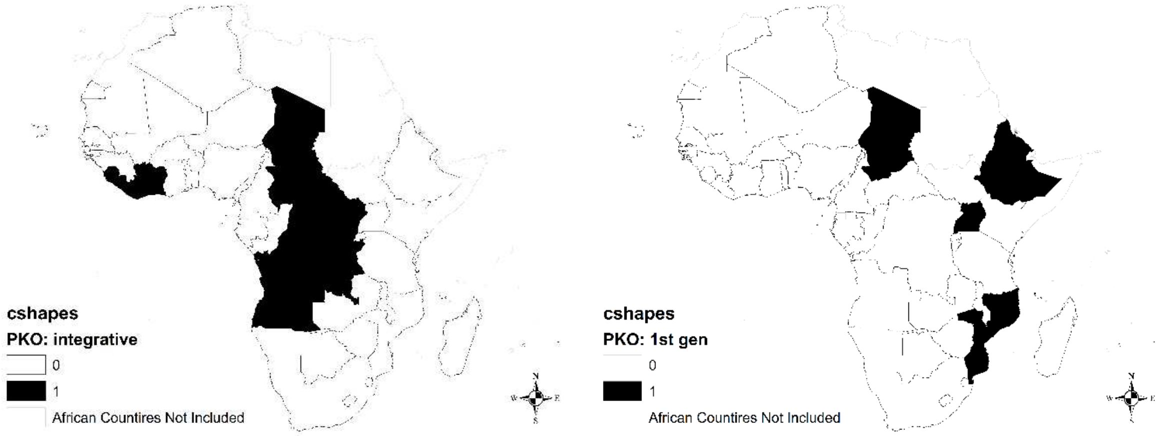
Figure 1: Maternal Mortality Rates (MMR) in 45 African Countries in the DID.



(a): 1990 (b): 2013

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.

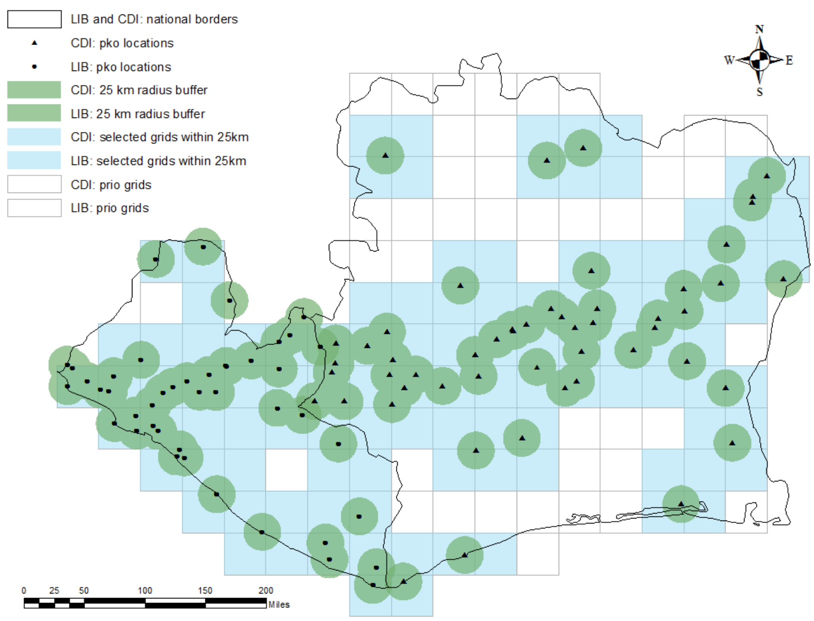
Figure 2: Integrative and 1st Generation PKOs.



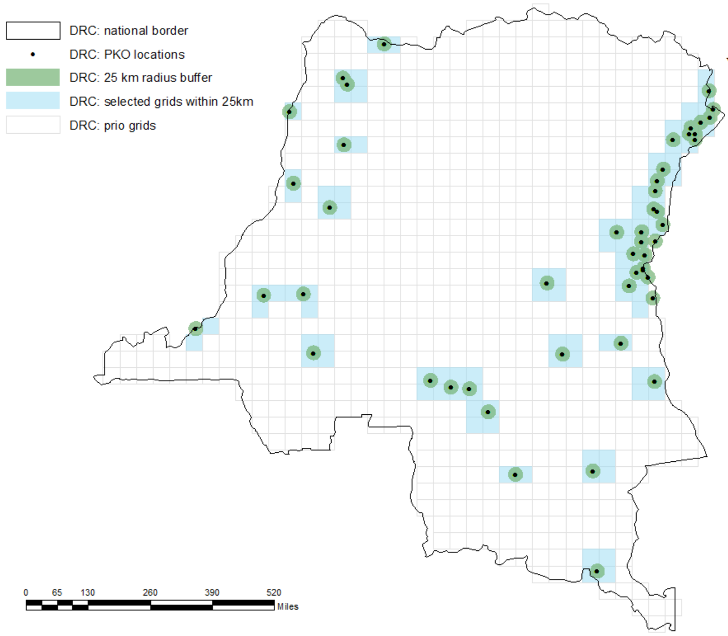
a): integrative PKOs b): 1st generation PKOs

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 (left) and Cote d'Ivoire.



(b): Democratic Republic of Congo.

Figure 3(a) and (b) use different scale because of different country size. The PRIO grids in both figures (in grey) are 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 Buffer Zone Size.