Association between conflict and usage of maternal health services in Egypt: an uncontrolled before and after study

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Declaration

I, Saji Saraswathy Gopalan, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Integrating Statement

Joining the DrPH programme at LSHTM has given me a strong platform for immense learning and practical applications. The structure and contents of the DrPH course work were suitable to acquire knowledge with a scope of application during the Organisational and Policy Analysis (OPA) and research.

Specifically, I have learnt new public health theories and their applications from the compulsory module - Evidence Based Public Health Policy (EBPHP). This module informed me with the history and evolution of public health policy making in different countries. The challenges and lessons learnt by different countries during policy making provided me with wider practical awareness. Another domain where I got exposure from EBPHP was 'policy analysis'- particularly its types, frameworks and tools. In fact, my OPA was based on the existing frameworks of policy analysis that I learnt during the course work. During the OPA, I reviewed a few of the existing policy analysis tools and compared their strengths and weaknesses.

The second compulsory module - Leadership, Management and Professional Development (LMPD) enabled me to learn new theories, concepts and tools on managerial competencies, organisational management, negotiations and team building. A retreat conducted as part of this module gave me a ground to employ managerial competencies and tips in a real life professional scenario. Several existing management tools and frameworks including the 'McKinsey 7-s framework' were critiqued and compared for their practical applicability.

The OPA findings were shared with different audience for policy implications. For instance, the quintessence of the OPA work was shared with the parent organisation where I performed the OPA. The findings provided an insight to improve its teamwork, funding mechanisms and staff supervision. Further, as my topic was related to non-communicable disease (NCD) policy making in low- and-middle-income countries, the findings also informed 'agenda setting and political prioritisation for NCDs' in such settings for a wider policy implication. Several theories, concepts and tools of 'public health evaluation', especially for projects and programmes were discussed in-depth during the course work. This helped with how to design

and implement evaluation for different types of health programmes in multi-cultural settings, using randomised-controlled trials and quasi-experimental designs.

The optional module on 'advanced statistics' was quite helpful, especially in providing tips to effectively deal with both perfect and imperfect data. This module was also a bonus while analysing data for the DrPH thesis. My research topic focused on multi-level modelling regression analysis to find the association between the Egyptian conflict 2011-2012 and maternal care use.

To conclude, the entire process and experience during the DrPH was quite helpful for learning and moulding my career path.

Abstract

Background: United Nations' data indicate that conflict-affected low- and middle-income countries contribute considerably to global maternal deaths. Usage patterns during conflict have not been examined in-depth and a cause-effect analysis is relevant for policy insights. This study assessed the association between the acute Egyptian conflict of 2011-2012 and maternal services usage and quality.

Methods: An uncontrolled before-and-after study used data from the 2014 Egypt Demographic and Health Survey. The hierarchical nature of data was addressed using multi-level modelling. The pre-conflict sample included 2,569 births occurring from January 2009 to January 2011 and the peri-conflict had 4,641 births from February 2011 to December 2012.

Results: After adjusting for potential socioeconomic confounders, conflict was not associated with antenatal service usage. Compared to pre-conflict births, peri-conflict births had lower odds of at least 24 hours post-delivery stay (8%; OR 0.92), delivery in public institutions (1%; OR 0.99), and institutional postnatal care (PNC) (1%; OR 0.99); and relatively higher odds of doctor-assisted deliveries (2%; OR 1.02), institutional deliveries (2%; OR 1.02), private institutional deliveries (3%; OR 1.03), and doctor-assisted PNC (2%; OR 1.02). During conflict, odds of doctor-assisted delivery increased more for oldest (>35 years) women (3%; OR 1.03); odds of receiving PNC decreased more for women aged 25-29 (8%; OR 0.92); and odds of skilled birth attendance increased more for rural women (2%; OR 1.02), primary-educated (4%; OR 1.04), employed (4%; OR 1.04), less poor (3%; OR 1.03) and middle household wealth quintiles (2%; OR 1.02). Odds of physician-assisted delivery increased more for rural women (3%; OR 1.03), primary-educated (5%; OR 1.05), employed (4%; OR 1.04), less poor and middle household wealth quintiles (3%; OR 1.03 each), and richest household wealth quintiles (2%; OR 1.02).

Conclusions: Conflict-associated changes in maternal care were minimal, generally reflecting pre-conflict usage patterns. Association between acute conflict and maternal care indicated vertical equity had changed from recent trends. Policy intervention may help improving post-delivery stay. Maternal policy requires 'specific in-built equity strategies' to address unpredictable effect of conflict.

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Abbreviations

ANC: Antenatal care

CPIA: Country performance indicator assessment

EBPHP: Evidence Based Public Health Policy

EDHS: Egypt Demographic and Health Survey

EmONC: Emergency obstetric and newborn care

FCS: Fragile and conflict-affected situations

FGD: Focus group discussion

IDI: In-depth interview

IPV: Intimate partner violence

IRB: Institutional Review Board

KM: Kilo meter

LMIC: Low and middle-income country

LMPD: Leadership, Management and Professional Development

PNC: Postnatal care

MCH: Maternal and child health

MICS: Multiple indicator cluster survey

MNH: Maternal and neonatal health

MoHP: Ministry of Health and Population

NCD: Non-communicable diseases

SBA: Skilled birth attendance

SDG: Sustainable development goals

TBA: Traditional birth attendant

UN: United Nations

USAID: United States Agency for International Development

WB: The World Bank

WHO: The World Health Organization

UNFPA: The United Nations Population Fund

UNICEF: The United Nations Children's Fund

Chapter 1. Introduction

Background

The last decade has witnessed several conflicts causing fatalities, injuries and displacement of populations, and destruction of governance and economic systems within countries. Currently, around 800 million people live in conflict-affected situations globally.[1] In 2014, there were 40 active armed-conflicts in 46 countries leading to 167,000 fatalities and displacement of 12,100,000 people across the world.[1,2] Of these deaths, half occurred in the Middle East and North Africa region.[2] At present, major conflict-affected countries include Egypt, Syria, Libya, Iraq and Yemen in the Middle East; parts of Nigeria, Somalia, South Sudan and Sudan-Darfur in Africa; Ukraine in Europe; Mexico and several Central American countries in Latin America; and Afghanistan, Pakistan, Myanmar, Philippines and South Thailand in Asia.[2]

As a region, the Middle-East has experienced persistent conflicts[2–4], many of which have increased over time.[2–4] This is partially due to external interference and historical inequities; support of regional militants and anti-government rebel groups; historical inter-country disputes over territories; and the failure of international peace-making processes.[2–4] In recent times, conflicts in one Middle-Eastern country have inspired similar upheavals in other countries in the region.[4]

Conflict-affected countries: a conceptual understanding

An examination of conflicts indicate that a country can be 'conflict-affected' when its routine socio-political, economic and/or civil life are disrupted due to armed conflicts or insurgency.[5] Usually, in an armed-conflict, the use of arms and ammunitions and violence persists for extended periods.[6] Non-armed conflicts are typically revolutionary in nature, through protests and strikes that demand social change, and can turn into armed conflicts.[5,6] Often, prolonged fragility characterised by weak governance, poor availability of social services and low standard of living can also contribute to conflict.[7,8] Typically, if the conflict is non-armed in nature, such a situation is called insurgency, civil unrest or revolution.[1] In an acute stage, usually conflict is severe, while it is also unpredictable, severity, geographical spread and duration.[9]The acute stage is generally severe as failure of governance and social security system, destruction of infrastructure are more common with an uncertainty in their immediate

recovery.[10] Security of people is also endangered with physical attacks on life and assets with possible fatalities.[11]

Despite conflict being a concern throughout history, lower-income countries have experienced more conflicts than their richer counterparts.[5,6] Conflicts are considered to be propelled by a range of factors, including ethnic grievances and identity politics, power assertion, corruption, politics, socio-cultural and religious issues, and poverty.[5,6] There are instances of unequal distribution of scarce resources causing conflicts among different ethnicities, impoverishment due to neglected governance uniting civilians to protest against governments, and socio-cultural, religious and political affiliations creating group-based conflicts.[5] Conflicts can destroy the formal economy, create a parallel war economy and distort formal markets.[12] Conflicts can cause considerable mortality, mental distress, displacement, impoverishment, failure of basic services, physical insecurity and reduced levels of law and order.[3,13] Thus, it can be said that conflict has the potential to make a country fragile and can adversely affect a country's political, socioeconomic and human development.[14]

Conflict and population health

Conflict is known to be associated with persistent poverty and poor human development, including weak health indicators (Figure 1).[15–19] The existing literature broadly classifies the impact of conflict on poverty and social welfare as 1) loss of entitlements, e.g. public goods, social networks and livelihood opportunities, 2) destruction of law and order, 3) increase in social inequality, and 4) poor economic and human development indicators.[20] Some evidence suggests a causal relationship between conflict, with its various adverse outcomes, and impoverishment.[11,17] For instance, mass conflicts can disrupt governance and law-making. Failure of governance can adversely affect provision of public goods such as livelihoods, health, water and sanitation.[15] Further, the law and order system can be weakened during conflicts of any nature.[20] Eventually, disrupted governance, law and order, and public service systems can result in deprivation of the basic entitlements of life, unequal distribution of social welfare, and social inequalities. The final outcomes are poor economic and human development and continuing poverty. As mentioned earlier, poverty and impoverishment are known triggers of conflict, yet conflict can further reinforce inequality and impoverishment in society.[21]

Figure 1. Conflict, poverty and human development
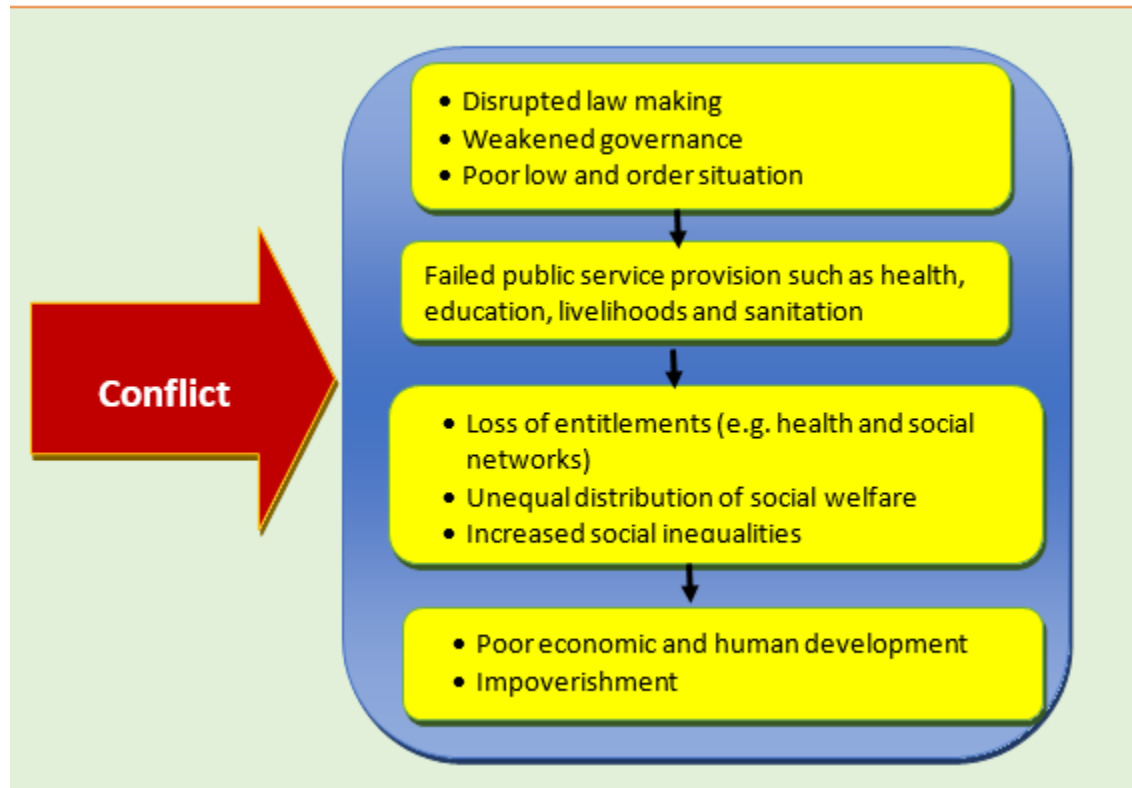
Source: Gopalan 2017 (Candidate's illustration based on literature review)

As regards to population health, existing evidence indicates that conflict can be harmful to health gains through multiple means (Figure 2).[1,20,21] For instance, conflict can harm people's health status directly and indirectly. Direct ways include mental trauma and injuries with less possibility of receiving proper care during and after conflicts.[22–24] Indirect ways include spread of infectious diseases and restricting timely and appropriate healthcare by retarding healthcare service systems and access to care.[10,20,25] Conflict can restrict appropriate healthcare provision, destroy healthcare infrastructure and afflict healthcare personnel.[26,27] During conflicts, the functioning of social networks, especially health communication channels and transportation arrangements can be impeded.[28] Both physical and financial access to care can be limited during and after conflicts.[29,30] All these can adversely affect appropriate healthcare utilisation and thus health improvements. For instance, during 2001-2003, conflict-affected settings in Sri Lanka reported a reduction in the number of physicians from 22 to 15 per 100,000 population.[9] During conflicts in Nepal, women received between 0.3 and 1.5 fewer antenatal care check-ups.[8] There are challenges to healthcare in the post-conflict phase also - restricted government funding, disintegrated healthcare system, and obstacles to human resources training and management.[14,23] A study from the International Red Cross compiled evidence from 16

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conflict-affected countries and found that conflicts threaten the lives of providers including frontline workers and impede essential healthcare service provision.[1] However, a few studies reported an enhancement in healthcare access during and after conflicts if emergency camps exist.[16,18,19,30] However, further evidence is required to establish this positive link between conflict and health on a sustained basis.[30]

Figure 2. Conflict and health impacts
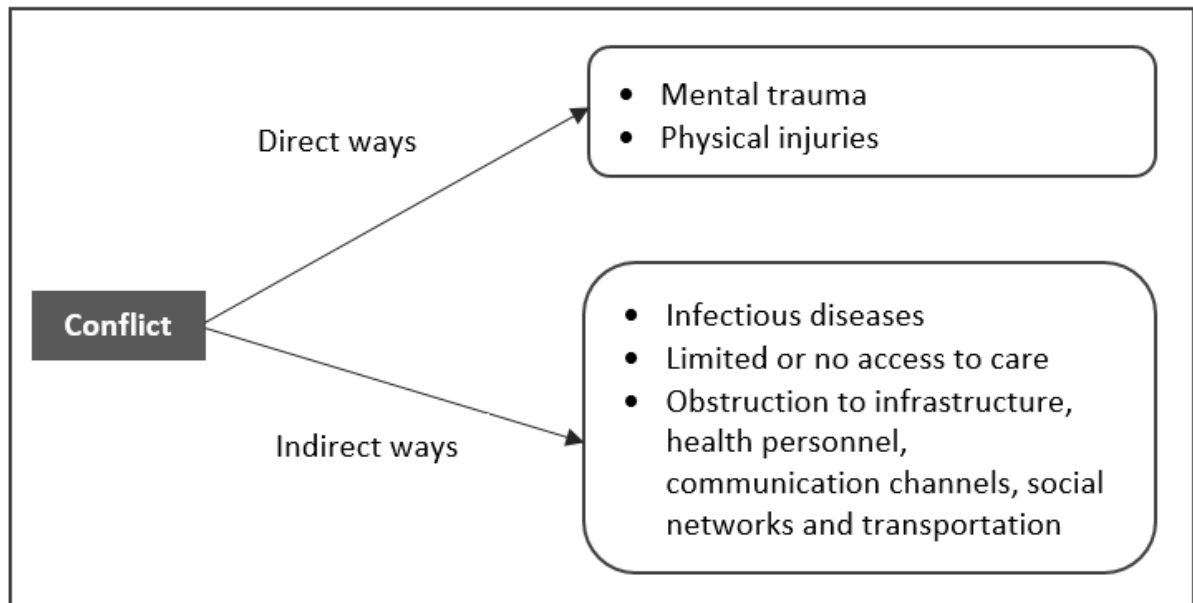
Source: Gopalan 2017 (Candidate's illustration based on literature review)

Although conflict retards improvements in health, the causal link between the two is not sufficiently documented for several reasons.[26] First, donors and development agencies are often forced to leave conflict-affected countries, and their absence limits the scope of analytical examination of conflict and its societal aftermath.[5] Second, there are systematic ambiguities with the concepts and measurement of conflict.[31] It is often unclear how to define a conflict-affected setting and conflict period.[20] Third, breakdown of governance and endangerment of life prevents proper availability and collection of data.[21] For instance, displacement of population challenges accurate mapping of populations.[22] Without mapping of geographies and people, accurate causality assessment is difficult.[5] In short, often it is challenging to collect reliable data during and after conflicts and lack of appropriate evidence limits the possibility of corrective measures and policy remedies.[1]

Effects of conflict on health systems and maternal health status

The literature establishes that conflicts impede healthcare delivery systems, as they destroy health infrastructure and the lives of health professionals, and interrupt health funding and governance.[33–35] Similarly, studies show the adverse effect of conflicts on timely and appropriate healthcare in general and maternal care specifically.[29,35] Studies also reflect that adverse socioeconomic determinants can potentially limit access to maternal care in and around conflicts. [16,36] Nonetheless, as mentioned in the rationale section, only a few studies can be considered as robust impact assessments of conflict on maternal health.[6,22] Relevant evidence from specific studies is described below.

Effects of conflict on health infrastructure and healthcare delivery

Several studies highlight that armed conflict and civil unrest can adversely affect healthcare delivery, access to care and appropriate health-seeking, and destroy healthcare infrastructure.[5,33,34,37] Only a few studies demonstrate improved access to healthcare during conflicts, where refugee camps prevail.[18,19] Destruction of healthcare infrastructure, especially attacks on health facilities and providers, were reported from Nepal, Somaliland, Eastern Myanmar and Bosnia-Herzegovnia.[16,22,38] Conflict led to migration of health-workers in Somaliland and attacks on patients in Eastern Myanmar and South Sudan.[36,39]

Effects of conflict on health-seeking and general health status

Respondents in Uganda and Pakistan indicated that health camps during conflicts could increase access to basic healthcare services and emergency care among small sections of populations, as refugee camps were supported by humanitarian agencies. However, the largest sections of the conflict-affected were still deprived of healthcare services in these countries.[29,35] Knowledge and use of contraceptives were found to be higher among refugee camp inhabitants in Liberia, Sierra Leone, and Guinea.[18,28]

Sexual abuse of children, loss of education, child slavery and child abduction are known challenges in conflict-affected settings.[5] Conflict-facing sub-Saharan countries had relatively worse median under-5 mortality at 197/1000 live births and a median of 27% under-weighed compared to those in their non-conflict counterparts (137/1000 live births and 27% under-weighed respectively).[5] Rwandan refugee camps reported a higher child mortality at 300 per 100 000 a day.[5] Displaced communities had 60% more child mortality than the general

population in Rwanda.[5] In Liberia, conflict during the 1990s adversely affected under-5 malnutrition.[19] However, existing evidence indicates that the health of women and children did not get worse in Bosnia and Herzegovina during conflicts.[5] Nepal reported an improvement in human development index, life expectancy and child health indicators in conflicts during 2000s.[22]

Effects of conflict on maternal health and service usage

According to the literature, civil unrest and armed conflict can disrupt access to appropriate maternal care and consequently worsen maternal health status.[16,36] Forced labour, soldier attacks, damage to food supplies, physical injuries, displacement and lack of healthcare services can cause illness and death in pregnancy.[16,26,36] Conflict's indirect effect on mothers include food deprivation, psychological and emotional distress, and infections.[27] A qualitative study in Burundi reported increased maternal and neonatal morbidity, prevalence of HIV/AIDs, prostitution, teenage pregnancy, clandestine abortion and fertility levels during conflicts.[40] Mexican women in conflict-affected areas reported limited access to emergency obstetric care and transportation.[41,42] Pregnant women encountered provider neglect in Burundi and Colombia during conflicts as providers showed partiality towards certain ethnic groups.[40] The occupied Palestinian territories reported a decline in access to antenatal and postnatal care; increased induced deliveries, home-based deliveries, and deliveries at military checkpoints; and constant gender-based violence during conflicts.[41] Conflict-affected Lebanese territories showed interruptions in regular maternity care and a higher pregnancy related complications.[21] However, studies from Mexico, Eastern Myanmar, Sri Lanka, Bosnia and Herzegovina indicated that due to lack of reliable data a direct causal link between conflict and maternal deaths could not be established.[5,41–43]

Conflict and health equity

Another key issue related to the way women use health services during conflict is that of health equity. Health equity is a complex concept to define and measure, and more so in conflict-affected settings.[44] Initially, the most common definition of health equity was "fair distribution of health determinants, outcomes, and resources within and between segments of the population, regardless of social standing".[45] Later, investigators realised that 'unfairness' is difficult to measure.[46] Currently, the concept of health equity aims at minimising avoidable inequalities in health and its determinants between different population groups with varying

levels of underlying social advantage or privilege.[47] Generally, to measure inequity in health status and access, disparities between people based on their social position are considered.[48] Social position is often characterised by income/wealth, occupation, education, geographic location, gender, and race/ethnicity. Equity is considered the absence of systematic and potentially remediable differences among population groups categorised socially, economically, or geographically.[48] Health inequalities based on inevitable conditions (e.g. biological/genetic variations) are not considered for measuring health inequity.[46]

Three important steps are considered to measure health equity: 1) categorisation of people based on socioeconomic or other social status; 2) measurement of health status, access or resource availability; and 3) quantification of inequities.[46,49] Literature considers that the current statistics on health equity is scant, mainly due to lack of clarity in measurement and availability of suitable data.[46] Usually, statistics present average or mean health status (e.g. maternal mortality) for different population groups or strata, categorised based on socioeconomic status.[49] Health equity can be of two types broadly – 1) horizontal equity and 2) vertical equity.[48,50]

Horizontal equity means equals are treated equally without any discrimination.[48] In other words, equal treatment of individuals or groups who share similar circumstances (e.g. women from the same economic strata are treated equally with the same preference without any discrimination by caregivers). As per another classification, horizontal equity requires women with the same health needs to be treated equally irrespective of morally irrelevant factors (e.g. age, ethnicity, income).[50]

Vertical equity involves differential treatment being given based on differences in socioeconomic or other social status (e.g. poor women get more resources than rich women due to the relatively higher economic vulnerability of the former).[48] In vertical equity, women with differing health needs should be prioritized differently according to morally relevant factors (e.g. need, autonomy, ability to benefit).[50] As per literature and policy evidence, for most low- and middle-income countries and resource-constrained settings, it is first necessary to address vertical equity.[44,47] However, unless disadvantaged groups are given differential treatment, the prevailing gaps in health status will not be reduced substantially.[44]

With respect to conflict-affected settings, the existing evidence shows that patterns of equity in healthcare, especially maternal care, are often inequitable, with conflict adversely affecting the healthcare options of socioeconomically challenged populations.[44,46] However, literature also indicates that the differential effect of conflict on healthcare or maternal care use among different population groups including the worse-off, can be unpredictable.[44] The well-off could be more adversely affected in terms of receiving appropriate healthcare access, depending upon conflict severity, duration, geographical spread, seasonality and presence of emergency preparedness to tackle conflict-induced healthcare access issues.[44,47] For instance, rural people are typically socioeconomically worse-off in a country. If conflict is more severe in urban areas, healthcare of the urban population can be more adversely affected than that of their rural counterparts. However, the evidence suggests more of a reinforcement of prevailing inequities and inequalities during conflict than creating new patterns.[44] Further, a well-developed and egalitarian health system creates relatively less inequalities during conflicts.[49,50] Thus, existing evidence reflects the need for in-depth understanding of how vertical equity is being addressed or how predictable are prevailing patterns of inequity during conflicts.

Egyptian conflict

The Egyptian revolution started in January 2011 and the acute phase of the conflict continued till early 2013.[3] The conflict's severity lessened in 2014, however Egypt is still not fully free from the risk of protests against the government and conflicts among different political and rebel groups.[4] The acute phase (2011-2013) began when thousands of civilians protested in an ideologically and socially diverse mass movement that led to the resignation of long-time president Mr Hosni Mubarak from office.[3,4] Although the military took over the government, there were constant conflicts between the military authority and different protest groups who demanded democratic rule. Meanwhile, Mr Mohamed Morsi from the Muslim Brotherhood party won the election and began drafting a new constitution in June 2012. However, protests resumed as people perceived his rule as autocratic and violating human rights and freedoms. His opponents including a group of young activists ('Tamarod') engaged in sometimes fatal protests against him across the country.

Mr Morsi resigned in June 2013 and military rule under Fattah al-Sissi with Mr Adly Mansour as interim President came into effect.[3,4] However, protests mostly from Morsi's Muslim Brotherhood party, supported by Palestinian militant groups, continued across the

country, causing additional fatalities.[4] Egypt had a new constitutional referendum in January 2014, supported by 98% of voters.[3,4] However, protests among Islamist groups, Brotherhood groups, and Tamarods continued through 2014, resulting in destruction of public infrastructure and several deaths.

The literature indicates that the 2011 Egyptian revolution commenced due to socioeconomic and political factors.[3,4] Political reasons included: 1) persistence of emergency law and dominance of terror in governance, 2) lack of political and civil rights, 3) police attacks on political activists, 4) corruption, and 5) the success of the bloodless Tunisian revolution.[3] Socioeconomic reasons included poor healthcare delivery systems, rising unemployment and inequality, and inflation of food prices caused by poor governance and dictatorships.[3]

Rationale and added value of the study

Why study maternal health and services usage in conflict-affected settings?

Although health issues of any kind are a matter of distress during conflicts, maternal care cannot be delayed during emergencies and thus requires relatively more attention, along with injuries and accidents.[24] Though there is ongoing debate, conflict is currently considered as one of the major reasons for many low- and middle-income countries not achieving global maternal health targets.[51] In 2013, among the 34 LMICs farthest from reaching the United Nation's (UN) target on reducing maternal deaths, 22 were conflict-affected.[23] Although debatable, as per the UN data, conflict-affected settings in LMICs contribute more than 56% of global maternal deaths.[53,54] The UN Sustainable Development Goals (SDG) agenda has solicited special attention to maternal health in conflict-settings to meet the maternal health goals globally.[15]

As per epidemiological evidence, ensuring appropriate maternal care use is a pre-requisite to improved maternal and neonatal health.[54] Quality skilled birth attendance (SBA) can reduce maternal deaths in LMICs, including conflict-affected settings.[55] Availing timely and appropriate antenatal care (ANC) can detect several emergency conditions such as eclampsia, foetal presentation, and high sugar in urine.[54]

Adherence to clinical standard guidelines during ANC and detection of eclampsia may prevent maternal deaths in LMICs and help in ensuring healthy babies.[54] Postpartum care is equally

essential for mothers and newborns, as 50% of maternal deaths occur in the first 24 hours following delivery in LMICs.[56]

Access and usage of appropriate maternal care is unpredictable in conflict-affected settings due to particular challenges.[57] First, they possess less than half of the recommended number of health-workers and infrastructure to address maternal care.[5] Provision of essential healthcare services and availability of skilled providers are frequently disrupted in and around conflicts.[38] Second, due to risks of violent death or injury, women may avoid accessing institutionalised care during acute conflict.[24] Third, affordability of care is typically lessened due to limited economic activities in acute conflict.[9] Fourth, disruptions of social networks and transportation are obstacles, especially for those living in remote or culturally isolated communities.[34] However, evidence is limited on maternal care and its quality in conflict-affected settings, especially during acute conflict. First, few studies quantitatively estimate the effect of conflict on maternal care usage.[58] Second, few studies have assessed the causal link between conflict and maternal care usage.[22,58,59] Third, few studies assess the effect of conflict on the full continuum of maternal healthcare quantitatively.[58] Although two studies examined conflict's effect on maternal heath, they primarily explored ANC and not the whole continuum of maternal care.[13,22] Finally, it is equally relevant to know how conflict affects care seeking of pregnant women from different socioeconomic backgrounds.[16,37,60] The trajectory of health service usage can be different in conflict-affected settings than in normal settings.[16,38] For example, women from socioeconomically well-off groups can be equally at risk with their worse-off counterparts when it comes to healthcare access in acute conflict.[13] In short, understanding the patterns of maternal care and socioeconomic determinants in conflict-settings would help policy-makers, programme implementers and humanitarian agencies in planning and delivery of appropriate remedial measures.

Why was Egypt chosen as study setting?

Egypt was chosen because it provides relevant data at appropriate time points in a relevant study context. First, a recent conflict is suitable to investigate the effect of conflict on maternal care usage, as the nature and trajectory of conflicts change over time.[1] Investigating a recent conflict can provide more recent and convincing evidence on maternal care and its various components for policy insights.

Second, exploration of doctoral research objectives required reliable and country-representative data on comprehensive maternal healthcare. Currently, the Demographic and Health Survey (DHS) provides the most representative secondary data on country-level reproductive, maternal and child health.[61] Although other countries (e.g. Syria, Afghanistan) experienced much more severe conflicts than did Egypt, recent DHS data that could enable a pre-post comparison of the effects of conflict was only available for Egypt.[2] Egypt's acute phase of crisis was during 2011-2013 and its 2014 DHS offers necessary maternal care information for the periods prior to and during conflict.[61]

Third, despite Egypt facing a prolonged conflict, the prevailing evidence demonstrating its effects on the health system and care-seeking, especially maternal care use, is scanty.[62] Egypt is prone to regular conflicts.[9] While the health system has undergone many reforms to improve its service provision and equity in the past decade,[62,63] relatively little attention has been given to improving health system resilience to conflicts.[3,4] Without a proper understanding of the trajectory of maternal care use in conflicts and its socio-economic determinants, policy strategising may not be effective and cost-efficient.

Finally, a pertinent issue in the Egyptian healthcare system has been its growing inequities in healthcare use and status.[62] These inequalities are more of a concern in maternal care as explained further in this paragraph. On maternal care, the Egyptian health system performs reasonably, especially when all essential maternal care services (e.g. 4+ ante natal care, post natal care and skilled delivery) have a minimum use of around 70% for the last few years.[64] However, as per the Ministry of Health, the greatest challenge in Egypt is not low use of maternal services, rather the increasing inequities in maternal health status and usage of services.[65] These growing inequities in maternal care are further accentuated by the increasing disparities in social determinants of care, availability of services and access to care.[64] For example, as per a recent study, one unit increase in socioeconomic and cultural capital was associated with 1.55 higher odds of availing any ANC and 1.31 higher odds of institutional delivery.[66] Rural areas have less availability of healthcare infrastructure, skilled staff and funding compared to urban areas[62], while social determinants of care (e.g. wealth and education status) are relatively better for the urban residents.[66] EDHS 2014 reported a gap in the proportion of women receiving any ANC services between the lowest (70%) and highest wealth quintiles (90%).[61] During 2009-2014, skilled birth attendance was 75% among the

former, while the latter reported 97%.[61] In this context, it is more relevant for the Egyptian context to explore how conflict was associated with equity patterns in maternal care. As per the literature, even if conflict does not affect overall level of usage of healthcare, (especially in less severe conflicts), it can still adversely affect equity patterns in service use, as trajectory of social determinants drastically change during conflicts.[67]

As per the existing literature, equity patterns can be quite unpredictable during conflict as the distribution and functioning of social determinants can be unpredictable in and around conflict.[44] It is equally necessary to know the predictability of the prevailing social determinants in conflict for effective health system preparedness.[44] Given the disparities in maternal care use across different groups, Egypt needs to address vertical equity. In other words, vulnerable women should have relatively more access to resources than their well-off counterparts. If the focus is on horizontal equity, where both poor and rich get the same level of resources, it will not substantially reduce the prevailing gaps in usage of maternal care in the immediate future.[68] In this context, this study assessed the association between conflict and level of maternal care use across different socioeconomic groups with a focus on vertical equity. As explained above, an examination of maternal care during conflict among different socio-economic groups may bring in more policy implications for emergency preparedness. Therefore, this study pays equal weightage to understand association of conflict with levels of maternal care in general and also equity patterns in maternal care. Also, given the fact that conflict was less severe and Egypt otherwise perform reasonably on levels of essential maternal care use, the study assumed to bring in more policy implications for addressing equity and social determinants of maternal care during future conflicts.

In summary, Egypt has been chosen as it provides relevant data at the appropriate time points in a relevant study context.

Added value of the study
Few studies have analysed the effect of conflict on the entire continuum of maternal healthcare. Although two studies were found examining the effect of conflict on maternal heath, they focused on ANC rather than the continuum of maternal healthcare.[13,22] To understand the association between conflict and levels of maternal care, this study was unique in exploring if there were changes in maternal care-seeking among a sub-sample of women both before and

during conflict. Examining maternal care use within the same sample at two different time periods (i.e. both pre-conflict and peri-conflict periods) could potentially reduce confounding while attributing the influence of conflict on maternal care.[69]

As mentioned earlier, globally, studies estimating the impact of conflict on healthcare in general and maternal care in particular are limited. Despite Egypt being prone to routine conflicts, there is no study exploring the effect of conflicts on maternal care usage in the country.[70] This study explored maternal care use among different socioeconomic, demographic and geographic groups, thus uniquely assessing if socioeconomic determinants affected maternal services usage differently before and during conflict.

Although this study used DHS data, its scope was beyond the analytical inputs of the DHS report. For instance, this research compared maternal care usage before and during acute conflict, while the DHS report only provided analytical results on maternal care usage without considering the conflict.[61] This study used a rigorous analytical tool, i.e. multi-level modelling on a national data sample (DHS is the most comprehensive data source on maternal care usage in countries). Multi-level modelling is a widely applied technique to analyse hierarchical data, such as DHS data, in an attempt to establish causal effects.[71] Due to the hierarchical nature of the data, conventional linear regression models that do not account for these multiple levels would underestimate the standard errors of the effect sizes, leading to a higher chance of Type I error.[59,72,73]

This study uniquely explored the patterns of post-delivery facility stay during conflict. In maternal care assessments, 'duration of post-delivery stay' is not typically included. As 50% of maternal deaths occur within the immediate phase of delivery, examining length of delivery stay is relevant to explore the potential effect of conflict on maternal health.

Aim and objectives

The aim of this doctoral research was to analyse the association of Egypt's acute 2011-2012 conflict with usage and quality of maternal healthcare and its socioeconomic determinants. Objectives were to:

1) assess the association of acute conflict with usage and quality score of selected maternal services (i.e. antenatal care and its quality, delivery and postnatal care) among the sample of women who gave birth either in the pre-conflict or peri-conflict period;

2) assess the association between acute conflict and usage of maternal services (i.e. antenatal, delivery, and postnatal care) among selected socioeconomic, demographic, and geographic groups;

3) assess the association of acute conflict with usage of maternal services (i.e. antenatal and delivery care) among a sub-sample of women who gave birth both before and during conflict.

Objective 3 only included those women who delivered both before and during conflict, because use of the same sample at two different time periods potentially reduces confounding while attributing the influence of conflict on maternal care. Objective 3 did not include postnatal care, as data were not available for the same sample of women to enable a before and after comparison.

Chapter 2. Methods

This chapter covers general study setting, study design, and methods for all chapter sub-studies. Sub-study chapters also include additional methodological detail. The first section describes the study setting, including an overview of Egypt's demographic and socioeconomic context, healthcare delivery system, and maternal and child health. Remaining sections describe the methodological approach, including study design, data source, sampling and sample size, survey instruments, study measures, data analysis, and ethical considerations.

Study setting

Egypt's socioeconomic and demographic profile

Egypt is a Muslim-majority country situated in the northeast of the African continent and generally included as part of the 'Middle East' region.[65] It has a surface area of 1,002,000 square kilometres and 7.7% of its area is inhabited.[65] Egypt is a lower-middle-income country and had a Gross National Income per capita of US$ 5,654 in 2012.[74] Egypt was ranked 108 in the human development index, while its gender inequality index rank was 131 in 2014.[75] The unemployment rate as a portion of total labour force was 13.40% in 2013.[76] The population density per square kilometre was 93.8, one of the highest in the Middle East region.[3] In 2013, 57% of the population lived in rural areas.[3] Egypt is divided into two regions.[3] Upper Egypt in the South is mainly rural with relatively poor socio-economic indicators. Lower Egypt in the North, including cities such as Cairo and Alexandria, is more urban and affluent. Administratively, there are 27 governorates of which four (i.e. Cairo, Alexandria, Port Said, and Suez) are fully urbanised.[3] Current challenges in the country include growing poverty, weak governance, and environment (e.g. scarcity of water and natural resources).[77] Details on socioeconomic, demographic and health indicators are given in table 1.

Healthcare system

The Egyptian healthcare system is largely pluralistic, with different types of public and private providers and financing agents.[65] The healthcare system is managed, financed and provided by government, parastatal, and private entities. Both for-profit and non-profit entities constitute the private sector. The Ministry of Health and Population's (MOHP) service delivery units are organised under different levels - geographical (rural and urban); structural (health units, health centres, hospitals); functional (maternal child health centres); and programmatic

(immunisation, diarrheal disease control).[76] The public sector charges user fees and does not have an in-built referral system for patients. In 2013, about half of the population depended on public sector inpatient care.[62,65,76] There are 50,000 functional private ambulatory care facilities and 61% of outpatient care is provided by the private sector.[65] The public sector faces constraints mainly in terms of inadequacy of skilled staff, infrastructure and supplies, especially in rural areas.[3,62] Staff in public facilities are reportedly under-paid and less motivated to perform.[62] In the Rural South region, 60% of public hospitals had drug stock-outs, while 20% had no doctors in 2014.[62] The number of nurses per health unit is 1.5 in the Rural South region versus 29 in the Lower Egypt.[64] Around 50% of physicians in Egypt are female and face social constraints working in remote areas.[76]

In meeting universal healthcare targets, financial risk-protection coverage and reducing inequalities are the major health system challenges in the country.[3] Donor-supported maternal and child care programmes and immunisation programmes have successfully contributed to improving service coverage in the Rural South region.[62] With respect to impact of conflict, the few existing studies have focused on trauma care and mental health rather than the health system.[63,78] However, evidence indicates that during the acute conflict (2011-2013) for every 10000 population, there was a decline in the number of physicians from 28 to 8, midwives from 35 to 14 and pharmacists from 16 to 2.[76]

Maternal and child health

The Directorate of Maternal and Child Health Care (MCH) under MOHP oversees MCH programmes.[65] Improving care-seeking and quality of care are key aims of the national MCH programme. Specific packages of services include basic and comprehensive essential obstetric care for normal delivery and management of obstetric complications.[65] Since 2000, maternal and child health outcomes have been varied.[76] Quoting the Egypt DHS 2014, USAID reported a 17% increase in the fertility rate and a decline in maternal care-seeking.[62] Despite 90% of pregnant women using some maternal services, only less than half had accessed all the WHO recommended essential services during 2009-2014.[61,79] Inequalities in MCH status and service usage have increased with the decrease in government funding and weakening of the public healthcare system as shown in the rationale section.[4,62] Generally, rural, poor and uneducated women access less maternal care, than their affluent counterparts.[62] Under-five mortality during 2008-2013 was 27 per 1,000 births.[61] Rural children are more likely to be anaemic than

urban children (29% and 23% respectively).[62] A child born in Upper Egypt had a 50% higher chance of dying in the neonatal period compared to its counterparts in the urban Lower Egypt region during 2009-2014.[62] The major attributes of these inequitable situations were low-quality health care services, poor health behaviours, and weak management of health systems in the public sector.[65] The Maternal Mortality Ratio was 82 per 100,000 live births in 2008.[80] A hospital-based study in Cairo during 2008-2009 indicated that obstetric haemorrhage, hypertensive disorders of pregnancy and cardiac arrest were major causes of maternal deaths.[78] Intimate partner violence (IPV) was also positively associated with maternal deaths.[66] Poor quality of care and delay in seeking care were also reasons for maternal deaths.[81]

Table 1. Basic demographic, economic and health indicators in Egypt

Indicators	Values
Human Development Indicators	
Gross National Income per capita	US$ 5,654
Human development index	0.716
Human development index Rank	108
Gender Inequality index	0.58
Population below income poverty line (%)	16.7
Life expectancy at birth (years)	71
Demographic Indicators	
Total Population (million)	82.54
Rural population (%)	57
Female population (%)	48.8
Under 15 population (%)	49.5
Population above 60 years (%)	3.4
Total fertility rate (per woman)	3.0
Crude birth rate (per 1000 population)	25.3
Crude death rate (per 1000 population)	6.2
Annual population growth rate (%)	1.9
Contraceptive prevalence rate (%)	60.3
Infant mortality rate (per 1,000 live births)	19
Adult literacy rate (%)	71
Literacy rate among women above 15 years (%)	63
Literacy rate among men above 15 years (%)	78
Population with sustainable access to water source (%)	99
Population with sustainable access to improved sanitation (%)	95
Healthcare system Indicators	
No. of public primary facilities	5,000

No. of public tertiary hospitals	1,100
No. of private tertiary hospitals	2,024
Distance to nearest health facility for most populations (KM)	5
Physicians/1000 population	28.3
Nursing and midwifery personnel/1000 population	35.2
Household out of pocket expenditure out of total health spending (%)	72
Total health expenditure as a proportion of gross domestic product (%)	5.6

Source: WHO 2010 [65]; UNDP 2015 [75]; WHO 2012 [82]; The World Bank 2013[83]; WHO 2014[84]

Study design

This quasi-experimental study used an uncontrolled before-and-after design to explore the cause-effect relationship between conflict and maternal care usage. Uncontrolled before-and-after studies assess the effect of a situation, event or intervention, when typical control is not present and a 'pre-post comparison' is possible.[85] The analytical strategy was to compare the levels of maternal care usage and quality before and during the acute conflict phase in the study population. Before-after comparison was conducted through multi-level modelling. Births occurring from 1 January 2009 to 31 January 2011 constituted the 'pre-conflict' sample and those from 1 February 2011 to 31 December 2012 were the 'peri-conflict' sample. Births occurring from 1 January 2013 onwards were excluded, as media reports indicated that acute conflict ended in early 2013.[3] As per media reports the spread and the end of the acute phase across the country was more or less at the same time. Conflict events were more prevalent in urban areas after the acute phase. Figure 3 shows conflict events across two study periods and Figure 4 shows number of conflict events across governorates in the peri-conflict phase. This indicates the uniform spread of events in the peri-conflict period (or acute conflict phase) across governorates.

Figure 3. Conflict events in pre-conflict and peri-conflict phases
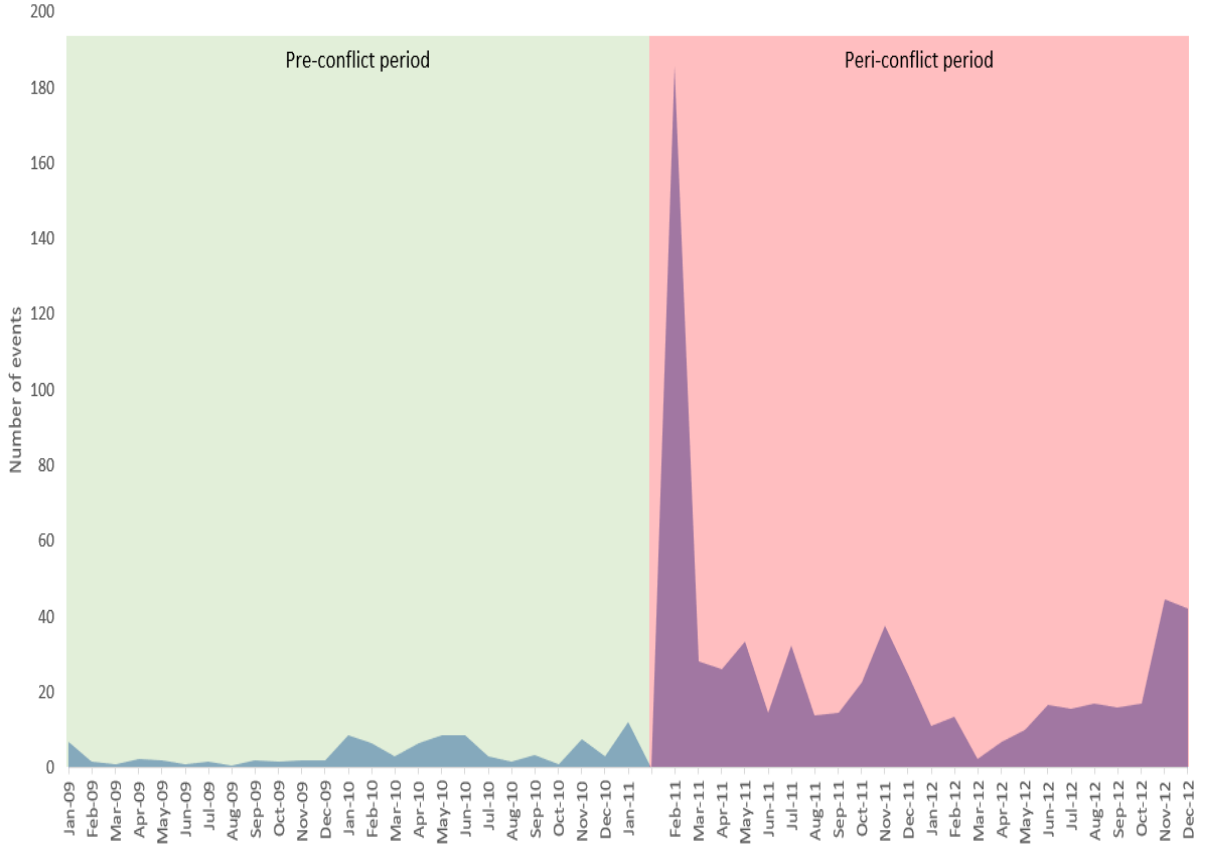
Source: ACLED Egypt Conflict Data[87]

Figure 4. Conflict events across governorates in peri-conflict phase (excluding Sinai)
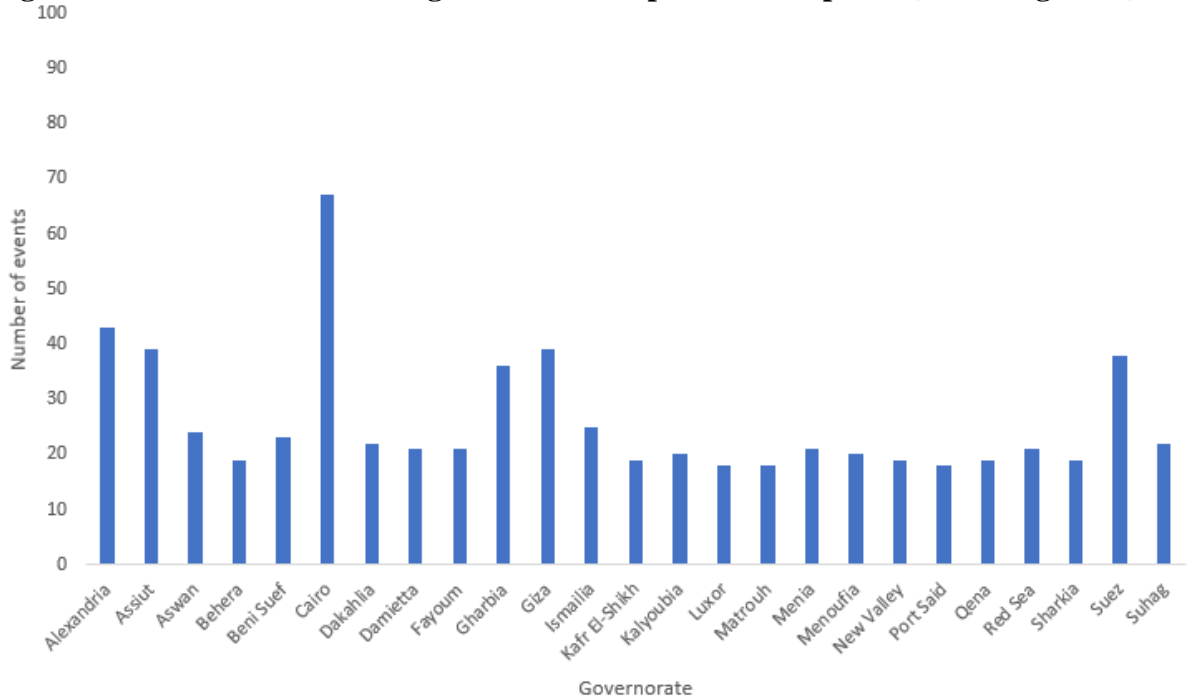
Study sites and population

This study used data from the most recent round of the Egypt Demographic and Health Survey (EDHS) that was undertaken in 2014.[61] The EDHS is a nationally representative study allowing estimates at the national as well as major subdivision levels.[61] The major subdivisions consist of six Governorates – urban, urban Lower Egypt, rural Lower Egypt, urban Upper Egypt, rural Upper Egypt, and the Frontier Governorates. However, the EDHS 2014 did not include North and South Sinai governorates as there were challenges in surveying them due to security reasons.[61]

Sample selection and size

The EDHS 2014 used multi-stage sampling with towns and villages as primary sampling units (PSU) for urban and rural areas respectively.[61] First, 884 PSUs were selected. Second, depending on PSU size, systematic sampling yielded 1-3 parts per PSU (1,000 households each). Third, each part was divided into equally-sized segments (200 households each), two to three of which were selected randomly from each PSU. A total of 1,838 segments (clusters) were selected from 884 PSUs. A household listing was undertaken in each segment. An average of 15 households was selected from each segment using systematic random sampling. Thus, a total of 29,471 households were included. Eligible participants were ever-married women aged 15-49 and present in selected households the night prior to interview. A total of 21,903 women were eligible for the survey. From each woman, details on childbirths for the five years preceding the date of survey were gathered.

Between 1 January 2009 and 31 December 2012, the EDHS recorded 7,210 births among 7,118 eligible women in 1,679 clusters. Table 2 shows the sample sizes for this study. Objectives 1 and 2 used the "full EDHS sample" and the unit of analysis was 'births'. These 7,210 births in the full-sample included both pre-conflict and peri-conflict periods. Specifically, the pre-conflict period had 2,569 births and the peri-conflict period had 4,641 births. As per the EDHS report, this considerable difference in the sample size between the pre-conflict period and the peri-conflict period was due to the unusual increase in births from 2011 in the country (Figure 3).[61] Government sources indicated that the Crude Birth Rate was 28.7 per thousand population in 2010 and increased to 31.9 in 2012 (Figure 5).[86] The total number of children born to all 15-49 aged women during 2012-2014 was 29,349, while it was only 8,109 during 2009-2010.

Thus, the total fertility rate among women aged 15-49 years increased from 3.0 (in 2009) to 3.5 (in 2013).[61]

Figure 5. Proportion of births in EDHS 2014 sample by year and crude birth rate
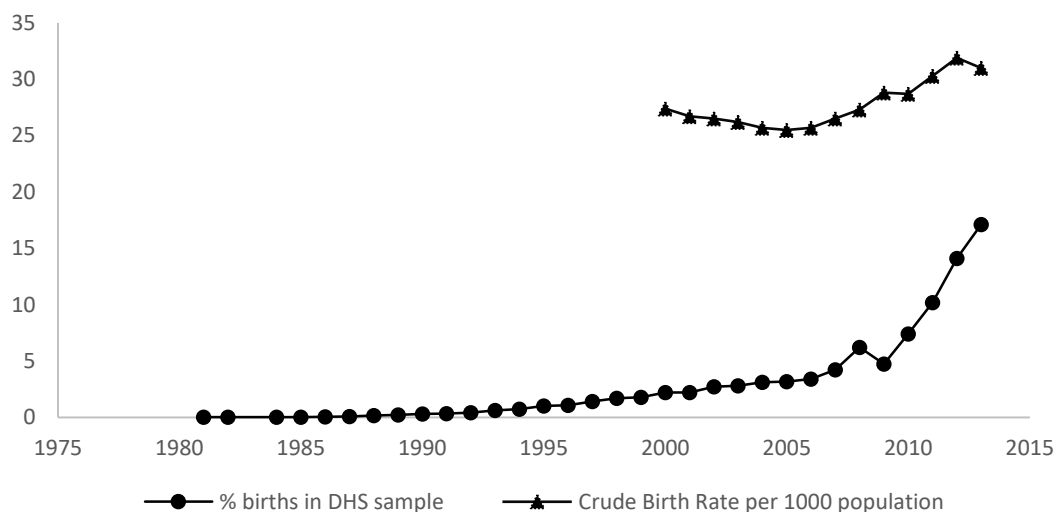
Source: EDHS 2014

Objective 2 used a sub-sample (Table 2) as it considered women who had a child born both before and during conflict. The unit of analysis was 'births'. The analysis included 3,468 births from 1,734 women in 992 clusters. Figure 6 and 7 show births by year for the "full-sample" and the "sub-sample" respectively.

Table 2. Study sample (2009-2012)

Sample	#Governorate	#Cluster	#Women	#Birth	Births pre-conflict	Births peri-conflict
Full-sample	6	1679	7118	7210	2569	4641
Sub-sample	6	992	1734	3468	1734	1734

Figure 6. Births by year (full-sample)

Source: Egypt Demographic and Health Survey, 2014
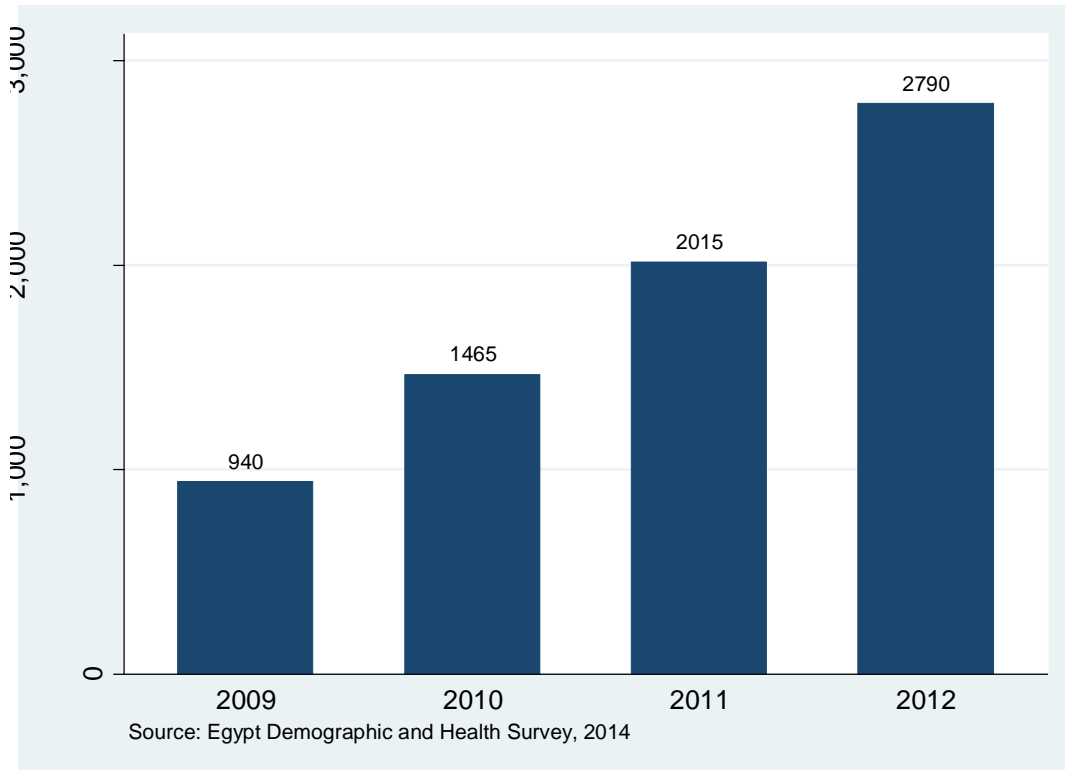
Figure 7. Births by year (sub-sample)

Source: Egypt Demographic and Health Survey, 2014
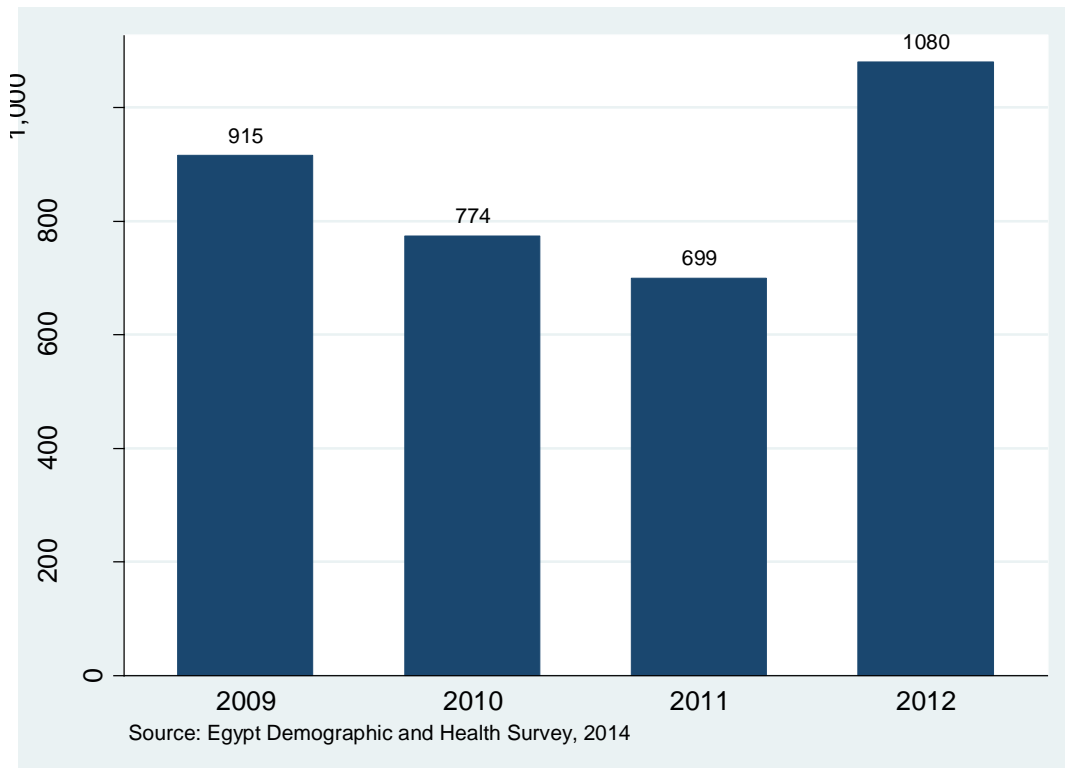
Data collection

EDHS data were collected during April-June 2014, with childbirth data including a five year recall period from 2009-2014.[61] EDHS data routinely uses a recall period of five years, i.e. all the data in this section records usage related to any birth that happened on or after 1 January 2009.[61] Data collection was performed by local enumerators who were recent university graduates. There were 14 enumeration teams, each consisted of a supervisor, a field editor and at least three enumerators. The field editors and interviewers were females, while supervisors were males. The 2014 EDHS questionnaires were adapted from model questions of the MEASURE DHS Phase III project.[61] Questionnaires were translated into Arabic from English. All questions were pre-tested on a sample of around 250 households and revised based on comments from the interviewers and tabulations of pre-test results.

The EDHS survey design consisted of two nationally-representative surveys: (1) survey of ever-married women ages 15 to 49 years and (2) health issues survey on hepatitis B and C and non-communicable diseases.[61] This research relied on the first component survey that gives information on fertility and MCH related information. This first component used two questionnaires: (1) a household questionnaire and (2) an ever-married woman questionnaire.[61] The household questionnaire enumerated all usual members of the sample households and collected information primarily on household demographic composition and socio-economic characteristics. The ever-married woman questionnaire collected data on respondents' and husbands' background characteristics, reproduction and contraception, pregnancy and breastfeeding, child immunisation and health, woman's work and decision-making and domestic violence. In terms of maternal care, the survey collected information on place of care seeking (i.e. home or institution), type of facility (public or private), type of provider (skilled or unskilled), and frequency, timeliness and contents of services received.

Study measures

Table 3 shows the study outcomes in detail. Components of maternal care usage constituted the main study outcomes. Maternal healthcare was disaggregated by the stage of pregnancy, i.e. antenatal, delivery, or postnatal. These outcome measures were selected by referring to the WHO's list of essential maternal care services for LMICs and the availability of relevant data in the EDHS.[79,88] Each outcome was analysed by contextual variants, such as place of care (institutional or otherwise), type of institution (public or private), provider (skilled or

otherwise), timing and number of visits. The selection of these outcome measures was intended to balance between WHO recommendation for a LMIC setting and Egypt's maternal care clinical guidelines.[79,89] For example, the WHO recommended timing for the first PNC visit was within 24 hours of delivery, while that of the Egyptian Government is 48 hours.[79,89] Thus, both these measures were included in the analysis.

ANC contents and quality

WHO advises that ANC should consist of a combination of technical and behavioural aspects by providers.[90] Technical aspects consist of appropriate history taking on medical and obstetric conditions; physical examinations of weight, height, blood pressure, abdominal palpation, symphysio-fundal height, and foetal heart rate; collection of urine and blood sample to check for diabetes, anaemia, syphilis, and pre-eclampsia; and advice on proper diet and danger signs. Non-technical aspects entail maintaining privacy during examination, counselling, and appropriate behaviour. As mentioned in the introduction section, these elements of ANC have the potential to reduce foetal and maternal health risks.[91]

However, the 2014 EDHS only collected information from women on receipt of a few technical aspects of ANC, i.e. weight and blood pressure measurement, urine and blood sample collection and prescription of iron tablets. This study assessed the receipt of ANC under two dimensions: 1) receipt of individual technical ANC elements mentioned above; and 2) receipt of adequate ANC quality. The quality of ANC was considered adequate if the woman reported receipt of all five key services: (i) being weighed, (ii) having blood pressure measured, (iii) having a urine sample collected, (iv) having a blood sample collected, and (v) having iron tablets prescribed. This variable was binary with a score of '1' if all services were received and '0' if one or more of these services were not received.

Explanatory variables

Explanatory variables were mother's age (<25, 25-29, 30-34, >35), education (no education, primary, secondary and above), occupation (currently working, not working), birth order (1, 2-3, 4-5, 6 and above), child gender, residence (urban, rural), and household wealth quintile (poor, less poor, middle, rich, richest). These explanatory variables were selected as they were likely to influence the study outcomes based on a literature search.[44,58,92–94] Although a univariable model building analysis is not required in a causal analysis (as opposed to

predictive) model building,[95] univariable analysis tables are given in Annex (page 136) showing the results of multi-level logistic regression performed separately for each explanatory variable with key outcome variables. Those variables which were suggested by the literature were also found out to be statistically significant in the univariable analysis.

The EDHS 2014 constructed a wealth index by using key household characteristics, possession of assets and urban-rural differences.[61] In the first step, characteristics common to both urban and rural areas were used to create a common factor score through principal component analysis (PCA). Typically in a PCA, weights are assigned to each variable (household characteristics and possession of assets) based on their relative importance.[96] Households with a higher possession of assets obtained a higher wealth index. In the second step, specific factor scores were created using area-specific identifiers separately for urban and rural areas. Finally, separate area-specific factor scores were combined to create a nationally representative wealth index by adjusting the area-specific score through regression on the common factor scores. Based on this index, the entire sample of households was categorised into five equal parts (quintiles) from poorest to the wealthiest.

Table 3. Outcome measures (Binary)

Maternal care	Variables
Antenatal care (ANC)	Whether ANC received
	At least 4 ANC received
	Whether ANC received from a public institution
	Whether ANC received from a skilled provider
	Whether ANC received from a doctor
	Whether first ANC received within 12 weeks*
ANC* content	Whether ANC included blood pressure measurement
	Whether ANC included weighing
	Whether ANC included collection of urine samples
	Whether ANC included collection of blood samples
	Whether ANC included prescription of iron tablets
ANC quality*	Whether ANC included all recommended elements, i.e. blood pressure, weight, urine and blood samples, iron tablets
Delivery care	Whether delivery occurred in an institution
	Whether delivery occurred in a public institution
	Whether delivery occurred in a private institution
	Whether delivery assisted by a skilled provider
	Whether delivery assisted by a doctor

	Post-delivery stay at least 24 hours
Postnatal care (PNC)*	Whether PNC received
	Whether PNC received from a skilled provider
	Whether PNC received from an institution
	Whether PNC received from a public institution
	PNC received within 24 hours
	PNC received within 48 hours

* Only available for the most recent birth

Analysis

Data analysis was undertaken in three ways: (a) descriptive analysis, (b) estimate of effects through multilevel modelling, and (c) sensitivity and goodness-of-fit tests. All data analyses were performed using Stata software version 13.[97]

Descriptive analysis

Descriptive analyses were undertaken for the sample based on key explanatory variables described in the previous section. Variables were summarised by period (i.e. pre-conflict, peri-conflict) with frequencies for categorical variables.

Multilevel modelling

Analysis units were hierarchical in this study. For instance, births were nested within households, households within clusters, clusters within primary sampling units (PSU), and PSUs were nested within Governorates in the DHS data.[61] Due to the hierarchical nature of the data, conventional linear regression models that do not account for these multiple levels would underestimate the standard errors of the effect sizes, leading to a higher chance of Type I error.[71,98] Conventional linear regression models assume that observations are independent and variances are equal across the clusters, which may not be the case in hierarchical data.[99] As health systems research delves more into investigating the impact of contextual factors on key health outcomes (e.g. state or district influences), there is a need to explore analytic methods that allow explorations of variance both within and between clusters.[99–102] Regression models known as multilevel models (also known as mixed effects model, hierarchical model and nested model) were developed to account for the clustered data and correct the dependency of observations in a cluster.[98,103] The fixed part is a linear function of individual and contextual-

level factors, whereas the random part presents variance components between its several multiple levels.[101]

Due to the hierarchical nature of the data, and obvious advantages of multilevel models (MLM) over conventional single-level ones, this study used the former in assessing the effect of conflict on key outcomes. Multi-level modelling in this study consisted of fixed effects (of individual and household-level factors) and random effects (between cluster characteristics).[73]

Except for research objective 3, the multilevel model considered the sample hierarchy at four levels – births (level 1), nested within clusters (level 2), nested within PSUs (level 3), and nested within governorates (level 4). For all research objectives, the study considered women at the same level of analysis as that of births since there were not many women who had more than one birth in either of the sample periods.[61]

In MLM, the most common model selection procedures are likelihood ratio tests and information criteria.[104] The likelihood ratio test statistic has three major drawbacks.[104] First, it is typically restricted to comparing pairs of nested models among the set of candidates. Second, there could be instances where it can select different models based on the order in which the models are compared. Third, it cannot be used for evaluating the support in the data for each of the models that is examined. Thus, model selection using information criterion was used. Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were estimated to find out the best fitting model with the least information loss.[95] They are suitable for testing the significance of the difference between the functions of different model specifications.[105] While assessing the quality of a model AIC gives means for model selection. With respect to BIC, the literature postulates that a model with the least BIC value is the best fit.[95]

As shown in table 3, due to the binary nature of the outcome variables, the multilevel analysis included logistic regressions for all objectives. MLM regressions were conducted by adjusting for the following covariates: mother's age, education, residence, wealth index, currently working status, gender of child and birth order for all objectives. As the EDHS applies sampling weights to the sample for national representativeness, these weights were accounted for in the multilevel regressions.[61] Sampling weights were rescaled since including raw weights without scaling in an MLM leads to biased parameters and standard errors.[71] In this study,

weights were scaled so that the new weights summed to the effective cluster size.[106] The following three sub-sections explain the analytical model for each objective.

Objective 1

This objective was to assess the association between acute conflict and usage of maternal services, i.e. ANC and quality, delivery services and PNC. The outcomes were assessed over the entire sample of eligible households that reported at least one birth between 1 January 2009 and 31 December 2012.

$$\log\left(\frac{Y_{ijkl}}{1-Y_{ijkl}}\right) = \alpha + \beta_1 X_{1ijkl} + \cdots + \beta_n X_{nijkl} + \gamma T_{ijkl} + \theta_l + \mu_{kl} + \eta_{jkl} + \varepsilon_{ijkl}$$

Where Y_{ijkl} is the binary outcome for birth i (level 1) within cluster j (level 2) within PSU k (level 3) within governorate l (level 4). α is a constant; $X_{1ijkl\ldots\ldots}X_{nijkl}$ are the aforementioned covariates with $\beta_1\ldots\ldots\beta_n$ as their coefficients; T_{ijkl} is a binary variable coded 1 for the peri-conflict period and 0 for the pre-conflict period, with γ as its coefficient; θ_l, μ_{kl}, η_{jkl}, and ε_{ijkl} are the error terms at governorate, PSU, cluster, and birth levels respectively.

For this objective, the sensitivity checks on alterations to model specification were checked in four ways. First, varying the cut-off for onset of conflict (Jan 2011 versus Feb 2011 versus Mar 2011). Second, changing the levels of analysis (4-level versus 3-level model). Third, applying sampling weights (no weights versus weighted unscaled versus weighted rescaled). Fourth, dropping births that took place closer to onset of conflict. Goodness-of-fit for the regression models was also assessed.

Objective 2

This objective was to assess association of conflict with usage of maternal services among different socioeconomic, demographic and geographic groups. The outcomes were assessed over the entire sample of eligible households that reported at least one births between 1 January 2009 and 31 December 2012. Stratified analysis of the strata within the explanatory variable was undertaken. Strata was classified based on (i) maternal age; (ii) residence; (iii) education; (iv) employment; and (v) household wealth quintile.

The following model specifications explain the stratified analysis.

$$\log\left(\frac{Y_{ijkl}}{1 - Y_{ijkl}}\right) = \propto + \beta_1 X_{1ijkl} + \cdots + \beta_n X_{nijkl} + \gamma T_{ijkl} + \theta_l + \mu_{kl} + \eta_{jkl} + \varepsilon_{ijkl}$$

where Y_{ijkl} is the stratum-specific outcome for birth i (level 1), within cluster j (level 2), within PSU k (level 3), within governorate l (level 4). α is a constant. X_{1ijkl} .... X_{nijkl} are the explanatory variables, with β_1 ...... β_n as their coefficients. T_{ijkl} is a binary variable that is 1 for the 'peri-conflict' sample and 0 otherwise with γ as its coefficient. θ_l, μ_{kl}, η_{jkl}, and ε_{ijkl} are the error terms at governorate, PSU, cluster, and individual birth levels respectively.

Objective 3

This objective was to assess the association of acute conflict with usage of maternal services, i.e. ANC and delivery services for women who gave birth to children in both pre and peri-conflict periods. The outcomes were assessed over the entire sub-sample of women that reported births in both pre- and peri-conflict periods. MLM regression was applied to estimate the effects on levels of maternal care use. The levels of analysis were slightly different for this objective as the outcomes were estimated over the same woman but for different births at two time periods. These levels were: births (level 1) nested within women (level 2), women nested within clusters (level 3), clusters nested within PSUs (level 4) and PSUs nested within governorates (level 5).

The following model specifications pertain to binary outcomes.

$$\log\left(\frac{Y_{ijkl}m}{1 - Y_{ijklm}}\right) = \propto + \beta_1 X_{1ijklm} + \cdots + \beta_n X_{nijklm} + \gamma T_{ijklm} + \theta_l + \mu_{kl} + \eta_{jkl} + \varepsilon_{ijkl} + \rho_{ijklm}$$

where Y_{ijklm} is the outcome for birth i (level 1) for woman j (level 2) within cluster k (level 3) within PSU l (level 4) within governorate m (level 5). α is a constant; X_{1ijklm} .... X_{nijklm} are the explanatory variables at individual and household levels (table 4) with β_1 ...... β_n as their coefficients; T_{ijklm} is a binary variable where it is 1 for the "after" sample and 0 otherwise with γ as its coefficient; θ_l, μ_{kl}, η_{jkl}, ε_{ijkl}, ρ_{ijklm} are the error terms at governorate, PSU, cluster, woman and birth levels respectively. For this objective, the sensitivity checks on alterations to model specification were checked in two ways. First, changing the levels of analysis (5-level versus 4-level model). Second, applying sampling weights (no weights versus weighted unscaled versus weighted rescaled).

Sensitivity and goodness of fit analyses

Sensitivity of the regression models was checked in the following ways and for the reasons described.

1) Changing the cut-off for onset of conflict: this was varied to examine the extent to which the results were sensitive to this study's specified timeline of the onset of conflict. The main MLM regression analysis considered February 2011 as onset of conflict. The cut-off for onset of conflict was moved by a month either way from February 2011 (i.e. January 2011 and March 2011).

2) Dropping the number of births that took place closer to conflict onset: due to the continuum of care required for maternal health (ANC followed by delivery and PNC), there is a possibility of misclassification of a particular maternal health event vis-à-vis exposure status to the conflict. For instance, a birth that occurred during the early conflict period may have had its ANC in the pre-conflict period. Similarly, for a birth that took place just before the onset of conflict would have its PNC in the conflict period. Thus, for births that occurred closer to onset of conflict (i.e. just before and just after), sensitivity of the outcomes were tested by dropping their components of maternal care (i.e. ANC and PNC respectively) from the analysis. These newly created samples excluded some births for ANC sample (births from January to September 2011) and PNC sample (births from December 2010 to January 2011).

3) Changing the levels of analysis: for research objectives 1 and 2, the main analytical model was a four-level model that included the births at the lowest level, followed by cluster, PSU, and governorate. Alternate analysis was undertaken with a three-level model by excluding governorate. For research objective 3, the main analytical model was a five-level model. Alternate analysis was undertaken with a four-level model by excluding governorate.

4) Sample weighting: the main model utilised a rescaled sample weighting. Sensitivity of this model was tested by including two other models, i.e. unweighted model and weighted unscaled model.

Goodness-of-fit for the regression model was tested for objective 1 to see the approximation of the predicted values to the observed values. Two alternate models were considered in this analysis based on 'levels of analysis' - a three level model and a four level model were included. Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were

estimated to find out the best fitting model with the least information loss.[95] Both AIC and BIC are tools to assess fitness of models penalised for the number of estimated parameters.[95] They are suitable for testing the significance of the difference between the functions of different model specifications.[105] While assessing the quality of a model AIC gives means for model selection. With respect to BIC, the literature postulates that a model with the least BIC value is the best fit.[95]

Other potential conflict-related data sources

This study was not intended as a causal analysis, instead assessing the association between conflict and maternal care use through a pre-post statistical comparison of an acute conflict. As an initial attempt to quantitatively examine the association of conflict with maternal care use through multi-level modelling on DHS data, this study focused for pragmatic reasons on the conflict temporality rather than its geographical location or magnitude. The Egyptian conflict was not severe, and during its acute phase violent events occurred across the country with minimal variation in geographical spread over time or in frequency over location and time.[63,44] Therefore, a pre-post temporal assessment was selected, including pre-conflict and peri-conflict phases, with the cut-off between them chosen based on the literature and relevant media reports (Figure 3).

A binary exposure variable was necessary to enable a pre-post comparison through multi-level modelling.[100] However, it was still necessary to determine whether the temporal variable selected was better than a location/magnitude variable. A variable that could provide a more granular conflict exposure, accounting for variation in location, magnitude, and timing would have been useful. Thus, popular conflict data sources the Armed Conflict Location & Event Data Project (ACLED) and Uppsala Conflict Data Program (UCDP) were examined to determine if there was a suitable variable providing differential location-specific conflict

exposure for Egyptian women, i.e. to determine association between levels of maternal care use and levels of conflict exposure.

ACLED, a publicly-available and disaggregated conflict analysis and crisis mapping project,[107] provides data on timing, location, fatalities, and injuries for all reported violent events during Egypt's 2011 conflict. First, ACLED's suitability was assessed. Although ACLED typically compiles conflict data from media, civil society, and human rights organizations, it relied exclusively on domestic and international media reports for the 2011 Egyptian conflict[107], which may have been biased[108] or duplicated.[109] Media-based conflict reporting is subject to selection bias of conflict events, description bias and reporting bias, e.g. events with few or no observers contained only rough location descriptions.[109] Bias was a concern, particularly as the researcher was not based in Egypt, but would not alone have precluded ACLED usage in sensitivity analyses if it had been statistically compatible with DHS data. Second, ACLED's compatibility with DHS data was assessed, by: (i) checking the onset, frequency and magnitude of conflict events to identify a conflict/non-conflict cut-off for locations (or to check whether conflict onset and frequency varied by location) to enable comparison with maternal care patterns; and (ii) ensuring conflict events could be aggregated at one comparable administrative level (e.g. province, district, sub-district). Assessing onset, frequency and magnitude of conflict events across geographical locations did not suggest an obvious cut-off for most locations (Figure 4). Both ACLED and media sources indicated that violence began and spread across the country during the study period with minimal differences in frequency, reducing the applicability of a location variable.[4,87,110] Aggregating conflict events at a comparable level is particularly necessary when two different datasets are compiled to observe an association between two phenomena across multiple locations.[111] This study was countrywide, making it necessary to aggregate conflict events at a particular level for

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comparison with maternal care. Attempted aggregation of conflict events at different geographic levels (e.g. marakiz) indicated that conflict was spread across time in the acute phase, limiting the scope of comparison. In short, the country-wide spread of conflict events in the study period limited the inclusion of a binary exposure variable based on locations and aggregation of conflict events at one administrative level. Given both accuracy and aggregation of conflict data were questionable, ACLED data were not used.

UCDP, a database of events of fatal organised violence collated by the Department of Peace and Conflict Research at Uppsala University, provides numbers of battle deaths, types of organisations involved, timing, and location.[112] UCDP compiles reports from media and international agencies including the United Nations, and is one of the most-cited conflict-data sources. UCDP defines a conflict event as "the incidence of the use of armed force by an organised actor against another organised actor, or against civilians, resulting in at least one direct death in either the best, low or high estimate categories at a specific location and for a specific temporal duration."[112] As UCDP has a stringent definition of conflict and relies on publicly-available reports, there is both a possibility of underestimation of non-fatal conflict events and overestimation of fatalities, due to multiple reports.[112] Thus, UCDP data were not appropriate for this study as UCDP only reported conflict-related deaths. The Egyptian conflict was insufficiently severe to have a large number of fatalities[4] and UCDP data could have led to either an underestimation or overestimation of the strength of association between conflict and maternal care use.

Manual derivation of conflict data was also assessed. Government, media and ACLED reports indicated conflict was widespread and frequent in the acute phase, limiting effective identification of a location-specific variable.[4,87,110]Additionally, reporting in publicly available

sources was inconsistent and already accounted for in ACLED.[3] As with ACLED data, not being able to validate locations of conflict events may have biased study results, especially when the researcher was not based in Egypt. Thus, the time variable (i.e. conflict cut-off period) – manually selected from the literature and media – was used rather than a location variable, as reporting on conflict timing was more consistent and could be tested in the sensitivity analysis. Limitations of the binary exposure variable and temporal versus locational, magnitude or combined exposure are further described in *Study limitations* (page 124).

Data management

Cleaned DHS data were stored on the DrPH researcher's allocated password-protected network drive at the London School of Hygiene and Tropical Medicine. All data, Stata do-files, and analytic templates will be kept until the DrPH viva voce is completed and related articles are externally published.

Ethics

As only anonymised publicly available secondary data were used this study did not require any specific ethical approval. The EDHS 2014 survey received ethical approval from the ICF International Institutional Review Board (IRB) in the USA and a statutory IRB constituted in Cairo with the support of MOHP.[113] The EDHS 2014 obtained written informed consent from all the respondents, after explaining the objectives of the survey and intended use of data to them.[61] All personal information was anonymised in publicly available DHS data. Before data entry, individual responses were coded for anonymity.[61]

Chapter 3. Maternal and neonatal service usage and determinants in fragile and conflict-affected situations in Asia and the Middle-East: a systematic review

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SECTION A – Student Details

Student	Saji Saraswathy Gopalan
Principal Supervisor	Natasha Howard
Thesis Title	Maternal and neonatal service usage and determinants in fragile and conflict-affected situations: a systematic review of Asia and the Middle-East

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	BMC Women's Health		
When was the work published?	2017		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	No		
Have you retained the copyright for the work?*	Yes	Was the work subject to academic peer review?	Yes

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Where is the work intended to be published?	
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Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I was the lead in conceptualisation, literature review, data analysis and manuscript drafting.

Student Signature: Date: September 1, 2017

Supervisor Signature: Date: 1 September 2017

Abstract

Background: Fragile and conflict-affected situations (FCS) in Asia and the Middle-East contribute significantly to global maternal and neonatal deaths. This systematic review explored maternal and neonatal health (MNH) services usage and determinants in FCS in Asia and the Middle-East to inform policy on health service provision in these challenging settings.

Methods: This systematic review was conducted using a standardised protocol. Pubmed, Embase, Web of Science, and selected development agency websites were searched for studies meeting inclusion criteria. Studies were assessed for methodological quality using an adapted evaluation tool. Qualitative and quantitative data were synthesised and pooled odds ratios generated for meta-analysis of service-usage determinants.

Results: Of 18 eligible peer-reviewed studies, eight were from Nepal, four from Afghanistan, and two each from Iraq, Yemen, and the Palestinian Territories. Fragile situations provide limited evidence on emergency obstetric care, postnatal care, and newborn services. Usage of MNH services was low in all FCS, irrespective of economic growth level. Demand-side determinants of service-usage were transportation, female education, autonomy, health awareness, and ability-to-pay. Supply-side determinants included service availability and quality, existence of community health-workers, costs, and informal payments in health facilities. Evidence is particularly sparse on MNH in acute crises, and remains limited in fragile situations generally.

Conclusions: Findings emphasize that poor MNH status in FCS is a leading contributor to the burden of maternal and neonatal ill-health in Asia and the Middle-East. Essential services for skilled birth attendance and emergency obstetric, newborn, and postnatal care require improvement in FCS. FCS require additional resources and policy attention to address the barriers to appropriate MNH care. Authors discuss the 'targeted policy approach for vulnerable groups' as a means of addressing MNH service usage inequities.

Background

The United Nations' post-2015 agenda calls for specific attention to address maternal and neonatal health (MNH) in fragile and conflict-affected situations (FCS).[51] Evidence indicates that without improving MNH service quality and usage in FCS, maternal and child health indicators will not improve sufficiently to achieve Sustainable Development Goal targets.[2] To implement strategic MNH interventions, FCS lack basic information on usage of MNH services and factors affecting access to MNH care.

Globally, 1.2 billion people inhabit fragile countries, while 800 million live in situations of conflict.[2] FCS are defined variously by different agencies.[2-4] However, key criteria include government not delivering core social services, instable governance with weak institutionalisation and accountability, low socioeconomic and human-development indicators, and threats to security and right to life from routine internal and external conflicts. Fragility and conflict coexist in many countries (e.g. Afghanistan, Palestinian Territories),[3] while post-conflict categorisations (e.g. Nepal), can still include fragility due to weak governance and social services delivery.[2-4] Weak governance, violent political conflict and adverse living situations challenge necessary improvement of health and living standards in FCS, and gradually impede global economic momentum.[4, 5]

Appropriate and equitable MNH service usage is prerequisite to reducing maternal and newborn ill-health, especially in FCS.[1] Evidence indicates that providing skilled birth attendance (SBA) and addressing complications during pregnancy is potential to reduce 13-33% of maternal deaths.[6] Similarly, up to two-thirds of newborn deaths are preventable with provision of essential newborn care at birth and during the first week of life.[6] FCS perform poorly on MNH as they lack the governance and infrastructural capacity to provide SBA, emergency obstetric and newborn care (EmONC), contraception, and address related maternal and neonatal complications.[1]

Although poor MNH status is a concern in FCS globally, FCS in Asia and the Middle-East are particularly relevant, with poor MNH indicators relegating several low- and middle-income FCS as some of the worst globally, e.g. Afghanistan and Yemen.[7] Several Asian countries did not achieve MDGs 4 and 5, due to fragility and conflict (e.g. Nepal, Afghanistan).[7-10] The average maternal mortality ratio in this region is 200 deaths per 100,000 live births.[9-10] Long-

term fragility is one key reason. For instance, Yemen, a chronically fragile country, has a higher maternal mortality ratio of 500/100,000.[9] Among other top contributors of maternal deaths in this region, the Palestinian Territories and Iraq are prone to conflicts, whereas Nepal has been fragile for years.[3] Asian FCS have some of the highest rates of neonatal mortality globally. For example, Afghanistan, a conflict-affected country, accounts for 2% (i.e. 36,777 deaths) of global neonatal mortality.[11-13]

FCS in Asia and the Middle-East require substantial informing evidence on MNH service usage and its determinants to help streamline policy strategising, yet available information is limited.[2] As levels of fragility and conflict vary among FCS, so does their ability to deliver MNH services.[7] Further MNH investments in the FCS of this region are unlikely to be cost-effective without a greater understanding of MNH service usage and identification of demand- and supply-side challenges and opportunities.

Objectives

The aim of this systematic review was to identify and analyse the literature on maternal and neonatal service-usage and potential determinants in FCS of Asia and the Middle-East. This region was selected because FCS here are leading contributors to the global maternal and neonatal morbidity burden and contribute relatively more eligible literature enabling a systematic review. Objectives were to (i) summarise the main findings on maternal and neonatal service-usage and (ii) identify key determinants of maternal and neonatal service usage. Implications for policy and practice were considered.

Methods

Protocol and registration

Using the criteria shown in table 4, eight low- and middle-income FCS were selected (i.e. Afghanistan, Iraq, Myanmar, Nepal, the Palestinian Territories, Syria, Timor-Leste, Yemen). As FCS were defined through national scoring, no attempt was made to include additional countries with sub-national areas of fragility (e.g. India) that did not fulfil scoring criteria. A pre-designed protocol guided the review processes, including search strategy, study selection, data extraction, quality assessment, and data synthesis. Reporting uses PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines.[13] This review is

registered with PROSPERO (International Prospective Register of Systematic Reviews) at the National Institute of Health Research, USA, as CRD42014014537.[18]

Table 4. Conceptual definitions

Concept	Definition
Asia	The largest continent in the world, occupying the eastern part of the Eurasian landmass and its adjacent islands, and bordered by the Ural Mountains, Arctic, Pacific and Indian Oceans, and Mediterranean and Red Seas. Countries eligible for inclusion are those territorially part of the Asian continent without any inter-continental territorial disputes.[14]
Middle East	A term referring, generally, to the geographical area and countries between the Black Sea to the north and the Arabian Sea to the south, including Iran and Egypt (e.g. Egypt, Iraq, Iran, Israel/Palestine, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen).[14]
Fragile and conflict-affected situation (FCS	The World Bank Harmonised List of Fragile Situations (FY14) was used, as it is accepted by several development banks and agencies.[16] Criteria are either (a) a harmonised average country performance Indicator assessment (CPIA) rating of 3.2 or less, or (b) the presence of a UN and/or regional peace-keeping or peace-building mission during the past three years. CPIA consists of performance rating against 16 criteria in four clusters: (i) economic management, (ii) structural policies, (iii) policies for social inclusion/equity, and (iv) public-sector management and institutions.[15]
Health services usage	Use of health services and supplies, it is commonly measured in terms of patterns or rates per unit of population at risk during a specified time-period.[16-17]
Maternal services	Any preventive and curative services related to pregnancy, childbirth and the postpartum period.[17] Services include antenatal care, any delivery-related care (e.g. home delivery, institutional delivery, skilled attendance), emergency obstetric care, and postpartum care.[16-17]
Newborn services	Any preventive and curative postnatal services during the first 28 days after birth, including early breastfeeding within an hour of birth, exclusive breastfeeding, treating illnesses and symptoms, and newborn vaccination.[16-17]

Information sources and search

The literature search was conducted in April 2014. First, authors searched electronic databases Embase, PubMed, and Web of Science systematically. Second, authors purposefully searched agency websites of Asian Development Bank, DFID, OECD, World Bank, and WHO. Third, authors identified potentially relevant citations from included studies and hand-searched them in relevant journals identified. Search strategies and terms were adapted as appropriate for each database and site, with a combination of MeSH and non-MeSH terms using Boolean operators "AND" and "OR." Key search words were:

"maternal health/care" [MeSH] OR "childbirth" [MeSH] OR "institutional delivery" OR "skilled birth attendance" OR "antenatal /prenatal" OR "postnatal/postpartum " OR "neonatal/perinatal/newborn" OR "infant" OR "child care/health" or "under-five care/health" AND "fragile setting/context" OR "crisis setting" OR "conflict-affected region/areas" OR "Afghanistan" OR "Nepal" OR "Myanmar/Burma" Or "Timor-Leste/East Timor" OR "Yemen" OR "West Bank and Gaza/Palestine/Palestinian Territories" OR "Iraq" OR "Syria" OR " Asia" OR " Middle-East"

Eligibility criteria and study selection

Inclusion and exclusion criteria were established through an iterative process. Authors agreed initial selection criteria based on the research question (i.e. "*What are the status and determinants of maternal and neonatal health and service-usage in FCS of Asia and Middle-East?*"), focusing on primary research. Any primary study (i.e. peer-reviewed article reporting quantitative, qualitative and mixed-methods design) was considered if published in English during 2000-2013 and reporting maternal or neonatal service usage or determinants in Asian and Middle-Eastern FCS.

Policy evaluations, reviews and discussion papers were excluded. Studies given a low quality-score during methodological assessment were also excluded. The first author reviewed title, abstract and key words of all articles retrieved. Those articles meeting eligibility criteria were selected for full review. A second author checked selection of relevant abstracts and full articles. Any disagreements prompted another round of scrutiny until consensus was reached.

Data collection

Data were extracted from each record into an Excel spreadsheet. Headings included: lead author, co-authors, year of publication, type of source (e.g. PubMed, website), study setting,

study design, outcomes of interest, number and type of participants, participant selection criteria, sample size, data analysis and reporting, limitations, and methodological quality score.

Data items

Study outcomes were restricted to service-usage for any of antenatal care (ANC), institutional delivery, skilled birth attendance (SBA), emergency obstetric and neonatal care (EmONC), postnatal care (PNC), early breastfeeding, newborn consultation for any perceived morbidity, and newborn vaccination. Any ANC was considered (e.g. any visit, all four visits, ANC from a skilled or unskilled provider). For PNC, any visit and PNC from a skilled or unskilled provider were considered. Factors affecting maternal and neonatal health services usages were included in the synthesis.

Risk of bias in studies

Authors adapted the McGill University Mixed-Methods Appraisal Tool (MMAT),[19] which has been used to assess methodological quality of both mixed-methods and primary cross-sectional studies (table 5). In adapting this tool, authors excluded irrelevant indicators (e.g. are measurements appropriate?) and included new ones (e.g. was there any recall bias in reporting data?). Nine indicators were considered for both quantitative and qualitative studies, with each scored 1 if present and zero otherwise. Summative scores indicated overall study quality (e.g. six and above was considered high quality, 4-5 medium quality, less than four low quality and therefore excluded). For mixed-method studies, the maximum summative score was 12 (i.e. nine and above was high quality, 6-8 was medium quality, less than 6 was low-quality and therefore excluded). Two authors assessed quality independently, with disagreements resolved by discussion.

Table 5. Methodological quality assessment criteria adapted from MMAT

Assessment criteria	Indicators
Scientific rigor of data collection, analysis and reporting of qualitative studies	Are the sources of qualitative data (i.e. informants, observations, documents) relevant to address the research question?
	Is the process for analysing qualitative data relevant to address the research question?
	Is appropriate consideration given to how findings relate to the context (e.g. setting in which data were collected?
	Is appropriate consideration given to how findings relate to researchers' influence (e.g. through their interactions with participants)?

scientific rigour of data collection, analysis and reporting of quantitative studies	Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?
	Is the sample representative of the population under study?
	Is there an acceptable response rate (e.g. 60% or above)?
	Are the statistical methods used appropriate for measurement?
	Was there any recall bias in reporting data?

Summary measures and data synthesis

Summary measures were percentages and odds ratios (ORs) with a confidence interval of 90%, 95% or 99% significance. Based on the heterogeneity of data, a narrative synthesis was conducted, combining both qualitative and quantitative data. If feasible, quantitative data were subjected to meta-analysis using fixed effects with odds ratios pooled for similar determinants in particular services. Forest plots were generated for each determinant with odds ratios and confidence intervals displayed. Heterogeneity among studies was tested using I^2 statistics in Stata 13. Narrative synthesis was used for qualitative data on determinants of MNH service usage to describe and compare findings across settings, types of services and population groups.

Results
Study selection

Figure 8 details the stages of study selection. Initially, after removing duplicates 1,319 records were identified as potentially relevant. After excluding irrelevant articles, 274 abstracts were screened, of which 36 were eligible for full text review. Finally, 18 peer-reviewed articles were selected for inclusion.

Figure 8. Selection of studies
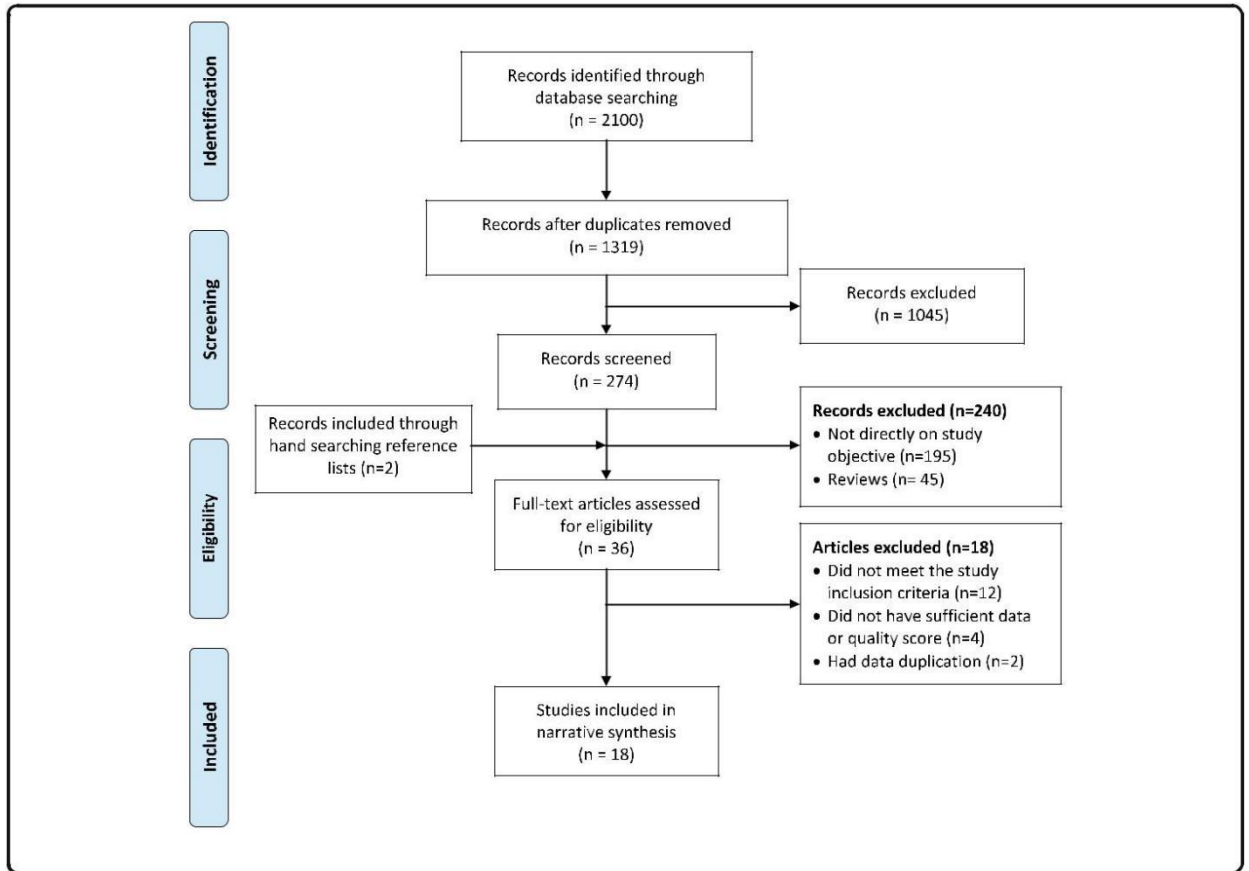
Study characteristics and methodological quality

Table 6 shows that among 18 studies included, eight (44%) were from Nepal,[20-27] four (22%) from Afghanistan,[28-31] and two (11%) each from Iraq, Yemen, and the Palestinian Territories.[32-37] Fourteen (77%) were quantitative studies (i.e. 11 cross-sectional surveys, 2 (11%) used national health survey data, 1 prospective cohort study), two (11%) were qualitative, and two (11%) used mixed-methods designs. All studies included met the required methodological quality criteria suggested by MMAT (table 5) particularly for data collection, analysis, and reporting. Twelve (66%) studies received a high methodological quality score and 7 (38%) received a medium score. Studies exhibited a few minor quality issues as described below.

None of the quantitative studies was nationally representative or generalisable. Data analysis was not presented with considerable details in Devkota and Bhatta 2011, Khorrami *et al*.2008, Mayhew *et al*.2008 or Njem and Al-deen 2011.[94,114–116] Khorrami *et al*.2008, Mayhew et al., Njem and Al-deen 2011, Sharma *et al*. 2014 and Ulak M *et al*. 2012 did not provide sufficient details on study settings.[94,115–118] Three studies (e.g. Devkota and Bhatta 2011, Karkee *et al*. 2013, Shrestha *et al*. 2012) focused on remote fragile settings.[55,114,119] Dhaher *et al*. 2008, by examining factors affecting postnatal care in Palestine, reflected the status of postpartum women in a conflict-affected setting.[120] Among qualitative studies, Rahmani and Brekke 2013 did not triangulate information from several data sources.[121]

Neither mixed-methods study (i.e. Kempe *et al*. 2013, Basaleem *et al*. 2012) was nationally representative and generalisability was not addressed.[122,123] Kempe *et al*. 2013, did not report adequate description on the processes of data analysis or the necessity of using qualitative data.[34] Basaleem *et al*. 2012 used a mixed-methods design to explore maternal health and influence of women's autonomy in Yemen.[35] In this study, details on study setting and quantitative data analysis were not clearly explained, while statistical analyses of determinants were not in-depth.[35]

Table 6. Study characteristics and quality score, ordered by country and year

Author (year)	Country	Design	Sample	Score
Newbrander *et al.* (2013)	Afghanistan	Qualitative	30 IDIs and 29 FGDs with community members in 5 districts	6/9
Rahmani and Brekke (2013)	Afghanistan	Qualitative	12 IDIs with pregnant/recently-delivered women and 15 IDIs with providers in 2 provinces	6/9
Hirose *et al.* (2011)	Afghanistan	Cross-sectional	411 paired couples surveyed at 1 regional hospital	7/9
Mayhew *et al.* (2008)	Afghanistan	Cross-sectional	9,917 recently-delivered (2yrs) women surveyed in 33 provinces	5/9
Khorrami *et al.* (2008)	Afghanistan	Cross-sectional	292 women inpatients with obstetric complaints surveyed at 1 hospital	5/9
Najem and Al-Deen (2011)	Iraq	Cross-sectional	251 primipara postnatal mothers surveyed at 1 hospital	4/9
Siziya *et al.* (2009)	Iraq	Secondary survey	22,980 recently-delivered (1yr) MICS participants	8/9
Sharma *et al.* (2014)	Nepal	Cross-sectional	240 recently-delivered (1yr) women surveyed in 1 district.	5/9

Choulagai *et al.* (2013)	Nepal	Cross-sectional	2,481 recently-delivered (1yr) women surveyed in 3 districts	7/9
Karkee *et al.* (2013)	Nepal	Prospective cohort	700 pregnant women in 1 district	7/9
Shrestha *et al.* (2012)	Nepal	Cross-sectional	732 married reproductive-age women	6/9
Ulak *et al.* (2012)	Nepal	Cross-sectional	352 mothers of infants attending vaccination	6/9
Devkota and Bhatta (2011)	Nepal	Cross-sectional	71 mothers of newborns	4/9
Dhakal *et al.* (2011)	Nepal	Cross-sectional	150 recently-delivered women	7/9
Dhaher *et al.* (2008)	Palestine	Cross-sectional	264 postpartum outpatient women	7/9
Giacaman *et al.* (2007)	Palestine	DHS survey	2,158 women residing in the West Bank and Gaza Strip	7/9
Kempe *et al.* (2013)	Yemen	Mixed-methods	220 women with childbirth experience in urban/rural areas	7/12
Basaleem (2012)	Yemen	Mixed-methods	1,678 women surveyed and 11 FGDs with men and women	9/12

Service-usage

Table 7 provides service-usage findings. Three studies (17%) described ANC usage.[20-21,34] Overall, at least one ANC visit was above 50% in both Nepal and Yemen. [20-21,34] More than 60% of Yemeni women obtained ANC from a professionally trained provider in the first trimester.[20]

Five studies (27%) mentioned SBA usage.[92,94,120,122,123] There was a sizable difference in SBA usage across studies from 13% in Nepal to 50% in Yemen.[13,122] Kempe *et al.* 2013 noted usage of untrained traditional birth attendants (32%) was much higher than of medical doctors (17%) or nurse-midwives (13%) in Yemen.[35] Three studies discussed institutional delivery,[21,23, 37] which ranged from 85% in Nepal to 97% in Palestine.[23,37] Giacaman *et al.* noted that usage was higher for government (56%) compared to private (28%) facilities for childbirth in the Palestinian Territories.[37]

Three studies (17%) discussed PNC, with less than 40% coverage found in Palestine, Yemen and Nepal.[22,34,36] More than 70% and 60% of those sampled received PNC from hospitals and trained physicians respectively.[22] Two studies (11%), from Nepal and Iraq, discussed newborn care.[21, 27,32] Breastfeeding within an hour of delivery ranged from 7% to 57%. In Nepal and Iraq studies, 70% of mothers did not seek any professional advice on newborn health and 30% did not vaccinate newborns.[20, 32]

Table 7. Maternal and neonatal service usage, ordered by service type and % usage

Service	Study	Outcome	% usage
Antenatal care (ANC)	Basaleem (2012)	Professional ANC	97.7%
		ANC in 1st trimester	60%
	Choulagai *et al.* (2013)	4+ ANC	57%
	Devkota and Bhatta (2011)	At least one ANC	71.8%
Skilled birth attendance (SBA)	Basaleem (2012)	SBA usage	50%
	Choulagai *et al.* (2013)	SBA usage	48%
	Dhakal *et al.* (2011)	SBA usage	31%
	Mayhew *et al.* (2008)	SBA usage	13%
	Kempe *et al.* (2013)	TBA usage (untrained)	71 (32%)
		TBA usage (trained)	10 (5%)
		No one attended delivery	30 (14%)
		Attended by medical doctor	37 (17%)
		Attended by nurse-midwife	29 (13%)
Facility-based delivery (FBD)	Devkota and Bhatta (2011)	Facility-based delivery	8.5%
	Giacaman *et al.* (2006)	Facility-based delivery	96.5%
		Delivered in govt hospital	56.4%

		Delivered in private hospital	28.3%
	Karkee *et al.* (2013)	Facility-based delivery	85%
Postnatal care (PNC)	Basaleem (2012)	Received any PNC	20%
	Dhaher *et al.* (2008)	Received any PNC	36.6%
	Dhakal *et al.* (2011)	Received any PNC	34%
		Received any within 48 hours of birth	19%
		Received from a hospital	78%
		Received from a trained physician	65%
		Received from a nurse	20%
		Received from another health-worker	16%
Newborn care	Devkota and Bhatta (2011)	Breastfed within 1 hr of delivery	7%
	Najem and Al-Deen (2011)	Breastfed within 1 hr of delivery	7%
		Never breastfed	13.5%
	Ulak *et al.* (2012)	Breastfed within 1 hr of delivery	57%
	Devkota and Bhatta (2011)	Did not seek health services for newborn complications	70.4%
		Did not vaccinate newborn	35.2%

Determinants of service usage

Table 8 summarises findings on determinants of service usage. Determinants of SBA were discussed in three studies from Iraq and Nepal.[92,94,124] Women who depended on TBAs for delivery were generally less educated, less wealthy, and older.[33] Having at least four ANC visits, knowledge of pregnancy danger signs, residing near a facility, being wealthier and better-educated were demand-side factors increasing the probability of SBA usage.[92,94,124] Pooled odds ratios (Figure 9) showed education was associated with a 20% increased odds of SBA usage (OR 1.2, 95% CI 1.07-1.33), whereas wealth quintile was not significant (OR 0.89, 95% CI 0.74-1.04). On the supply-side, having more than one female traditional birth attendant (TBA) and community health-worker in the community, and at least one female doctor and provision of antenatal and emergency obstetric care in the facility increased SBA usage.[124] Similarly, absence of user fees and availability of health insurance increased the odds of SBA usage.[94] Qualitative studies indicated that women's autonomy over decision-making about her health and personal life was a decisive factor in using SBA.[35] However, despite having

autonomy several nomadic women in Yemen reported not wanting SBA.[30, 35] Two studies (11%) indicated that informal payments restricted timely access to facility care among pregnant women.[30, 35]

Determinants of facility-based delivery were discussed in five (27%) studies. [23, 25-26, 33, 37] Usage was higher among women with at least one ANC visit, more education, younger, employed, belonging to higher-status social groups, and who resided near facilities and in physically-accessible areas.[22-23, 25-26, 37] Meta-analysis indicated education was a significant determinant across most studies. Pooled odds ratios showed education was significantly associated with a higher proportion of facility-based delivery (OR 2.78, 95% CI 1.63-3.94). Qualitative research in Yemen indicated women preferred facility-based delivery given adequate staff, medicines, emergency care, cleanliness and arrangements for labour induction and neonatal resuscitation.[34] Public hospitals were reportedly preferred by Yemeni women due to the presence of qualified staff.[34] However, some women preferred home delivery for feelings of security, family support, and lower costs.[34]

Determinants of delayed EmONC was discussed in two (11%) studies.[28-29]These included not attending any ANC, care-seeking from traditional healers, and not wanting facility-based delivery. Absence of a midwife in the community or a facility also contributed to delayed EmONC. One study showed that residing near a facility, availability of an automobile for travel, inexpensive services, and perceived availability of safe care at the facility all increased the odds of EmONC usage.[29]

Table 8. Factors affecting maternal and neonatal service usage, ordered by service type and outcome

Author (year), country	Outcomes	Determinants	Odds ratio or percentage
Skilled birth attendance			
Choulagai *et al.* (2013), Nepal	SBA usage	*Education*	
		Informally educated	OR 1.18 (CI0.92–1.51), p<0.05
		Educated intermediate and above	OR 4.41 (CI2.89–6.72), p<0.05
		Wealth quintile	
		Q2 (poorer)	OR 1.08 (CI 0.81-1.43), p<0.05
		Q5 (wealthiest)	OR 1.90 (CI 1.42-2.56), p<0.05
		Knowledge	
		Knowledge of at least one danger sign	OR 1.31 (CI 1.08-1.58), p<0.05
		Distance	
		Staying ≤ 30 minutes from facility	OR 1.31 (CI 1.08-1.58), p<0.05
		ANC use	
		≥4 ANC visits	OR 2.39 (CI 1.97-2.89), p<0.05
Mayhew *et al.* (2008), Nepal	SBA usage	*Wealth quintile*	
		Q2 (poorer)	OR 1.6 (CI 1.2-2.3), p<0.01
		Q5 (wealthiest)	OR 6.3 (CI 4.4-8.9), p<0.01
		Distance	
		Walking distance to clinic (31–60 minutes)	OR 0.7 (CI 0.6-0.8), p<0.01
		Walking distance to clinic (>90 minutes)	OR 0.4 (CI 0.3-0.6), p<0.01
		Education	
		Formally educated	OR 3.8 (CI 3.2-4.5), P<0.05
		Earlier been to this health facility	OR 1.7 (CI 1.3-2.1), p<0.05
		At least some basic EmONC equipment in facility	OR 1.0 (CI 0.7-1.3), p<0.05
		≥1 Community health worker in catchment area	OR 0.7 (CI 0.6-0.95), p<0.05
		≥1 female TBA in catchment area	OR 1.3 (CI 1.0-1.7), p<0.05
		≥1 female doctor or midwife at health facility	OR 1.4 (CI 1.1-1.8), p<0.05

		User fees collected in facility	OR 0.8 (CI 0.6-0.96), p<0.05
		Antenatal care provided in facility	OR 1.1 (CI 0.8-1.5), p<0.05
Siziya *et al.* (2009), Iraq	TBA usage	*Wealth quintile* Q2 (poorer) Q4 (wealthier)	OR 2.90 (CI 2.49-3.39), p<0.05 OR 0.79 (CI 0.65-0.96), p<0.05
		Age Women aged 25–34 years	AOR 1.22 (CI 1.08-1.39), p<0.05
		Education Formally educated	OR 1.08 (CI 0.96-1.22), p<0.05
		Children Having 1-2 children	AOR 0.72 (CI 0.59-0.87), p<0.05
Facility-based delivery			
Dhakal *et al.* (2011), Nepal	FBD	*Age* 25+ years 20-24 years	OR1.38 (CI 0.34-5.55), p<0.001 OR 2.67 (CI 0.70-10.19), p<0.001
		Occupation Housewife Working women	OR 4.77 (CI 2.16-10.54), p<0.001 OR 5.80 (CI 0.91-36.84), p<0.001
		Education Educated up to primary level Educated to secondary and above	OR 2.29 (CI 0.82-6.37), p<0.001 OR 16.59 (CI 6.27-43.80), p<0.001
		ANC use ≥1 ANC visit	OR 20.0 (CI 2.64-151.51), p<0.001
Giacaman *et al.* (2006), Palestine	FBD	*Client satisfaction* Avoiding public facilities due to dissatisfaction	OR 2.77 (CI 1.89-4.05), p<0.001
		Financial reasons Insurance or low cost for opting facility	OR 5.83 (CI 3.96-8.59), p<0.001
Karkee *et al.* (2013), Nepal	FBD	*Education* Educated up to primary level Educated to higher-secondary or above	AOR 3.57 (CI 1.60-7.94), p<0.001 AOR 12.39 (CI 5.09-30.2), p<0.001
		ANC use ≥4 ANC visits	AOR 2.15 (CI 1.25-3.69), p<0.005
		Distance ≤30 minutes 31-60 minutes	OR 11.61 (CI 5.77-24.0), p<0.001 AOR 1.72 (CI 0.93-3.19), p<0.001
Sharma *et al.* (2014), Nepal	FBD	*Education* Formally educated	OR 2.8 (CI 1.58-4.97), p<0.001
		Distance <60 minutes to facility	OR 3.12 (CI 1.61-0.04), p<0.001

		ANC use	
		Had antenatal visits	OR 5.82 (CI 2.95-11.5), p<0.001
Shrestha *et al.* (2012), Nepal	FBD	*Distance*	
		Residing in remote area	OR 2.81 (CI1.08-7.30), p<0.05
		Community	
		Newer community	OR 2.56 (CI 1.19-5.55), p<0.05
		Education	
		Formally educated	OR 2.66 (CI 1.18-6.01), p<0.05
		ANC use	
		No ANC visits	OR 5.53 (CI 2.12-14.4), p<0.05
Emergency obstetric care			
Hirose *et al.* (2011), Afghanistan	Delay in seeking EmONC	*ANC use*	
		Lack of ANC	AOR 4.6 (CI 1.7-12.2), p<0.05
		Socio-cultural factors	
		Usage of traditional healer	
		Weak relationship with her birth family	AOR 3.2 (CI 1.2-8.5), p<0.05 AOR 2.0 (CI 0.9-4.4), p<0.05
		No plan to use health facility for delivery	AOR 2.0 (CI 0.9-4.2), P<0.05
		System factors	
		Absence of a midwife	AOR 2.2 (CI 1.1-4.5), p<0.05
Khorrami *et al.* (2008), Afghanistan	Timely EmONC usage	*Distance to facility*	
		<100 miles	N=249 (85.3%)
		≥100 miles	N=43 (14.7%)
		Mode of travel	
		Automobile	N=192 (65.8%)
		Bus	N=97 (33.2%)
		Cost as a limitation	
		Yes	N=38 (30.7%)
		No	N=86 (69.4%)
		Safety felt about care at this hospital	
		Moderately safe	N=100 (34.4%)
		Mildly safe	N=177 (60.8%)

NB: *CI is 95% confidence interval. AOR is adjusted odds ratio.

Figure 9. Association of determinants with MNH care seeking

Study	Country	ES (95% CI)	Weight
Education on facility delivery			
Dhakal et al. 2011	Nepal	2.29 (0.82, 6.37)	17.34
Shrestha et al. 2012	Nepal	2.66 (1.18, 6.01)	22.90
Karkee et al. 2013	Nepal	3.57 (1.60, 7.94)	13.29
Sharma et al. 2014	Nepal	2.80 (1.58, 4.97)	46.48
Subtotal (I-squared = 0.0%, p = 0.947)		2.78 (1.63, 3.94)	100.00
Education on skilled birth assistance			
Mayhew et al. 2008	Nepal	3.80 (3.20, 4.50)	3.83
Siziya et al. 2009	Iraq	1.08 (0.96, 1.22)	95.73
Choulagai et al. 2013	Nepal	4.41 (2.89, 6.72)	0.44
Subtotal (I-squared = 97.4%, p = 0.000)		1.20 (1.07, 1.33)	100.00
Wealth quintile on skilled birth assistance			
Mayhew et al. 2008	Nepal	6.30 (4.40, 8.90)	0.44
Siziya et al. 2009	Iraq	0.79 (0.65, 0.96)	92.70
Choulagai et al. 2013	Nepal	1.90 (1.42, 2.56)	6.86
Subtotal (I-squared = 94.4%, p = 0.000)		0.89 (0.74, 1.04)	100.00

0.1   1   10
Less care seeking   More care seeking

NB: ES is the estimated statistic (odds ratio); weight, assigned weights by study in the estimation of pooled estimate.

Discussion

Summary of evidence

This systematic review synthesised the limited qualitative and quantitative evidence on maternal and neonatal service usage and its determinants in fragile and conflict-affected situations in Asia and the Middle-East. Relevant findings are similar to those in non-FCS, but more difficult to resolve given the unique challenges of FCS. These include disparities in the usage of essential MNH services among different socioeconomic, demographic and geographic groups even within FCS, with disadvantaged groups (e.g. women with no formal education, living at a distance from health facilities) facing additional barriers. This highlights the need to improve delivery of key MNH services (e.g. SBA, EmONC, PNC) in Asian and Middle-Eastern FCS. Similarly, recognised demand-side barriers from non-FCS, including lack of awareness, money, and transportation, still need to be sufficiently addressed in Asian and Middle-Eastern FCS. This review revealed evidence gaps in MNH in Asian and Middle-

Eastern FCS, particularly for EmONC, PNC, newborn care, and service usage in acute-conflict situations.

Both low- and middle-income countries were included in this review, and usage of MNH services and their determinants were found to be similar across both categories. These findings reiterate the similarly limited healthcare infrastructure, service delivery and demand-side pre-disposing factors, found in FCS irrespective of national income.[40-41] Most studies focused on remote and marginalised populations within FCS, which while useful in describing in-country social and political fragility, limited generalisability. No studies distilled MNH service-usage during acute conflict, though Afghanistan, Iraq and the Palestinian Territories included areas of acute conflict. Existing evidence indicates that even better-performing FCS are unable to effectively address MNH during recurrent crises.[6, 38-39] Without ensuring EmONC and transportation services during acute crises, maternal and neonatal deaths in FCS will not be curtailed.[6] Additional research is needed to explore MNH services access and adaptive responses during acute crises (e.g. EmONC) to improve services sufficiently to achieve global MNH targets.[38]

Evidence is particularly limited on usage of some essential maternal and neonatal health services for EmONC, PNC, and newborn care in the FCS of Asia and Middle-East. Overall, MNH service usage trends in Asian and Middle-Eastern FCS were similar to those found for FCS globally (e.g. low SBA and PNC usage).[42-47] Usage of all MNH services was low, though highest for ANC. However, data collection emphasised receiving any ANC rather than the 4+ ANC visits recommended by WHO. Thus, it is not possible to conclude that existing ANC usage is adequate in these FCS. More research is necessary on timing of first visit and completion of 4+ ANC visit.[7]

SBA usage differed significantly across studies within the same countries, though usage was universally low. This intra-country variation appears due to socioeconomic differences, with SBA usage higher in relatively wealthier areas within countries (e.g. Nepal). Additionally, some differences could be attributed to substantial variations on sample sizes across studies. In FCS, presence of a female traditional birth attendant (TBA) or community health worker (CHW) increased the possibility of receiving SBA. As demonstrated by several other resource-

constraint settings (e.g. Kenya and Uganda), mainstreaming TBA or CHW into formal primary care system can be a feasible option to improving access to MNH care in FCS as well.[48-49]

Facility-based delivery was higher than SBA usage, and highest in the Palestinian Territories. Literature indicates that the Palestine Territories, despite fragility and ongoing conflict has a comparatively higher rate of dependence on skilled professionals for maternal care, even in refugee camps, though quality of care is a concern.[40-41] Small geographical size of the territories likely contributes to higher SBA usage.[39] Elsewhere, dependence on TBAs was considerable, and generally attributed to inadequate availability of professional care and potential lack of awareness.[35] Over-reliance on TBAs is commonly reported in FCS globally due to demand- and supply-side barriers to usage of professional services.[38-39]

Usage of newborn services was mixed. Usage of public facilities was higher than for private facilities in these FCS,[34] a trend recognised in FCS globally (e.g. Zimbabwe, Somalia).[7, 42-43] While findings were mixed on initiation of early breastfeeding within an hour of birth, no study found timely care-seeking for neonatal health concerns. Several women reported using traditional healers instead, as reported in other FCS.[7, 42-47]

It is essential to highlight the fundamental inequity found in MNH services usage in the studies included. Both demand- and supply-side factors favoured wealthier women. For example, MNH services usage was higher among women who were wealthier and in geographically-accessible areas. It is likely these women had more knowledge, income, and/or available services encouraging greater usage. Inequity in MNH services access is found in both FCS and non-FCS (e.g. Nigeria, Uganda)[45-46] as social programmes tend to favour advantaged populations through existing structures and practices in coverage and implementation.[46] However, FCS must address a relatively stronger vicious circle of inequity due to weak governance and policy paralysis, which augment these inequities.[50-51]

To address the barriers and inequities discussed, FCS require more support than do non-FCS. However, international donor presence does not necessarily streamline health policy-making in FCS.[3-4] For example, though targeted policies and strategies for vulnerable groups were planned by donors, often no commensurate improvement in living and health standards is visible, due to issues such as weak aid coordination, planning and institutional support.[3-5]

Authors propose adapting targeted policy approaches to improve coordination of aid and planning. Specific demand-side initiatives are needed to address socio-cultural barriers and women's financial access to healthcare in FCS. Given the often limited finances available to women in FCS, policy-level action is necessary to reduce demands for informal payments.[30, 35] Supply-side issues with availability of community-based workers and transportation services were emerging themes that require additional research.

Limitations

This review is limited by the studies available. Though incorporating a vast literature, this review included only peer-reviewed research articles with a minimum level of methodological quality, thus considerable gaps remain. Authors adhered to the FCS classification used by the World Bank, which may have omitted some potential fragile countries in Asia or the Middle-East. Additionally, authors did not analyse sub-national fragility and therefore omitted non-FCS with higher burdens of maternal and neonatal ill-health (e.g. India).[51] Caution should be used in interpreting findings, as studies included were primarily non-generalisable.

Despite limitations, this review is relevant for contributing analysis of the evidence on MNH service-usage in FCS and potentially increasing policy attention for this under-researched topic. As this review covers the relatively under-studied factors associated with MNH and service-usage in Asian FCS, inclusion of both qualitative and quantitative data strengthened potential triangulation.

Conclusions

Findings emphasise that poor MNH in FCS is a leading contributor to the burden of maternal and neonatal ill-health in Asia and Middle-East. FCS require additional resources and policy attention if they are to address key barriers to effective MNH care. While existing evidence is relatively minimal, particularly for acute-crises, similarities in MNH service-usage and determinants were found in Asian and Middle-Eastern FCS. Overall, usage remains low due to supply-side (e.g. limited services, quality, costs) and demand-side (e.g. education) barriers. More evidence is necessary on timing of first ANC visit, completion of 4+ ANC visits, and increasing usage of EmONC, PNC and newborn services. Initiatives to increase effective coverage of SBA, EmONC, PNC and newborn services are particularly needed, while prevailing service-usage inequities can be tackled through targeted policy approaches.

Chapter 4. Association between conflict and maternal care for full-sample

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SECTION A – Student Details

Student	Saji Saraswathy Gopalan
Principal Supervisor	Natasha Howard
Thesis Title	Associations between acute conflict and maternal care usage in Egypt: an uncontrolled before-and-after study using Demographic and Health Survey data

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	International Journal of Health Policy and Management
Please list the paper's authors in the intended authorship order:	Saji S Gopalan, Richard J Silverwood, Natasha Howard
Stage of publication	Not yet submitted

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I was the lead in conceptualisation, literature review, data analysis and manuscript drafting.

Student Signature: Date: September 1, 2017

Supervisor Signature: Date: 1 September 2017

Abstract

Background: United Nations' data indicate that conflict-affected low- and middle-income countries contribute considerably to global maternal deaths. Improved access to quality maternal care can reduce maternal health risks. Although access to maternal care can be hindered in conflict-affected settings, usage patterns during conflict have not been examined in depth and a cause-effect analysis is relevant for policy insights. Thus, this study assessed the impact of the acute Egyptian conflict (2011-2012) on maternal services usage and quality.

Methods: An uncontrolled before-and-after study used data from the 2014 Egypt Demographic and Health Survey. The 'pre-conflict sample' included births occurring from January 2009 to January 2011. The 'peri-conflict sample' included births from February 2011 to December 2012. The hierarchical nature of DHS data was addressed using multi-level modelling.

Results: 2,569 pre-conflict and 4,641 peri-conflict births were reported. After adjusting for socioeconomic variables, conflict did not significantly affect antenatal service usage. Compared to the pre-conflict period, peri-conflict births had slightly lower odds of delivery in public institutions (OR 0.987; 95% CI 0.975-0.998; $p<0.05$), institutional postnatal care (OR 0.995; 95% CI 0.98-1.00; $p=0.05$), and at least 24 hours post-delivery stay (OR 0.921; 95% CI 0.906-0.935; $p<0.01$). Peri-conflict births had relatively higher odds of doctor-assisted deliveries (OR 1.021; 95% CI 1.004-1.035; $p<0.05$), institutional deliveries (OR 1.022; 95% CI 1.00-1.04; $p<0.05$), private institutional deliveries (OR 1.035; 95% CI 1.017-1.05; $p<0.001$), and doctor-assisted postnatal care (OR 1.015; 95% CI 1.003-1.027; $p<0.05$). Sensitivity analysis did not change results significantly.

Conclusions: Maternal care showed limited associations with the acute conflict, generally reflecting pre-conflict usage patterns. Further qualitative and quantitative research could identify the effects of larger conflicts on maternal care-seeking and usage, and inform approaches to building health system resilience.

Background

Conflicts affect population health and human development adversely.[11]Currently, 800 million people live in conflict-affected settings globally.[1] In 2014, 40 active armed-conflicts in 46 countries caused 167,000 fatalities.[1,2] Conflict is considered a major barrier to achieving UN Sustainable Development Goals (SDGs), including improved maternal health status.[15,51] Conflicts in low- and middle-income countries (LMICs) are associated with poor maternal and child health (MCH) outcomes.[125] For instance, among the 34 LMICs farthest from reaching global MCH targets, 22 are conflict-affected. Conflict-affected settings are considered to contribute a significant share of global maternal and child deaths (about 30% to 50%), though this is a source of ongoing debate.[37]

Inadequate maternal care-seeking is considered a leading cause of poor MCH indicators in conflict-affected settings.[126] During conflict, maternal care requires additional attention to emergency obstetric and newborn care along with routine antenatal (ANC) and postnatal (PNC) care visits.[24] However, conflict-affected countries generally have less than half of the recommended numbers of health-workers or infrastructure necessary to address maternal care.[20,21,23] Maternal and child deaths surge during and after conflict, mainly due to physical violence and the breakdown of healthcare delivery systems.[20] Epidemiological estimates indicate that access to skilled birth attendants and ANC can reduce maternal deaths considerably (e.g. by 33% and 12% respectively in LMICs), including during conflict.[54,127] Although appropriate maternal care usage has been identified as the most effective means of improving MCH in conflict-affected settings, evidence on maternal care-seeking and usage patterns remains limited.[23] Without better evidence on these patterns during conflict, policy and practice responses may not be effective or efficient.[57]

The Middle-East is a region historically known for persistent conflicts and Egypt is a conflict-prone country in the region.[2,4] During 2011-2013, Egypt experienced acute conflict as thousands of civilians protested against the government.[3] Prolonged armed and unarmed protests across the country disrupted governance and civil life. In addition to increased fatalities and injuries, the conflict was expected to weaken economic growth and human development indicators.[3] Political paralysis damaged public service delivery systems, access

to health services, and healthcare-seeking.[14] Nonetheless, evidence of the impact of the conflict on population health is limited.[3]

Due to the inadequacy of existing data, few studies focus on maternal care usage in conflict-affected settings.[14] While primary data are preferable when undertaking such cause-effect analyses, collection of primary data is often challenging during conflict.[11] Reliable secondary data, especially a country-wide demographic and household survey (DHS), may be a feasible alternative option. Egypt was chosen for the following three reasons: (1) a recent conflict is better for investigating the effects of conflict on maternal care usage and provides fresh evidence, as the nature and trajectory of conflicts change over time; (2) the 2014 Egypt DHS provides country-wide data on comprehensive maternal care, enabling a before-and-after comparison of the effect of conflict; and (3) analysis of the effect of the Egyptian conflict on the health system and maternal care remains limited.[61]

Objectives

This uncontrolled before-and-after study examined the association between the acute 2011-2012 Egyptian conflict and maternal care usage and quality, using 2014 Egypt DHS data. Objectives were to estimate: (i) the association of conflict with usage of antenatal, delivery, and postnatal services; and (ii) the association of conflict with quality of antenatal services received.

Methods

Study setting

The pluralistic Egyptian healthcare system demonstrates inequities, with rural areas possessing poorer infrastructure, funding, and human resources than urban areas.[3,65] Private out-of-pocket spending was 72% of total health spending in 2014, while total health spending was 5% of gross domestic product in 2011.[70] The public sector, despite being the largest healthcare provider, faces constraints such as limited funding, staff, and managerial capacity.[62,65,76] During the last decade, MCH scenario in Egypt has been showing some progress with growing inequalities.[70] In 2012, the under-five mortality rate was 27 per 1,000 live births while the maternal mortality ratio was 82 per 100,000 live births.[61] Rural children were more at risk of anaemia than urban children (29% and 23% respectively) in 2014.[80] A hospital-based study in

2009 indicated obstetric haemorrhage, hypertensive disorders of pregnancy and cardiac arrest were major causes of maternal deaths.[78] Poor quality care and delay in seeking care were also other reasons reported for maternal deaths.[78]

The Egyptian revolution began in January 2011, and its acute phase continued until 2013.[3] Media reports indicate the country is still at risk of conflicts among different political groups.[4] The acute phase began when thousands of civilians protested against the Government, led by then long-time president Hosni Mubarak.[3,4] Despite his resignation, conflicts continued and became widespread under the military regime. When an elected government took office in 2012, protests became more acute.[3] Contributing factors to the rise of mass protest, included an autocratic government, rising poverty, and inequitable social programmes.[3,4]

Study design

A quasi-experimental 'uncontrolled before-and-after' design was selected to explore the cause and effect relationship between conflict and maternal care usage. This design enabled comparison of changes in levels of maternal care usage and quality of care before and during acute conflict. Multi-level modelling (MLM) was applied as it enables exploration of a cause-effect relationship within DHS data (as DHS analysis units are hierarchical),[73] accounts for the clustered nature of the data, and reduces the chance of Type 1 error.[102,103] Births occurring from 1 January 2009 to 31 January 2011 constituted the 'pre-conflict' sample and those from 1 February 2011 to 31 December 2012 were the 'peri-conflict' sample. Births occurring from 1 January 2013 onwards were excluded, as media reports indicated that acute conflict ended in early 2013.

The study adopted a working definition of 'conflict-affected' from the relevant literature[1,2,5,6,20,24] as a setting in which routine socio-political, economic and/or civil life are disrupted due to armed political conflict.

Data source and sampling

Data were drawn from the Egypt Demographic and Household Survey (EDHS) 2014[61], a nationally representative study providing both national and sub-divisional data, though excluding North and South Sinai governorates for political reasons. EDHS data were collected

in April-June 2014.[61] The EDHS 2014 used multi-stage sampling, with towns and villages as primary sampling units (PSU) for urban and rural areas respectively.[61] [61] First, 884 PSUs were selected. Second, depending on PSU size, systematic sampling yielded 1-3 parts per PSU (1,000 households each). Third, each part was divided into equally-sized segments (200 households each), two to three of which were selected randomly from each PSU. A total of 1,838 segments (clusters) were selected from 884 PSUs. A household listing was undertaken in each segment. An average of 15 households was selected from each segment using a systematic random sample procedure. Thus, yielding a total of 29,471 households for the 2014 EDHS. Eligible participants were ever-married women aged 15-49 and present in selected households the night prior to interview. There were a total of 21,903 eligible women for the entire survey. From each woman, details on childbirths for the preceding five years from the date of survey were gathered.

Between 1 January 2009 and 31 December 2012, there were 7,210 births recorded from 7,118 eligible women in 1,679 clusters as per EDHS. These 7,210 births came from both pre-conflict and peri-conflict periods. Specifically, the pre-conflict period had 2,569 births and the peri-conflict period had 4,641 births.

Data collection and outcome measures

Local enumerators, who were recent university graduates, collected data using an Arabic version of the DHS questionnaire. All questions were pre-tested and revised to suit the local context. This study used the component survey of ever-married women aged 15-49 years, focusing on usage of maternal and child health services. This component questionnaire collected data on respondent background, reproduction, pregnancy and breastfeeding, child immunisation and health, husband's background, and respondent employment and decision-making. Maternal care data included location of care-seeking (home, institution), facility type (public, private), provider type (skilled, unskilled), and frequency, timeliness, and content of services received.

Study outcomes were components of maternal care usage, as maternal healthcare is usually categorised by maternity stage, i.e. antenatal, delivery, and postnatal (Table 9). Each outcome was analysed by contextual variants, i.e. location (facility, non-facility), provider (skilled,

unskilled), and number of ANC or PNC visits. Explanatory variables were mother's age (<25, 25-29, 30-34, >35), education (no education, primary, secondary and above), occupation (currently working and not working), birth order (1, 2-3, 4-5, 6 and above), child gender, residence (urban/rural), and household wealth quintile.

Wealth quintiles were derived from the EDHS wealth index, which weighted household characteristics and asset possession using principal component analysis (PCA) of their relative importance.[61] The index categorised sampled households into quintiles from poorest to wealthiest. ANC quality was considered adequate if the woman reported receipt of all five key services: (i) being weighed, (ii) having blood pressure measured, (iii) having a urine sample collected, (iv) having a blood sample collected, and (v) having iron tablets prescribed. This variable was binary, taking value 1 if all services were received and 0 if one or more of these services were not received.

Table 9. Outcome measures

Maternal care	Variables
Antenatal care (ANC)	Whether ANC received
	At least 4 ANC received
	Whether ANC received from a public institution
	Whether ANC received from a skilled provider
	Whether ANC received from a doctor
	Whether first ANC received within 12 weeks*
ANC* content	Whether ANC included blood pressure measurement
	Whether ANC included weighing
	Whether ANC included collection of urine samples
	Whether ANC included collection of blood samples
	Whether ANC included prescription of iron tablets
Adequate ANC quality*	Whether ANC included all recommended elements, i.e. blood pressure, weight, urine and blood samples, iron tablets
Delivery care	Whether delivery occurred in an institution
	Whether delivery occurred in a public institution
	Whether delivery occurred in a private institution
	Whether delivery assisted by a skilled provider
	Whether delivery assisted by a doctor
	Post-delivery stay at least 24 hours
Postnatal care (PNC)*	Whether PNC received
	Whether PNC received from a skilled provider
	Whether PNC received from an institution
	Whether PNC received from a public institution

| | PNC received within 24 hours |
| | PNC received within 48 hours |

*NB: *Only available for most recent birth*

Data analysis

Data analysis, performed using Stata version 13, included (i) descriptive analyses; (ii) estimates of effects through MLM; and (iii) sensitivity checks. *Descriptive analyses* were undertaken on key explanatory variables. Variables were summarised by period (pre-conflict, peri-conflict), using means for continuous variables and frequencies for categorical variables.

MLM analysis enabled investigations of variance within and between clusters,[101] as EDHS data are hierarchical (i.e. births nested within households, households within clusters, clusters within PSUs, PSUs within Governorates).[61] Conventional regression models do not account for data hierarchy and may underestimate standard errors of the effect sizes, increasing the likelihood of Type 1 error.[71,98] Multilevel regression models account for data clustering and correct for the dependency of observations within a cluster.[98,103] The fixed component is a linear function of individual and contextual factors, while the random component represents variance between units within the same level.[71] This analysis considered the sample hierarchy at four levels: births (level 1), nested within clusters (level 2), nested within PSUs (level 3), and nested within governorates (level 4). The study considered women at the same level of analysis as births, since few women had multiple births.[61]

Multilevel logistic regressions were performed adjusting for mother's age, education, residence, employment status, household wealth, child gender, and birth order. Since the DHS applies sampling weights to the sample for national representativeness, these weights were applied in the multilevel regressions.[61] Sampling weights were rescaled, since including raw weights without scaling in an MLM leads to biased parameters and standard errors.[71] In this analysis, weights were scaled so that the new weights summed to the effective cluster size.[106]

The following model specification was used:

$$\log\left(\frac{Y_{ijkl}}{1-Y_{ijkl}}\right) = \propto + \beta_1 X_{1ijkl} + \cdots + \beta_n X_{nijkl} + \gamma T_{ijkl} + \theta_l + \mu_{kl} + \eta_{jkl} + \varepsilon_{ijkl}$$

Where Y_{ijkl} is the binary outcome for birth i (level 1) within cluster j (level 2) within PSU k (level 3) within governorate l (level 4). α is a constant; X_{1ijkl} .... X_{nijkl} are the aforementioned

covariates with $\beta_1 \ldots \beta_n$ as their coefficients; T_{ijkl} is a binary variable coded 1 for the peri-conflict period and 0 for the pre-conflict period, with γ as its coefficient; θ_l, μ_{kl}, η_{jkl}, and ε_{ijkl} are the error terms at governorate, PSU, cluster, and birth levels respectively.

Sensitivity analysis assessed the effects of alterations of study definitions and model specifications in four ways. First, varying the cut-off for onset of conflict (January 2011 versus February 2011 versus March 2011). Second, changing levels of analysis (4-level versus 3-level model). Third, applying sampling weights (no weights versus weighted unscaled versus weighted rescaled). Fourth, dropping births that took place closer to conflict onset.

Results

Sample characteristics

Table 10 shows the distributions of socioeconomic and demographic variables for 2,569 births in the pre-conflict period and 4,641 in the peri-conflict period. There was a marked shift to younger maternal age between the pre- and peri-conflict periods. In the pre-conflict period 66% of births were to women aged 30+ years, but by the peri-conflict period this had declined to 41%. Most births were to women educated to secondary level or above (58.2% pre-conflict, 61.7% peri-conflict), living in rural settings (65.1% pre-conflict, 69.2% peri-conflict). Slightly above half (55% pre-conflict and 52.9% peri-conflict) of births were boys and most mothers already had 2-3 children (60.1% pre-conflict, 54% peri-conflict). No notable differences were found in wealth status between conflict periods, though most births (23.8% pre-conflict, 25.1% peri-conflict) were to women in the middle quintile and non-working women (84.9% and 86.7% respectively). In both periods, approximately 97% of births were to Muslim women, while the rest were Christian.

Table 10. Sample characteristics for births

Characteristics	Pre-conflict N=2569		Peri-conflict N=4641	
Age group	**n**	**%**	**n**	**%**
< 25	157	6.1	1040	22.4
25-29	709	27.6	1713	36.9
30-34	853	33.2	1091	23.5
>35	850	33.1	798	17.2

Education				
No education	550	21.4	840	18.1
Primary	524	20.4	937	20.2
Secondary and above	1495	58.2	2863	61.7
Residence				
Urban	897	34.9	1429	30.8
Rural	1672	65.1	3212	69.2
Gender of child				
Male	1413	55	2455	52.9
Female	1156	45	2186	47.1
Wealth index				
Poorest	465	18.1	784	16.9
Poorer	504	19.6	928	20
Middle	611	23.8	1165	25.1
Richer	516	20.1	993	21.4
Richest	473	18.4	770	16.6
Currently working				
No	2181	84.9	4024	86.7
Yes	388	15.1	617	13.3
Birth order				
1	252	9.8	1109	23.9
2 -3	1544	60.1	2506	54
4 - 5	622	24.2	863	18.6
6 and above	154	6	162	3.5
Religion				
Muslim	2479	96.5	4488	96.7
Christian	90	3.5	158	3.4

Effect of conflict on antenatal service usage and quality

Table 11 shows both unadjusted and adjusted estimates of the association between conflict and antenatal service usage. After adjusting for socioeconomic (i.e. age, education, residence, wealth, working status) and biological determinants (i.e. child gender, birth order), no associations between conflict and ANC usage were found.

Table 11. Multilevel modelling estimates of the association of conflict with ANC usage and quality

	Means			**Odds ratio (95% CI)**
	Pre-conflict	**Peri-conflict**	**Unadjusted**	**Adjusted[#]**
Any ANC visit	88.3	90.4	1.029** (1.008-1.050)	1.014 (0.995-1.033)
Had four or more ANC visits	92.0	92.8	1.012** (1.003-1.020)	1.008 (0.996-1.019)

ANC received from a government provider	17.4	16.4	0.987 (0.971-1.030)	0.987 (0.973-1.001)
ANC received from a doctor	61.5	62.1	1.005 (0.978-1.033)	1.006 (0.980-1.032)
First ANC received within 12 weeks	26.0	56.6	1.030 (0.990-1.060)	1.020 (0.990-1.040)
Weighed during ANC	90.1	89.4	0.999 (0.981-1.017)	1.000 (0.977-1.024)
Blood pressure measured during ANC	93.2	93.9	1.009*** (1.004-1.014)	1.007 (0.997-1.018)
Urine sample given during ANC	75.7	77.2	1.021* (1.002-1.041)	1.005 (0.975-1.036)
Blood sample given during ANC	77.2	79.8	1.031*** (1.019-1.043)	1.020 (0.997-1.042)
Iron tablet received during ANC	64.0	66.6	1.039*** (1.016-1.062)	1.015 (0.987-1.044)
Adequate ANC quality	49.7	53.2	1.035*** (1.012-1.057)	1.022 (0.996-1.048)

*# Multilevel modelling estimates adjusted for age, education, residence, wealth, working status, child gender and birth order; * <0.05; ** <0.01; *** <0.001; sample size – pre-conflict 2569; peri-conflict 4641*

Effect of conflict on delivery service usage

Table 12 shows that the adjusted odds of doctor-assisted deliveries were 2% higher (OR 1.021; 95% CI 1.004-1.035; p<0.05); odds of institutional delivery were 2% higher (OR 1.022; 95% CI 1.004-1.039; p<0.05); odds of delivering in a private institution were 3% higher (OR 1.035; 95% CI 1.017-1.053; p<0.001); odds of delivering in a public institution were 1% lower (OR 0.987; 95% CI 0.975-0.998; p<0.05); and odds of a woman's post-delivery stay lasting for at least 24 hours were 8% lower (OR 0.921; 95% CI 0.906-0.935; p<0.01) for peri-conflict births compared to pre-conflict births.

Table 12. Multilevel modelling estimates of association of conflict with delivery service usage

	Means		Odds ratio (95% CI)	
	Pre-conflict	**Peri-conflict**	**Unadjusted**	**Adjusted#**
Delivery by skilled provider	91.3	92.5	1.017*(1.001-1.034)	1.012 (0.999-1.024)
Delivery by doctor	87.8	89.8	1.027**(1.008-1.045)	1.021*(1.004-1.035)
Delivery in an institution	86.2	88.4	1.029**(1.009-1.05)	1.022*(1.004-1.039)
Delivery in a public institution	28.2	26.1	0.977***(0.966-0.988)	0.987*(0.975-0.998)
Delivery in a private institution	57.5	61.6	1.053***(1.037-1.07)	1.035***(1.017-1.053)
Post-delivery stay at least 24 hours	58.3	50.7	0.929** (0.911-0.948)	0.921**(0.906-0.935)

*# Multilevel modelling estimates adjusted for age, education, residence, wealth index, currently working status, child gender and birth order; * <0.05; ** <0.01; *** <0.001; sample size – pre-conflict 2569; peri-conflict 4641*

Effect of conflict on postnatal service usage

Table 13 shows that the adjusted odds of doctor-assisted PNC were 2% higher (OR 1.015; 95% CI 1.003-1.027; p<0.05) and the odds of receiving PNC from an institution were 1% lower (OR 0.995; CI 0.98-1.00; p=0.05) for peri-conflict versus pre-conflict births.

Table 13. Multilevel modelling estimates of the association of conflict with PNC service usage

	Means			OR (95% CI)
	Pre-conflict	Peri-conflict	Unadjusted	Adjusted[#]
Had any PNC	32.0	33.8	1.022*(1.005-1.039)	1.008(0.987-1.03)
PNC received within 24 hours	24.5	24.7	1.00(0.969-1.031)	1.005(0.979-1.032)
PNC received within 48 hours	37.7	35.9	0.977(0.922-1.036)	0.983(0.928-1.041)
PNC received from a skilled provider	99.9	99.6	0.998(0.993-1.003)	0.999 (0.995-1.003)
PNC received from a doctor	96.0	96.8	1.008(0.994-1.022)	1.015*(1.003-1.027)
PNC received in an institution	97.5	97.6	0.999(0.993-1.005)	0.995*(0.98-1.00)
PNC received in a public institution	17.7	16.6	0.987(0.956-1.02)	0.996 (0.963-1.03)
PNC received in a private institution	81.7	83.0	1.015(0.977-1.054)	1.009 (0.971-1.049)

*#Multilevel modelling estimates adjusted for age, education, residence, wealth index, currently working status, child gender and birth order; * <0.05; ** <0.01; *** <0.001; sample size – pre-conflict 2569; peri-conflict 4641*

Discussion

Primary findings

This study is one of the first attempts to use DHS data to explore the cause-effect relationship between a conflict and maternal services usage.[13,27] Given the general lack and low quality of primary data in conflict-affected settings, DHS is perhaps the most reliable current data source to explore associations between conflict and maternal health.[61] Similar approaches could be applied in more severe conflicts or to examine healthcare usage for other reproductive health issues. This study identified minor associations, both negative and positive, of the acute 2011-2012 Egyptian conflict with usage of selected maternal services. Overall, maternal services usage during the conflict was not found to be considerably different from routine usage in

Egypt. The existing literature assessing the impact of conflict on maternal care is limited. Therefore, authors triangulated findings with other studies reporting maternal care levels in conflict-affected settings, though these generally could not attribute changes to conflict. Due to scarcity of evidence, comparisons were not limited to acute conflicts.

This study was one of the first attempts to assess the association of conflict with post-delivery stay. As optimum post-delivery stay is a pre-requisite to reducing postpartum deaths, its inclusion in maternal care assessment is important. However, its assessment is not common in existing studies and these findings may inspire future studies to examine delivery stay in maternal care analysis, especially in conflict-affected settings. Among the negative impacts of conflict was an estimated 8% lower odds for staying at least 24 hours following delivery during the peri-conflict phase. The average maternity ward stay during conflict was 16 hours (not shown in results), considerably less than the WHO recommended minimum of 24 hours for uncomplicated vaginal delivery.[71] The literature postulates that the threat to life of patients and health professionals may shorten delivery stays during acute conflict.[24] In some places, hospitals are at risk of violence and mothers prefer to leave with their babies immediately after delivery.[19,26] This finding is important as reduced facility stay is known to increase morbidity and mortality risks to both mothers and newborns.[125,128] Epidemiological evidence indicates that almost 50% of maternal deaths globally occur within 24 hours after birth, while it is 40% in Egypt.[56,128,129]

Findings indicated a slight decline in use of public institutions for delivery during conflict. Relatively lower dependence on public institutions for childbirth was a noticeable recent trend in Egypt.[129] The literature is mixed on facility choice for delivery during acute conflicts.[11,57,130,131] It may not be an issue of trust, but rather accessibility and safety when choosing a provider during conflict.[13] In Egypt, women reported limited capacity in public institutions as a reason for choosing private providers.[129] Even during conflict, they may have considered that private providers could ensure a safer delivery than their public-sector counterparts.

No association between conflict and ANC usage was found in this study. The literature shows a mixed trend in ANC service usage during conflict.[48-50] Provisional facility-based

arrangements in Pakistan during acute conflict suggested higher rates of ANC usage and early initiation of ANC visits.[132] Community outreach also enhanced early ANC usage during conflicts in South Asia and Africa.[13,40,132] Alternatively, during the 2006 Lebanon conflict, women reported delayed initiation of ANC.[17] A Nepal study reported a decline in early ANC use and number of ANC visits during conflict.[13] Increased policy attention and initiatives to improve ANC quality in Egypt in the last decade have led to gradual improvement in reported adherence to ANC clinical guidelines.[129] The 2% increased odds in adequate ANC quality during conflict could be due to this ongoing focus on enhancing ANC quality. As the conflict was not severe in violence or duration, providers would still have been expected to comply with treatment protocols. Other studies indicate that prevailing healthcare quality may not be compromised if conflicts are not severely life-threatening.[18,22] In contrast, during severe armed conflicts in Afghanistan and Yemen, quality of maternal care worsened drastically,[133,134] while quality of care in refugee camps was mixed depending on contextual factors.[18,19]

The slight increases in odds of institutional deliveries, doctor-assisted deliveries, and childbirth in private institutions support recent trends in Egypt seen in EDHS findings for 2009-2014.[61] Even during acute conflict, Egyptian women preferred institutional deliveries, particularly in private institutions. Limited trust in public institutions, especially primary and community-level was identified as reason to choose private institutions for delivery.[62,70,135] This preference would have increased the likelihood of doctor-assisted deliveries.[22] The literature is mixed on delivery location during acute and mild conflicts. Due to poor-quality services, women chose home deliveries during the acute conflict in Lebanon.[17] Similarly, a study of several sub-Saharan African countries reported a decline in skilled birth attendance during conflicts.[69] A study among Liberian women in Buduburam refugee camp in Ghana showed that reproductive health services were less prioritised, leading to reduced usage of essential maternal services.[93] However, a Nepal study reported increased skilled birth-attendance and institutional deliveries during conflict.[130]

This study found a slight conflict-associated increase in any PNC usage and doctor-assisted PNC and a decline in institutional PNC. This decline is most likely related to early post-delivery discharge during conflict. Studies from other settings reported that women preferred to informally consult a community-based health worker for postpartum health

concerns.[10,132,136] Without any perceived need or emergency, they were less likely to seek PNC.[10] Low PNC usage is typical in conflict-affected settings, unless women access refugee camps.[18] During conflict, only 20% usage of any PNC was reported in Yemen[123], while in Palestine only 36% usage of any PNC was reported due to limited skilled personnel.[120]

Implications

The association of the 2011-2012 Egyptian conflict with health service usage is not well documented. Media reports indicate the conflict did not intentionally disrupt healthcare delivery, but indirect disruptions were likely.[3] The overall damage to governance and economy could have adversely affected both the health system and maternal service use.[3] A solid coordination of community-based networks with primary health facilities may help in encouraging women to access services in a timely manner and in bringing women to health centres safely.[137] If mothers feel staying at health facilities post-delivery is risky during acute conflict, community-based networks can regularly monitor the health of mothers and babies to reduce health risks. Based on varying cultural needs, local NGOs in the Middle-East and Southeast Asia have motivated pregnant women to use maternity services.[17,34] Community-level support systems and women's groups have helped in meeting maternal health objectives in conflict-affected Myanmar, Pakistan, Sri Lanka, and the Philippines.[9,10,38,138]

The Egyptian health system devolves authority locally.[65] Local authorities need adequate autonomy to implement remedial measures that address maternal care during emergencies.[22] During conflicts in the region, national governments have reportedly had limited scope and governance capacity to address maternal needs.[2,66] Further, problem solving to address maternal health needs can be more feasible locally than nationally during conflicts, as shown in Myanmar, Nepal, the Occupied Palestinian Territories, and Pakistan.[10,13,17,132]

More research is needed to establish how conflict affects maternal health status and usage in Egypt and elsewhere. Application of robust statistical methods can establish the cause-effect relationship between conflict and maternal care, while qualitative studies are equally essential to explore the contextual determinants of service usage and relevant remedial measures. Research is also needed to understand how health systems in conflict-prone countries can be resilient in minimising the risks to maternal health during conflict.

Limitations

Primary research would have secured additional relevant data, beyond the scope of the DHS (e.g. access to emergency obstetric care). Although conflict continued for a longer period, a shorter study period was selected due to reliable data availability. Qualitative data analysis could help corroborate the influence of contextual factors on maternal care usage.

Underlying temporal trends would have affected the effect size, although the period under consideration was too short for a large temporal trend to occur. DHS limits its sampling frame to households and excludes homeless and institutionalised women.[61] DHS did not cover North and South Sinai regions due to chronic political instability. As this study focused on acute conflict within a fixed time period, these regional exclusions would not have affected study outcomes.

Further, the unexpected differences in sample size between pre-conflict and peri-conflict periods limits study's internal validity. This study solely depended on reporting of birthdate by DHS and it did not exercise any additional validation for birth rate data. Therefore, there could have been a possibility of either overestimation or underestimation of maternal care use in this study. DHS surveys are typically based on reporting of births by women, both the accuracy of the birth dates reported and possible omission of births are concerns in DHS surveys.[139] DHS data are susceptible to recall and social desirability biases, as mothers recall details of their pregnancy and childbirth experiences in the past few years.[61] The possibility of recall bias affecting women's responses could have been more in the pre-conflict period. DHS data are also prone to errors during sampling, questionnaire enumeration and administration, leading to either over-reporting or omission of births. [66,139]

However, a validation study in LMICs found a moderate to high sensitivity and a moderate validity for self-reported coverage of maternal care in surveys. [140,141] These studies also validated that DHS data are representative of the childbirth experience of women in the general population as DHS employs standardised procedures to ensure data quality and tools are well-tested across time.[140,141]Additionally, as per a post-DHS study that examined birth reporting by EDHS 2014, there was a less chance for over reporting of births. As per this validation study, increased birth rates during the DHS period (2009-2014) was mainly due to a shift

towards fertility among younger women below 25 years and among more educated women (i.e. secondary and above). However, this validation study was not adequate to indicate a doubling of birth rate in the peri-conflict period.

Additionally, given the country-wide geographical spread of the conflict and lack of data on region-specific exposure, this study considered all women to be equally exposed to conflict and could not differentiate level of exposure to conflict. This would have potentially lead to either underestimation or overestimation of the estimates, implying a limited scope of internal validity. Thus, birth rate discrepancy, recall bias, data quality issues and lack of conflict data could have led to any measurement errors. However, it is difficult to say how they could impact the direction of results, as study results more or less reflected the recent maternal care patterns in Egypt. Additionally, Egyptian conflict was not severe and it did impact healthcare and service delivery substantially.[62] This study was not a causal analysis and it only tried to assess temporal association between conflict and maternal care in an acute conflict. Study results may not be generalizable to indicate conflict's impact on maternal care, especially in severe conflicts. Despite these limitations, this is one of the first attempts to analyse the effect of conflict on maternal care in Egypt and LMICs more generally through a multi-level modelling analysis.

Conclusions

This study analysed DHS data to estimate the effects of conflict on maternal care usage. Overall, the acute conflict did not appear to have a major impact on maternal care usage as maternal care usage patterns during conflict were generally similar to recent trends in the country. This study did not find that conflict significantly affected ANC service use, while small positive associations were found in ANC quality score, institutional delivery, doctor-assisted childbirth, and private institutional attendance for delivery and PNC. This study found slightly reduced odds of post-delivery stay of at least 24 hours, childbirth at public institutions, and institutional PNC usage. Further studies are required to fully assess the effects of conflict on maternal morbidity and mortality, investigate contextual drivers of maternal care usage, and identify potential ways to improve health system resilience to support maternal needs in future conflicts.

Sensitivity and goodness of fit analyses

This section presents the results of sensitivity analyses by service. Analyses were performed by altering conflict period cut-off, sample weighting, levels of analysis, and by omitting births occurring closer to the conflict onset (only for ANC and PNC variables).

Sensitivity analysis for ANC services

For ANC indicators, Tables 14 &15 show that the alternate models gave more or less similar results except a few minor changes.

- Only the weighted unscaled model showed a 2% (OR 1.02; 95% CI 1.00-1.04; p<0.05) higher odds of blood sample collection at ANC in the conflict period, than pre-conflict (Table14). Similarly, this model also showed a 3% (OR 1.03; 95% CI 1.00-1.06; p<*0.05)* higher odds of receiving adequate ANC quality during conflict, than pre-conflict (Table14). The main model, (i.e. weighted rescaled) did not show any association of conflict with these indicators.

- In the alternate model, when the births from January to September 2011 were omitted, the peri-conflict period witnessed a 2% (OR 0.98; CI 0.96-0.99; p<0.01) reduction in the odds of receiving ANC from a government provider, than pre-conflict (Table 15). The main model did not show any association of conflict with this indicator.

- Similar to the four-level analysis, the alternate analysis (i.e. three-level analysis) did not show any association of conflict with the ANC indicators (Table 15).

Table 14. Association of conflict with ANC services by conflict cut-off and sample weighting

Association of conflict with ANC services by conflict cut-off			
	Jan-11	**Feb-11 (Main analysis)**	**Mar-11**
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Had any ANC visit	1.007(0.988 - 1.025)	1.014 (0.995-1.033)	1.015(0.994 - 1.037)
Had four or more ANC visits	1.007(0.993 - 1.022)	1.008 (0.996-1.019)	1.009(0.996 - 1.021)
ANC received from a government provider	0.984(0.975 - 0.993)	0.987 (0.973-1.001)	0.986(0.974 - 0.998)
ANC received from a doctor	1.003(0.976 - 1.030)	1.006 (0.98-1.032)	0.999(0.983 - 1.017)
First ANC received within 12 weeks	1.014(0.989-1.04)	1.02 (0.99-1.04)	1.019(0.997-1.042)
Weighed during ANC	0.999(0.975 - 1.023)	1.00 (0.977-1.024)	0.997(0.976 - 1.020)

Blood pressure measured during ANC	1.007(0.992 - 1.023)	1.007 (0.997-1.018)	1.007(0.998 - 1.016)
Urine sample given during ANC	1.010(0.983 - 1.038)	1.005 (0.975-1.036)	1.003(0.976 - 1.031)
Blood sample given during ANC	1.022*(1.004 - 1.040)	1.02 (0.997-1.042)	1.02(1.000 - 1.040)
Iron tablet received during ANC	1.015(0.981 - 1.050)	1.015 (0.987-1.044)	1.015(0.990 - 1.041)
Adequate ANC quality	1.022(0.996-1.048)	1.022 (0.996-1.048)	1.021(0.994-1.048)

Association of conflict with ANC services by sample weighting

	Unweighted	Weighted unscaled	Weighted rescaled (Main analysis)
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Had any ANC visit	1.014(0.996 - 1.032)	1.018(0.989 - 1.048)	1.014 (0.995-1.033)
Had four or more ANC visits	1.008(0.991 - 1.025)	1.003(0.993 - 1.013)	1.008 (0.996-1.019)
ANC received from a government provider	0.987(0.965 - 1.009)	0.993(0.977 - 1.010)	0.987 (0.973-1.001)
ANC received from a doctor	1.006(0.979 - 1.033)	1.014(0.988 - 1.042)	1.006 (0.98-1.032)
First ANC received within 12 weeks	1.015(0.993-1.037)	1.017(0.987-1.048)	1.02 (0.99-1.04)
Weighed during ANC	1.000(0.982 - 1.019)	1.001(0.982 - 1.020)	1.00 (0.977-1.024)
Blood pressure measured during ANC	1.007(0.992 - 1.022)	1.009(0.993 - 1.025)	1.007 (0.997-1.018)
Urine sample given during ANC	1.005(0.980 - 1.031)	1.004(0.963 - 1.048)	1.005 (0.975-1.036)
Blood sample given during ANC	1.020(0.995 - 1.045)	1.020*(1.000 -1.041)	1.02 (0.997-1.042)
Iron tablet received during ANC	1.015(0.989 - 1.042)	1.018(0.983 - 1.053)	1.015 (0.987-1.044)
Adequate ANC quality	1.022(0.992-1.051)	1.032*(1.004-1.061)	1.022 (0.996-1.048)

*# Multilevel modelling estimates adjusted for age, education, residence, wealth index, child gender, currently working status and birth order; * <0.05; ** <0.01; *** <0.001*

Table 15. Association of conflict with ANC services by levels of analysis and number of births

Association of conflict with ANC services by levels of analysis

	Three levels$	Four levels# (Main analysis)
	Odds ratio (95% CI)	Odds ratio (95% CI)
Had any ANC visit	1.012(0.994 - 1.029)	1.014 (0.995-1.033)
Had four or more ANC visits	1.008(0.990 - 1.026)	1.008 (0.996-1.019)
ANC received from a government provider	0.987(0.965 - 1.010)	0.987 (0.973-1.001)
ANC received from a doctor	1.008(0.982 - 1.036)	1.006 (0.98-1.032)
First ANC received within 12 weeks	1.015(0.992-1.038)	1.02 (0.99-1.04)
Weighed during ANC	0.998(0.979 - 1.017)	1.00 (0.977-1.024)
Blood pressure measured during ANC	1.007(0.992 - 1.023)	1.007 (0.997-1.018)
Urine sample given during ANC	1.005(0.979 - 1.031)	1.005 (0.975-1.036)
Blood sample given during ANC	1.019(0.993 - 1.045)	1.02 (0.997-1.042)
Iron tablet received during ANC	1.012(0.985 - 1.040)	1.015 (0.987-1.044)
Adequate ANC quality	1.019(0.989-1.05)	1.022 (0.996-1.048)

Association of conflict with ANC services when omitting births occurring closer to the conflict onset		
	Omitted births from Jan to Sept, 2011 **Odds ratio** **(95% CI)**	**Full birth sample** **(Main analysis)** **Odds ratio** **(95% CI)**
Had any ANC visit	1.011(0.994 - 1.028)	1.014 (0.995-1.033)
Had four or more ANC visits	1.006(0.991 - 1.022)	1.008 (0.996-1.019)
ANC received from a government provider	0.975**(0.957 - 0.993)	0.987 (0.973-1.001)
ANC received from a doctor	1.008(0.970 - 1.046)	1.006 (0.98-1.032)
First ANC received within 12 weeks	1.018(0.994-1.043)	1.02 (0.99-1.04)
Weighed during ANC	0.992(0.963 - 1.022)	1.00 (0.977-1.024)

 # Multilevel modelling estimates adjusted for age, education, residence, wealth index, child gender, currently working status and birth order; * <0.05; ** <0.01; *** <0.001; $ Three levels – birth, cluster and PSU; #Four levels - birth, cluster, PSU, governorate

Sensitivity analysis for delivery services

When different cut-offs for the onset of conflict (i.e. January 2011, February 2011 and March 2011) were included, there were not considerable differences in the effect sizes for most delivery indicators (Table 16). By changing the sampling weights in the model also, there were no observed differences in the effect sizes for most indicators. Similarly, most of the delivery indicators showed similar effect sizes between three and four level analytic models (Table 17).

Table 16. Association of conflict with delivery services by conflict cut-off and weighting

Association of conflict with delivery services by conflict cut-off			
	Jan 2011 **Odds ratio** **(95% CI)**	**Feb 2011** **(Main analysis)** **Odds ratio** **(95% CI)**	**Mar 2011** **Odds ratio** **(95% CI)**
Delivery by skilled provider	1.007(0.993 - 1.021)	1.012 (0.999-1.024)	1.016(1.000 - 1.033)
Delivery by doctor	1.017(0.999 - 1.034)	1.02*(1.004-1.035)	1.025**(1.008 - 1.042)
Delivery in an institution	1.021*(1.002 - 1.041)	1.022*(1.004-1.039)	1.027*(1.007 - 1.049)
Delivery in a public institution	0.988(0.973 - 1.004)	0.987*(0.975-0.998)	0.991(0.974 - 1.009)
Delivery in a private institution	1.034***(1.017 - 1.050)	1.035***(1.017-1.053)	1.037**(1.016 -1.059)
Post-delivery stay at least 24 hours	0.921**(0.908-0.934)	0.92**(0.906-0.935)	0.923**(0.907-0.94)

Association of conflict with delivery services by weighting			
	Unweighted	**Weighted unscaled**	**Weighted rescaled** **(Final model)**

	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Delivery by skilled provider	1.007(0.993 - 1.021)	1.012 (0.999-1.024)	1.016(1.000 - 1.033)
Delivery by doctor	1.017(0.999 - 1.034)	1.02*(1.004-1.035)	1.025**(1.008 - 1.042)
Delivery in an institution	1.021*(1.002 - 1.041)	1.022*(1.004-1.039)	1.027*(1.007 - 1.049)
Delivery in a public institution	0.988(0.973 - 1.004)	0.987*(0.975-0.998)	0.991(0.974 - 1.009)
Delivery in a private institution	1.034***(1.017 -1.050)	1.035***(1.017-1.053)	1.037**(1.016 - 1.059)
Post-delivery stay at least 24 hours	0.921**(0.908-0.934)	0.92**(0.906-0.935)	0.923**(0.907-0.94)

*# Multilevel modelling estimates adjusted for age, education, residence, wealth index, child gender, currently working status and birth order; * <0.05; ** <0.01; *** <0.001*

Table 17. Association of conflict with delivery services by levels of analysis

	Three levels$ Odds ratio (95% CI)	Four levels# (Main analysis) Odds ratio (95% CI)
Delivery by skilled provider	1.010(0.995 - 1.025)	1.012 (0.999-1.024)
Delivery by doctor	1.018*(1.000 - 1.035)	1.02*(1.004-1.035)
Delivery in an institution	1.020*(1.001 - 1.039)	1.022*(1.004-1.039)
Delivery in a public institution	0.988(0.964 - 1.012)	0.987*(0.975-0.998)
Delivery in a private institution	1.032*(1.006 - 1.059)	1.035***(1.017-1.053)
Post-delivery stay at least 24 hours	0.92**(0.896-0.944)	0.92**(0.906-0.935)

*# Multilevel modelling estimates adjusted for age, education, residence, wealth index, child gender, currently working status and birth order; * <0.05; ** <0.01; *** <0.001; $ Three levels – birth, cluster and PSU; #Four levels - birth, cluster, PSU, governorate*

Sensitivity analysis for PNC services

As shown in Table 18 & 19, the alternate models showed more or less similar results as in the main model. However, there were some marginal differences noticed. Only the four-level analysis (i.e. main analysis) provided evidence of an increase (2%; OR 1.02; 95% CI 1.00-1.03; p<*0.05)* in the odds of receipt of physician-assisted PNC during conflict, than pre-conflict.

Table 18. Association of conflict with PNC services by conflict cut-off and weighting

Association of conflict with PNC services by conflict cut-off			
	Jan 2011 Odds ratio (95% CI)	Feb 2011 (Main analysis) Odds ratio (95% CI)	Mar 2011 Odds ratio (95% CI)
Had any PNC	1.000(0.973 - 1.029)	1.008(0.987-1.03)	1.014(0.995 - 1.034)

PNC received within 24 hours	1.018(0.99-1.047)	1.005(0.979-1.032)	0.999(0.966-1.032)
PNC received within 48 hours	0.998(0.94-1.061)	0.983(0.928-1.041)	0.985(0.925-1.048)
PNC received from a skilled provider	0.999(0.995 - 1.003)	0.999(0.995 - 1.003)	0.999(0.995 - 1.003)
PNC received from a doctor	1.018**(1.006-1.030)	1.015*(1.003-1.027)	1.015*(1.002 - 1.027)
PNC received in an institution	0.996(0.992 - 1.001)	0.995*(0.99-1.00)	0.993*(0.986 - 0.999)
PNC received in a public institution	1.001(0.975 - 1.028)	0.993(0.963-1.03)	0.996(0.964 - 1.028)
PNC received in a private institution	1.004(0.973 - 1.037)	1.009(0.971-1.049)	1.009(0.972 - 1.047)

	Association of conflict with PNC services by weighting		
	Unweighted	**Weighted unscaled**	**Weighted rescaled (Main analysis)**
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Had any PNC	1.008(0.983 - 1.034)	1.002(0.980 - 1.025)	1.008(0.987-1.03)
PNC received within 24 hours	1.005(0.963-1.049)	1.009(0.997-1.022)	1.005(0.979-1.032)
PNC received within 48 hours	0.983(0.937-1.03)	1.005(0.972-1.04)	0.983(0.928-1.041)
PNC received from a skilled provider	0.999(0.994 - 1.004)	1.000(0.999 - 1.001)	0.999 (0.995-1.003)
PNC received from a doctor	1.015(0.998 - 1.033)	1.026***(1.016-1.036)	1.015* (1.003-1.027)
PNC received in an institution	0.995(0.981 - 1.009)	0.997(0.984-1.010)	0.995*(0.98-1.00)
PNC received in a public institution	0.996(0.960 - 1.033)	0.975(0.932-1.020)	0.996 (0.963-1.03)
PNC received in a private institution	1.009(0.972 - 1.047)	1.035(0.987 - 1.085)	1.009(0.971-1.049)

 # Multilevel modelling estimates adjusted for age, education, residence, wealth index, child gender, currently working status and birth order;* <0.05; ** <0.01; *** <0.001

Table 19. Association of conflict with PNC services by sample sizes and levels of analysis

Association of conflict with PNC services by levels of analysis		
	Three levels$	**Four levels# (Main analysis)**
	Odds ratio (95% CI)	**Odds ratio (95% CI)**
Had any PNC	1.007(0.982 - 1.032)	1.008(0.987-1.03)
PNC received within 24 hours	1.005(0.964-1.048)	1.005(0.979-1.032)
PNC received within 48 hours	0.983(0.939-1.029)	0.983(0.928-1.041)
PNC received from a skilled provider	0.999(0.995 - 1.003)	0.999 (0.995-1.003)
PNC received from a doctor	1.015(0.996 - 1.034)	1.015* (1.003-1.027)
PNC received in an institution	0.995(0.981 - 1.009)	0.995*(0.98-1.00)
PNC received in a public institution	0.998(0.962 - 1.035)	0.996 (0.963-1.03)
PNC received in a private institution	1.007(0.971 - 1.045)	1.009(0.971-1.049)

Association of conflict with PNC services by conflict date specification		
	Omitted births from Dec 2010 to Jan 2011	**Full birth sample (Main analysis)**
	Odds ratio	**Odds ratio**

	(95% CI)	(95% CI)
Had any PNC	1.006(0.980 - 1.033)	1.008(0.987-1.03)
PNC received within 24 hours	1.012(0.981-1.044)	1.005(0.979-1.032)
PNC received within 48 hours	0.985(0.929-1.045)	0.983(0.928-1.041)
PNC received from a skilled provider	0.999(0.995 - 1.003)	0.999 (0.995-1.003)
PNC received from a doctor	1.017**(1.004 - 1.030)	1.015* (1.003-1.027)
PNC received in an institution	0.995(0.990 - 1.000)	0.995*(0.98-1.00)
PNC received in a public institution	0.997(0.963 - 1.032)	0.996 (0.963-1.03)
PNC received in a private institution	1.008(0.968 - 1.050)	1.009(0.971-1.049)

 # Multilevel modelling estimates adjusted for age, education, residence, wealth index, child gender, currently working status and birth order; * <0.05; ** <0.01; *** <0.00; $ Three levels – birth, cluster and PSU; #Four levels - birth, cluster, PSU, governorate

Goodness of fit

Goodness of fit for the regression models were tested to see the approximation of the predicted values to the observed values with Akaike (AIC) and Bayesian Information Criterion (BIC).[95] Table 20 shows model goodness of fit values for selected outcome variables. From the lower AIC and BIC values, it is clear that models with four levels of analysis are better fit than the three level models.

Table 20. Tests for model goodness-of-fit

	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	Received at least one ANC		**Post-delivery stay at least 24 hours**		**Received at least one PNC**	
df	20	21	20	21	20	21
AIC	2871.7	2853.1	8180.1	8168.1	6938.7	6929.4
BIC	3003.8	2991.7	8313.3	8301.7	7070.8	7061.0
	Blood sample given during ANC		**Delivery by a skilled provider**		**PNC received from a doctor**	
df	20	21	20	21	20	21
AIC	5091.4	5078.2	1325.3	1309.4	1024.9	1022.9
BIC	5220.9	5211.1	1457.4	1448.0	915.4	907.9
	Adequate ANC quality		**Delivery in a private institution**		**PNC from government provider**	
df	20	21	20	21	20	21
AIC	6638.3	6604.8	7098.3	7055.1	1496.9	1495.1
BIC	6767.8	6740.7	7230.4	7193.8	1605.9	1601.5

Model 1 – Three levels with covariates; Model 2 – Four levels with covariates; df – degrees of freedom; AIC – Akaike Information Criterion; BIC – Bayesian Information Criterion.

Chapter 5. Analysis of Equity

This chapter provides results on Objective 2 in research article format.

Abstract

Background: Equity of access to maternal services during conflict is considered key to reducing maternal health risks globally. However, evidence showing how conflict affects equity in maternal care use is scant. This study tested the association between the Egyptian acute conflict of 2011-2012 and equity in maternal care use among different socioeconomic, demographic, and geographic groups.

Methods: An 'uncontrolled before-and-after' study design was used to perform multi-level modelling stratified regression analysis on 2014 Egypt Demographic and Health Survey data. The pre-conflict sample included 2,569 births occurring from January 2009 to January 2011 and the peri-conflict sample included 4,641 births from February 2011 to December 2012.

Results: During conflict, compared to respective reference groups, odds of doctor-assisted delivery increased more (3%) for oldest (>35 years) women (OR 1.03; 95% CI 1.00-1.06); odds of receiving PNC decreased more (8%) for women aged 25-29 (OR 0.92; 95% CI 0.88-0.96), than pre-conflict. Odds of SBA increased more for rural women (2%; OR 1.02; CI 1.02-1.03), educated to primary level (4%; OR 1.04; 95% CI 1.01-1.07), employed (4%; OR 1.04; 95% CI 1.01-1.07), less poor quintiles (3%; OR 1.03; 95% CI 1.02–1.05) and middle quintiles (2%; OR 1.02; 95% CI 1.01–1.04), than pre-conflict. Odds of physician-assisted delivery increased more for rural women (3%; OR 1.03; CI 1.02-1.04; p<0.01), educated to primary level (5%; OR 1.05; 95% CI 1.01-1.10), employed (4%; (OR 1.04; 95% CI 1.01- 1.07), less poor and middle quintiles (3% each; OR 1.03; 95% CI 1.01-1.05) and richest quintiles (2%; OR 1.02; 95% CI 1.00-1.03), than pre-conflict.

Conclusions: The association between acute conflict and equity in maternal services usage indicated some vertical equity, as equity patterns during conflict differed from recent trends in Egypt. The association between conflict and maternal care among socioeconomically advantaged groups was minimal and not particularly inequitable. Authors call for specific equity strategies in maternal policy to address unpredictability in conflict's potential effect on equity of maternal care. Further research is needed to determine how conflict affects potentially catastrophic out-of-pocket expenditures for maternal care and quality-of-care among different socioeconomic groups.

Background

Inequitable access to appropriate and good-quality maternal care is a key challenge to addressing maternal and child health in low and middle-income countries (LMICs), including conflict-affected settings.[7] Improving health equity includes removing unfair and avoidable differences in healthcare access and usage among populations, e.g. those based on socioeconomic, demographic, or geographical status.[7,142,143] Nearly 60% of global maternal deaths occur in conflict-affected LMICs,[136] with a maternal mortality ratio per 100,000 live births of 417 in 2014.[24] In the same year, skilled birth attendance (SBA) was 85% higher among the richest women in LMICs, while the chances of four or more antenatal care visits were 25% higher among highest educated women.[56] A study conducted in 19 conflict-affected LMICs reported that mean access to SBA among the lowest socioeconomic quintile was 12.2% compared to 81.2% among the richest quintile.[7] The United Nations' sustainable development goal agenda recommends reducing inequities in maternal care access in conflict-affected LMICs to improve maternal health.[144] However, evidence is limited on the patterns of maternal care-seeking and how conflict affects equity in access to or usage of maternal healthcare.

Health equity is a complex concept to define and measure generally and more so in conflict-affected settings.[7,47,48] Health equity can be categorised as horizontal or vertical.[7,47,48] Horizontal equity determines that women with the same health needs are treated equally, irrespective of morally irrelevant factors (e.g. age, ethnicity, income).[7,47,48] In other words, horizontal equity means equals are treated equally without any discrimination (e.g. women from the same economic strata are treated equally by caregivers without any discrimination).[7,47,48] Vertical equity determines that women with differing health needs can be prioritised differently, according to morally relevant factors (e.g. need, autonomy, ability to benefit).[7,47,48] Vertical equity means differential treatment is given based on socioeconomic or other differences (e.g. poor women get more resources than rich due to their relatively higher economic vulnerability).[47,48] This study focuses on vertical equity in usage of maternal care services during the acute Egyptian conflict.

As the Egyptian healthcare system is known for increasing inequities in maternal care and wider disparities in social determinants of care, availability of services, access and usage,[66] it seems most relevant to assess how women with unequal status (or unequal endowment of social determinants) were treated during the acute conflict. Literature and policy evidence, for

most LMICs and resource-constrained settings, indicates that vertical equity should be addressed prior to horizontal equity.[23]Unless disadvantaged groups are given differential treatment, prevailing gaps in health status will not be reduced substantially.[23]

Addressing equity in maternal care is challenging in conflict-affected settings, particularly during acute conflict.[1,22,143,145] Conflict and violence can reduce health system capacity for equitable health service delivery.[1,143] Social determinants of health may function less predictably during conflict[142], e.g. violence may prevent facility access even if financial barriers are removed.[146,147] Lack of reliable data on maternal care use and equity patterns during conflict limits health system preparedness to support women during conflicts.[22,145] In this context, this study tested the association between the acute 2011-2012 Egyptian conflict and maternal care usage among different socioeconomic, demographic, and geographic groups.

Egypt was chosen as a case study as 2014 DHS data enabled a before-and-after comparison of the association of conflict with equity of maternal care usage. Evidence is limited on the 2011-2012 Egyptian conflict's effect on maternal care in general and equity dimensions in particular.[62] Egypt is considered at risk of further conflict,[62,3] yet despite health system reforms in the last decade, policy attention to building resilience to conflict has been limited.[4] A better understanding of the socioeconomic determinants of maternal care could help inform policy in addressing equity during future conflicts.[61] Additionally, maternal care in Egypt has become increasingly inequitable in the past decade.[148,149] For example, a recent study reported that one unit increase in the mean socio-cultural resourcefulness score is associated with 1.55 higher odds of using any antenatal care (ANC) and 1.31 higher odds of institutional delivery.[66] Rural areas have a relatively lower percentage (20%) of total health centres in the country.[75,149,150] Other questions are how predictable social determinants of maternal care are during acute conflict and whether maternal care use changes differently during conflict among different socioeconomic groups.

Objectives
This study assessed the association between the 2011-2012 Egyptian conflict and usage of maternal services among women in different socioeconomic, demographic and geographic groups in order to examine vertical equity. Objectives were to compare usage of antenatal,

delivery, and postnatal services before and during the conflict, by: (i) maternal age; (ii) residence; (iii) education; (iv) employment; and (v) household wealth quintile.

Methods

Study setting

Egypt is a lower-middle-income country in northern Africa with a Gross National Income per capita of US$ 5,654 in 2012.[70] The pluralistic health care system is inequitable, with greater scarcity of resources (i.e. staff, funding, supplies, infrastructure) in rural areas compared to the urban areas.[151] Under-five mortality during 2008-2013 was 27 deaths per 1,000 births.[151] The maternal mortality ratio was 82 per 100,000 live births in 2008.[56] Poor quality of care and delay in seeking care are known reasons for maternal deaths in LMICs in general and Egypt in particular.[64,152]

The Egyptian revolution started in January 2011, when thousands of civilians protested against the government, eventually leading to the resignation of long-time president Mr Hosni Mubarak.[3,4] While the acute phase ended early in 2013,[4] Egypt is not considered fully free from the threat of civil unrest. Despite an elected government taking office in 2012, political protests continued.[3] Several socio-political and economic reasons behind the revolution, including rising poverty and perceived government autocracy and neglect of people's welfare have not yet been addressed.[4] Although evidence is still emerging, conflict is considered to have adversely affected Egypt's economic and human development indicators.[3]

Study design

A quasi-experimental 'uncontrolled before-and-after' design was selected, using multi-level modelling (MLM) regression of 2014 EDHS data, to compare levels of maternal care usage before and during the acute 2011-2013 Egyptian conflict across socioeconomic groups. The study adopted a working definition of 'conflict-affected' from relevant literature as a setting in which routine socio-political, economic and/or civil life are disrupted due to armed political conflict.[1,2,5,6,9] The 'pre-conflict' sample included births from January 2009 to January 2011 while the 'peri-conflict' sample included births from February 2011 to December 2012. Based on media reports describing the end of the acute phase of the conflict in early 2013, births from January 2013 onwards were excluded.[4] Analysis thus included 7,210 births from 7,118 eligible women in 1,679 clusters (i.e. 2,569 pre-conflict births and 4,641 peri-conflict births).

Sampling and data collection

Data were drawn from the 2014 Egypt Demographic and Household Survey (EDHS), which provided a nationally-representative sample (excluding North and South Sinai governorates).[61] The 2014 EDHS used multi-stage sampling. [61] First, 884 primary sampling units (PSUs) were selected. Second, depending on PSU size, systematic sampling yielded 1-3 parts per PSU (1,000 households each). Third, each part was divided into equally-sized segments (200 households each), two to three of which were selected randomly from each PSU. A total of 1,838 segments (clusters) were selected from 884 PSUs. A household listing was undertaken in each segment. An average of 15 households was selected from each segment using systematic random sampling. Thus, a total of 29,471 households were included in the 2014 EDHS. Eligible participants were ever-married women aged 15-49 and present in selected households the night prior to interview. A total of 21,903 women were eligible for the survey. From each eligible woman, details were gathered on childbirths for the preceding five years from the date of survey.

2014 EDHS data were collected in April-June 2014.[61] Maternal data, collected by local recently-graduated enumerators in Arabic, included place of care-seeking, type of facility, provider and frequency of attendance, timeliness, and contents of services received. All questions were pre-tested and revised based on comments from interviewers, pre-testing, and tabulations of pre-test results.

Outcome and explanatory variables selected

Outcome variables were usage of seven binary maternal care components, selected based on data reliability, i.e. (A) antenatal care: (i) 4+ ANC visits completed, (ii) ANC from government provider, (iii) ANC from a doctor; (B) delivery: (iv) delivered with a skilled attendant, (v) delivered with a doctor, (vi) delivered in public facility; and (C) postnatal care (PNC): (vii) any PNC received.

Explanatory variables were four maternal characteristics, i.e. (i) age, (ii) education, (iii) employment, (iv) urban/rural residence, and household wealth status. Household wealth was

already calculated in the 2014 EDHS dataset in quintiles from poorest to wealthiest. EDHS calculations used a step-wise approach with key household economic characteristics and assets weighted using principal component analysis.[61]

Analysis

Data were analysed, using Stata software version 13, both descriptively and by estimating effects through multilevel modelling. Descriptive analyses summarised key explanatory variables by period (pre-conflict, peri-conflict) with frequencies for categorical variables. EDHS data are hierarchical, i.e. births are nested within households, households within clusters, clusters within PSUs, and PSUs within Governorates.[61] Multilevel regression models were developed to account for data clustering and allow for the dependency of observations within clusters, as conventional linear regression models that do not account for multiple levels would underestimate the standard errors of effect sizes with a higher chance of Type I error.[71,72,98]

The multilevel model accounted for sample hierarchy at four levels, with a random intercept at each, excluding level 1: births (level 1), household nested within clusters (level 2), cluster nested within PSUs (level 3), and PSU nested within governorates (level 4). MLM included both fixed effects of individual factors and random effects of between-cluster characteristics.[72] Logistic regressions were performed for binary variables, adjusting for maternal age, education, employment, residence, and household wealth. The sampling weights, applied by EDHS statisticians for national representativeness, were accounted for in multilevel regressions. Sampling weights were rescaled, since including raw weights without scaling in MLM leads to biased parameters and standard errors, so that the new weights would sum to the effective cluster size.[72]

Stratified analysis of the strata within the explanatory variable was undertaken. The following model specifications explain the stratified analysis.

$$\log\left(\frac{Y_{ijkl}}{1 - Y_{ijkl}}\right) = \propto + \beta_1 X_{1ijkl} + \cdots + \beta_n X_{nijkl} + \gamma T_{ijkl} + \theta_l + \mu_{kl} + \eta_{jkl} + \varepsilon_{ijkl}$$

where Y_{ijkl} is the outcome for birth i (level 1), within cluster j (level 2), within PSU k (level 3), within governorate l (level 4). α is a constant. X_{1ijkl} .... X_{nijkl} are the explanatory variables,

with $\beta_1 \ldots \beta_n$ as their coefficients. T_{ijkl} is a binary variable that is 1 for the 'peri-conflict' sample and 0 otherwise with γ as its coefficient. θ_l, μ_{kl}, η_{jkl}, and ε_{ijkl} are the error terms at governorate, PSU, cluster, and individual birth levels respectively.

Results

Sample characteristics

Table 21 shows descriptive analysis of key socio-demographic variables. The pre-conflict sample included 2,569 births and the peri-conflict sample included 4,641 births. In the pre-conflict sample, a third of births were to older women (ages 30 and above), while during conflict, most (37%) were to women aged 25-29. Most births were to women with secondary or higher education (58% pre-conflict, 61% peri-conflict) and from rural settings (65% pre-conflict, 69% peri-conflict). Slightly above half of babies (55% pre-conflict, 53% peri-conflict) were male in the last birth. The largest wealth quintile was the middle (24% pre-conflict, 25% peri-conflict). Most births were to working women (85% pre-conflict, 87% peri-conflict). Most women already had 2-3 children (60% pre-conflict, 54% peri-conflict). Most women (97%) were Muslim, while the rest were Christian.

Table 21. Sample characteristics

Characteristics	Pre-conflict N=2569		Peri-conflict N=4641	
Age group	**n**	**%**	**n**	**%**
< 25	157	6.1	1040	22.4
25-29	709	27.6	1713	36.9
30-34	853	33.2	1091	23.5
>35	850	33.1	798	17.2
Education				
No education	550	21.4	840	18.1
Primary	524	20.4	937	20.2
Secondary and above	1495	58.2	2863	61.7
Residence				
Urban	897	34.9	1429	30.8
Rural	1672	65.1	3212	69.2
Gender of child				
Male	1413	55	2455	52.9
Female	1156	45	2186	47.1
Wealth index				
Poorest	465	18.1	784	16.9

Poorer	504	19.6	928	20
Middle	611	23.8	1165	25.1
Richer	516	20.1	993	21.4
Richest	473	18.4	770	16.6
Currently working				
No	2181	84.9	4024	86.7
Yes	388	15.1	617	13.3
Birth order				
1	252	9.8	1109	23.9
2 -3	1544	60.1	2506	54
4 - 5	622	24.2	863	18.6
6 and above	154	6	162	3.5
Religion				
Muslim	2479	96.5	4488	96.7
Christian	90	3.5	158	3.4

Association between conflict and maternal services usage by maternal age

Table 22 provides stratified analysis of adjusted associations of age-group with maternal outcomes in the peri-conflict period compared to the pre-conflict period. During conflict versus pre-conflict, compared to respective reference groups, odds of receiving ANC from a government provider were relatively lower (9%) for youngest women (OR 0.91; 95% CI 0.83-0.99; p<0.05) and relatively higher (1%) among women ages 30-34 (OR 1.01; 95% CI 1.00–1.02); odds of doctor-assisted delivery were relatively higher (3%) for oldest women (OR 1.03; 95% CI 1.00-1.06); odds of public institutional delivery were relatively lower (7%) for youngest women (OR 0.93; 95% CI 0.87–0.99); and odds of receiving PNC were relatively lower (8%) among women ages 25-29 (OR 0.92; 95% CI 0.88-0.96).

Table 22. Multilevel modelling estimates of the association between conflict and maternal care usage by maternal age

Period	<25 years (n=457) ORᵇ (95%CI)	25-29 years (n=1749) ORᵇ (95%CI)	30-34 years (n=1704) ORᵇ (95%CI)	>35 (n=1532) ORᵇ (95%CI)
4+ ANC visits				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.92-1.09)	1.00 (0.94-1.06)	1.02 (0.99-1.05)	1.00 (0.95-1.05)
ANC from a government provider				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	0.91*(0.83-0.99)	0.96 (0.93-1.00)	1.01* (1.00-1.02)	0.98 (0.95-1.02)
ANC from a doctor				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.09 (0.95-1.25)	1.04 (0.96-1.12)	0.97 (0.94-1.01)	0.99 (0.98-1.01)

Delivery by skilled provider				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	0.99 (0.92-1.07)	1.01 (0.99-1.03)	1.01 (0.99-1.03)	1.02 (0.99-1.04)
Delivery by doctor				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	0.96 (0.87-1.06)	1.02 (0.99-1.06)	1.02 (0.98-1.04)	1.03*(1.00-1.06)
Delivery in public institution				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	0.93*(0.87-0.99)	0.99 (0.95-1.03)	1 (0.96-1.04)	0.99 (0.96-1.02)
Any PNC				
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	0.98 (0.87-1.11)	0.92***(0.88-0.96)	1.03 (0.99-1.08)	1.05 (0.99-1.11)

*Multilevel modelling estimates adjusted for age, education, residence, child gender, household wealth status, currently working status and birth order; * <0.05; ** <0.01; *** <0.001; sample size – pre-conflict 2569; peri-conflict 4641*

Association between conflict and maternal services usage by maternal residence

Table 23 shows that during conflict versus pre-conflict, rural women had relatively lower odds (1%) of receiving ANC from a government provider (OR 0.99; 95% CI 0.98-0.99); relatively higher (2%) odds of SBA (OR 1.02; CI 1.02-1.03); and relatively higher (3%) odds of physician-assisted delivery (OR 1.03; CI 1.02-1.04; $p<0.01$), while urban women had relatively lower (3%) odds of public sector institutional delivery (OR 0.97; 95% CI 0.95-0.99).

Table 23. Multilevel modelling estimates of the association between conflict and maternal care usage by maternal residence

Period	Rural (n=3188) OR[b] (95% CI)	Urban (n=2254) OR[b] (95% CI)
	4+ ANC visits	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.01 (1.00-1.02)	1.01 (0.99-1.03)
	ANC received from a government provider	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	0.99***(0.98-0.99)	0.99 (0.96-1.01)
	ANC received from a doctor	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.96-1.05)	1.01 (0.99-1.03)
	Delivery by skilled provider	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.02*** (1.02-1.03)	1.00 (0.99-1.01)
	Delivery by doctor	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.03*** (1.02-1.04)	1.01 (0.98-1.04)
	Delivery in a public institution	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.98-1.01)	0.97* (0.95-0.99)

		Any PNC	
Pre		1.00 (Reference)	1.00 (Reference)
Peri		1.01 (0.97-1.04)	1.01 (0.99-1.03)

*Multilevel modelling estimates adjusted for age, education, residence, child gender, household wealth status, currently working status and birth order; * <0.05; ** <0.01; *** <0.001; sample size – pre-conflict 2569; peri-conflict 4641*

Association between conflict and maternal services usage by maternal education

Table 24 shows that during conflict versus pre-conflict, women educated to primary level had more higher odds of SBA (4%; OR 1.04; 95% CI 1.01-1.07) and doctor-assisted deliveries (5%; OR 1.05; 95% CI 1.01- 1.10), while women educated to secondary level had more lower odds of delivery in a public institution (3%; OR 0.97; 95% CI 0.96–0.99).

Table 24. Multilevel modelling estimates of the association between conflict and maternal care usage by maternal education level

Period	No education (n=1109) OR^b (95% CI)	Primary (n=1123) OR^b (95% CI)	Secondary (n=3210) OR^b (95% CI)
	4+ ANC visits		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	0.99 (0.98-1.00)	1.00 (0.97-1.03)	1.02 (1.00-1.04)
	ANC received from a government provider		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.94-1.05)	0.98 (0.92-1.05)	0.98 (0.96-1.00)
	ANC received from a doctor		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.01 (0.95-1.07)	0.96 (0.84-1.10)	1.01 (0.98-1.04)
	Delivery by skilled provider		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.96-1.05)	1.04* (1.01-1.07)	1.00 (0.99-1.01)
	Delivery by doctor		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.97-1.05)	1.05* (1.01-1.10)	1.01 (1.00-1.03)
	Delivery in a public institution		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.01 (0.95-1.07)	1.02 (0.99-1.05)	0.97*** (0.96-0.99)
	Any PNC		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Peri	1.05 (0.99-1.12)	1.03 (0.97-1.10)	0.98 (0.94-1.03)

Association between conflict and maternal services usage by maternal employment

Table 25 shows that during conflict versus pre-conflict, employed mothers had relatively higher odds (4%) of SBA (OR 1.04; 95% CI 1.01-1.07) and physician-assisted delivery (7%; OR 1.07; 95% CI 1.02-1.11), while unemployed mothers had relatively higher odds (1%) of physician-assisted delivery (OR 1.01; 95% CI 1.00-1.02).

Table 25. Multilevel modelling estimates of the association between conflict and maternal care usage by maternal employment status

Period	Unemployed (n=4640) OR[b] (95% CI)	Employed (n=802) OR[b] (95% CI)
	4+ ANC visits	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.01 (0.99-1.02)	1.01 (0.98-1.04)
	ANC received from a government provider	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	0.98 (0.96 - 1.00)	1.00 (0.93 - 1.08)
	ANC received from a doctor	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.96 - 1.04)	1.03 (0.98 - 1.08)
	Delivery by skilled provider	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.01 (1.00 - 1.02)	1.04* (1.01 - 1.07)
	Delivery by doctor	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.01* (1.00 - 1.02)	1.07*** (1.02 - 1.11)
	Delivery in a public institution	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	0.99 (0.97 - 1.01)	0.98 (0.91 - 1.05)
	Any PNC	
Pre	1.00 (Reference)	1.00 (Reference)
Peri	1.00 (0.98 - 1.03)	1.04 (0.97 - 1.11)

Association between conflict and maternal services usage by household wealth

Table 26 shows that during conflict versus pre-conflict, women from less-poor households had more higher odds (1%) of any ANC (OR 1.01; 95% CI 1.01-1.02) and women from richest

households had more lower odds (3%) of receiving ANC from a government provider (OR 0.97; 95% CI 0.95-0.98) than poorest women. During conflict, odds of SBA were 3% higher (OR 1.03; 95% CI 1.02 – 1.05) and 2% higher (OR 1.02; 95% CI 1.01–1.04) for births of women from less poor and middle households respectively than poorest. During conflict, odds of physician-assisted delivery were more (3%) higher for women from less poor and middle income quintiles (OR 1.03; 95% CI 1.01 – 1.05) and richest quintiles (2%; OR 1.02; 95% CI 1.00-1.03) than for poorest.

Table 26. Multilevel modelling estimates of the association between conflict and maternal care usage by household wealth quintile

Period	Poorest (n=1032) OR^b (95%CI)	Less poor (n=1079) OR^b (95%CI)	Middle (n=1084) OR^b (95%CI)	Richer (n=1100) OR^b (95%CI)	Richest (n=1147) OR^b (95%CI)
			4+ ANC visits		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	1.00 (0.98-1.02)	1.01***(1.01-1.02)	1.01 (0.98-1.04)	1.01 (0.99-1.04)	1.01 (0.99-1.02)
			ANC from a government provider		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	0.99 (0.94-1.03)	1.00 (0.98-1.03)	1.01 (0.94-1.08)	0.99 (0.94-1.03)	0.97***(0.95-0.98)
			ANC from a doctor		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	1.02 (0.95-1.10)	0.95 (0.84-1.06)	1.01 (0.98-1.04)	1.02 (0.98-1.07)	1.01 (0.99-1.03)
			Delivery by skilled provider		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	1.01(0.99 - 1.04)	1.03***(1.02-1.05)	1.02***(1.01-1.04)	1.00(0.98-1.02	1.00(0.99 - 1.02)
			Delivery by doctor		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	1.01(0.98 - 1.03)	1.03***(1.01-1.05)	1.03***(1.01-1.05)	1.02(0.99-1.07)	1.02* (1.00 - 1.03)
			Delivery in public institution		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	0.99(0.94 - 1.05)	1.00 (0.96-1.05)	0.98 (0.93-1.03)	1.04 (0.97-1.10)	0.96 (0.90 - 1.01)
			Any PNC		
Pre	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00(Reference)	1.00 (Reference)
Peri	1.04(1.00 - 1.08)	1.00 (0.98-1.03)	0.99 (0.93-1.06)	1.01(0.97-1.05)	0.99 (0.93 - 1.05)

*Multilevel modelling estimates adjusted for age, education, residence, child gender, household wealth status, currently working status and birth order; * <0.05; ** <0.01; *** <0.001 ; sample size – pre-conflict 2569; peri-conflict 4641*

Discussion

Primary findings

This study focused on dimensions of health equity during acute conflict, by assessing the association of the 2011-2012 Egyptian conflict with usage of essential maternal services among different socioeconomic, demographic, and geographic groups. The associations between acute conflict and maternal services usage were generally equitable, challenging prevailing assumptions in the literature.[44] A comparison of study findings with those from the 2014 EDHS report, which examined maternal care use over a longer period (2009-2014), helps interpretation of study associations within broader socioeconomic trends.

Patterns of equity in maternal care usage during the conflict differed from recent trends in Egypt, indicating vertical equity did not worsen and in some cases improved for identified vulnerable groups during conflict. For example, while associations between conflict and maternal care among socioeconomically advantaged women were minimal, known vulnerable groups (e.g. rural women) had relatively higher odds of maternal care during conflict than pre-conflict.

Recent trends in Egypt indicate higher maternal care use among richer women, while evidence elsewhere indicates that maternal care for both rich and poor can be adversely affected during conflicts[17] However, compared with pre-conflict, the odds of receiving maternal care during conflict increased for both poorer and richer women. Contrary to recent trends in Egypt, the odds of maternal care increased during conflict as maternal age increased. Research from Nepal, Sri Lanka and Yemen indicated a negative association of conflict with age, while Iraq reported lower use of SBA (22%) among women under 25.[55,68,122,124,153–156] Also contrary to recent trends in Egypt, and evidence elsewhere, odds of maternal care during conflict did not increase with increased educational attainment.[7,61] Contrary to recent trends, rural women had relatively higher odds of using maternal services during conflict, while evidence elsewhere shows conflict could impact both rural and urban women adversely.[17,34] Reinforcing recent trends in Egypt, and existing evidence from LMICs, employed mothers had higher odds of maternal service use during conflict. However, the odds of physician-assisted delivery during conflict also increased for unemployed mothers.

Age-related findings are comparable with those from the 2014 DHS report. Both reported that women aged 30-34 were more likely to deliver in public institutions.[61] Evidence suggests that public providers are more frequently chosen by older, poorer, and more rural residents in Asia,[151] mainly due to trust in provider behaviour, affordability, and availability in rural areas.[143,157] Another study in Egypt also indicated a higher reliance on public sector childbirth among women above age 30.[78,80] Additionally, the fertility rate in Egypt is somewhat higher among older women living in rural areas, where public-sector facilities are more readily available.[66,145,149]

This study found lower odds of any PNC visits for women aged 25-29 than older women during conflict compared to pre-conflict, while recent country trends indicate comparatively higher PNC use in this age group. PNC attendance is typically higher among women who deliver in private institutions in LMICs, particularly in Egypt.[82,145]An assessment of maternal care in conflict-affected settings indicated that women's PNC usage depended on perceived need and ability to access care without endangering life.[144,158] Other studies indicated women may have wanted to reach home safely rather than wait for PNC during acute conflict.[30,150]

In Egypt, urban areas report better physical access to health centres,[149,150] while socioeconomic and cultural barriers are more profound in rural areas.[66] Despite this, rural women had higher odds of using maternal services during the conflict, possibly reinforcing media reports that conflict was more severe in urban areas.[3] The existing literature is inconclusive as to how the severity of conflict affects maternal care. Evidence from Nepal, Morocco and Afghanistan indicates that it was not the severity of conflict but rather availability of services that determined maternal usage.[55,159,160] Conversely, evidence from 19 conflict-affected sub-Saharan African countries and Sri Lanka indicated that maternal care was more adversely affected in urban areas during severe conflict.[69,156]

Contrary to the existing literature and 2014 DHS report, the odds of maternal care use (i.e. ANC, SBA, or public sector delivery) did not considerably increase among highly educated women compared with pre-conflict.[18,55,124,161] Pooled odds ratios from a systematic review showed that education level was associated with 20% higher odds of SBA usage during conflicts in Asia and the Middle-East.[162] Qualitative evidence from Egypt and culturally-similar settings indicated that socio-cultural barriers to maternal care that are more frequent

for less-educated women can be stronger during conflict.[62,124] For example, the literature indicates that less-educated women in Asia have relatively weak autonomy in decision-making, travel, and purchasing power, especially during conflict.[10,163] Thus, compared to more-educated women, they tend to use public rather than more expensive private facilities.

Similar to the 2014 DHS report and a study from Yemen, employed women had relatively higher odds than unemployed women of using SBA and physician-assisted delivery during conflict.[61,122] However, unlike the DHS report, this study did not find significantly greater ANC and PNC use among employed women during the conflict compared to pre-conflict. The higher odds of physician-assisted delivery suggests employed women had more access to private institutional care during conflict. Another study from Egypt reported working women were more likely to use quality maternal care and physician-assisted delivery from private institutions irrespective of conflict.[66,164] However, a slight increase in the odds of physician-assisted delivery among unemployed women during the conflict compared with pre-conflict is worth noting. Women could have felt safer with physicians during acute conflict. Alternatively, the extensive policy attention on quality of maternal care could have prompted them to seek physician services.[165]

Unlike the 2014 DHS report and other studies in Egypt, women from poor households had higher odds of using maternal care during conflict, possibly reinforcing the role of conflict in driving maternal care beyond the level of affordability.[61,62,151] This finding supported the literature, which indicates that the effect of household wealth on maternal services use during conflict is unpredictable.[7] Pooled odds ratios from a systematic review showed that household wealth was not associated with increased odds of SBA usage during conflicts in Asia and the Middle-East.[162] However, the literature does indicate that restricted financial access is still a driver of maternal care use during and after conflict. Catastrophic financial implications can be higher during acute conflict, especially for maternal emergencies.[7,143] Although poor women used services, given the regressive health financing system and inadequacy of supplies in public hospitals, there could have been a higher chance of financial catastrophe, which was not assessable.[1,3,14]

Policy and research implications

Study findings show that existing equity patterns in maternal care changed unpredictably during the acute conflict. If the healthcare delivery system is well-developed with progressive health financing, the scope for a conflict to cause larger inequities is limited. However, given the limited availability of quality maternal care, inequities in service delivery, and regressive health financing in Egypt, maternal policy could benefit from specific in-built equity strategies to address unpredictable effect of conflict on equity. [7,143] For example, strategic involvement of community-based groups, volunteers, and local providers has helped pregnant women during emergencies.[3] Depending on the severity of conflict and women's relative vulnerability, failure to implement remedial measures can worsen equity.[7,143]

Experiences in several conflict-affected countries (e.g. Nepal, Myanmar) showed that post-conflict reconstruction could offer opportunities to build more equitable health systems than existed previously.[10,22] The commitment shown by Egyptian policy-makers in implementing multi-sectorial policy measures to address health inequities is worth acknowledging.[65,70] Improved maternal care use among socioeconomically disadvantaged groups could be partially due to this increased policy attention. Increasing the involvement of non-state actors may strengthen the government's equity-driven initiatives further. For instance, active participation of civil society in policy-making may inspire maternal health policies to be more equity-focused.[25] Given the financial and technical constraints in the public health system, development partners and the private sector could leverage funding and technical capacity to implement equitable maternal care strategies.[58] Enhancing the capacity of providers and community-based networks could reduce access barriers for previously marginalised groups.[25]

Due to data constraints, this study did not assess the association between conflict and out-of-pocket expenditure and financial catastrophes due to maternal care. Egypt's proportion of out-of-pocket healthcare expenditure is high at more than 70%, while its financial risk-protection measures are still evolving.[76] User fees and lack of pre-payment systems are known limitations in the Egyptian health system.[57,166] During major conflicts, financial access to care typically deteriorates due to collapsing livelihoods and healthcare delivery services.[7] Though the 2011-2012 Egyptian conflict was not particularly severe, maternal needs could have engendered financial hardship, particularly among poorer groups.[64,167–169]

In-depth research is needed to explore the underlying drivers of maternal care equity during future conflicts.[44] It should be noted that socioeconomic adversity in Egypt is more concentrated in the Rural South Region, which was relatively less conflict-affected than the affluent urban areas.[62,151] This could be a reason for maternal care among vulnerable groups not being adversely affected by conflict in this study. Egypt has recently been implementing several maternal and child health initiatives in the Rural South Region,[62] which could have positively influenced maternal care among socioeconomically disadvantaged groups. Additional evidence is needed on the differential association of conflict and quality of maternal care used by different groups. Assessing the equity dimension in quality of maternal care would help understanding of conflict's potential effect on maternal health status among different groups.[52] The literature indicates that LMICs generally provide relatively low-quality maternal services to economically poorer women, as is the case in Egypt.[169,170]

Limitations

Several potential limitations relate to the nature of the secondary data. First, as DHS data were not specifically collected to assess the effects of conflict, customising DHS data led to omitting relevant ANC and PNC variables due to incompatibility with a before-and after analysis. Second, as this study relied on DHS birth data without any additional validation, internal validity of the study needs to be judged carefully. Although EDHS reported an unusual increase in birthdate during 2009-2014, this equity analysis did not have a scope to validate the birth data. A validation study on EDHS reported birth rates showed that DHS period (2009-2014) witnessed a hike in birth rate mainly due to a marked shift towards fertility among younger women below 25 years and among more educated women (i.e. secondary and above).[139] Based on this validation study it would be difficult to say that the peri-conflict period witnessed a doubling of birth rate. This discrepancy in the birth rate between the two study periods could have led to any measurement error with a possibility of either overestimation and underestimation of effect sizes. Self- reporting in DHS is prone to recall bias, information bias and social desirability bias, with a higher chance of recall bias affecting pre-conflict data.[171]

However, it is difficult to say if this recall bias could have driven results in one particular direction, as study results were quite similar to recent studies.[62,172] Although DHS employs standardised procedures to ensure data quality and tools are well-tested across time, possible errors in data administration cannot be overlooked.[66] However, a validation study in LMICs found a moderate to high sensitivity and a moderate validity for self-reported coverage of maternal care in surveys.[140,141] Although this study focused on temporal association of conflict with maternal care, including women's differential exposure to conflict based on locations would have provided more reliable results. In other words, discrepancies in sample size, recall bias and absence of location-specific conflict data could have possibly lead to any measurement error, limiting the scope of internal validity.

Third, the EDHS wealth index is potentially biased against rural households, in including more items or utilities (e.g. electrical appliances) suited to urban populations.[171] Thus, there could be a chance of misclassification of different quintiles among rural population in DHS.[66] Therefore, the wealth index classification used in this study might provide a biased classification of rural women's economic status or in other words, a misclassification of rural women into different income quintiles.[66] This misclassification of income quintiles for rural women would have possibly driven the study results in a positive or negative direction. In short, the study would have possibly either underestimated or overestimated the maternal care use for a particular income quintile actually. Therefore, maternal care patterns on different rural income quintiles need to be carefully judged. Finally, underlying temporal trends including cultural factors could have influenced the measurement of effect size leading to plausible measurement error.[141]

Conclusions

Despite limitations, this study is a rare attempt to measure the association between an acute conflict and equity of maternal services usage. The association between acute conflict and maternal services usage was generally vertically equitable in Egypt, as opposed to prevailing evidence in LMICs. Authors call for specific equity strategies in maternal policy to address the unpredictable effect of conflict on equity of maternal care. Additional evidence is needed on how conflict affects out-of-pocket expenditure and financial catastrophe and quality of maternal care among different socioeconomic groups.

Chapter 6. Association between conflict and maternal care: sub-sample analysis

Background

This chapter provides results for Objective 3 of the doctoral research. The context for choosing the objective was the scarcity of evidence showing the association between conflict and maternal care in LMICs such as Egypt. This study assessed the association between Egypt's acute conflict during 2011-2012 and usage of maternal services (i.e. antenatal care and delivery services) for the sub-sample of women who gave birth during both pre-conflict and peri-conflict periods. As DHS data were not collected to assess the impact of conflict on maternal care, inclusion of this sub-sample was expected to reduce confounding while attributing the influence of the conflict on the level of maternal care use.

Methods

Outcome measures

Table 27. Outcome measures (sub-sample analysis)

Outcome measures
Had any ANC visit
Had four or more ANC visits
ANC received from a government provider
ANC received from a doctor
Delivery by skilled provider
Delivery by doctor
Delivery in an institution
Delivery in a private institution

PNC variables were not included as data were not available for the same during both pre- and peri-conflict periods to enable a before and after comparison

Data analysis

As in the other two sub-studies, data analysis was undertaken in three ways, using Stata version 13: (a) descriptive analysis, (b) estimate of effects through multilevel modelling, and (c) sensitivity checks.[97]

Descriptive analysis

As previously, descriptive analyses were undertaken for the sample based on key explanatory variables including mother's age (<25, 25-29, 30-34, >35), education (no education, primary, secondary and above), occupation (currently working and not working), birth order (1, 2-3, 4-5, 6 and above), child gender, residence (urban/rural), and household wealth quintile (poor, less poor, middle, rich and richest). Variables were summarised by period (i.e. pre- and peri-conflict) with frequencies for categorical variables.

Multilevel modelling

The outcomes were assessed over the entire sub-sample of women that reported births in both pre-conflict and-peri-conflict periods. MLM regression was applied to estimate the effects on levels of maternal care use. The levels of analysis were slightly different for this objective as the outcomes were estimated over the same woman but for different births at two time periods. These levels were births (level 1) nested within women (level 2), women nested within clusters (level 3), clusters nested within PSUs (level 4) and PSUs nested within governorates (level 5).

The following model specifications pertain to binary outcomes.

$$\log\left(\frac{Y_{ijklm}}{1-Y_{ijklm}}\right) = \propto + \beta_1 X_{1ijklm} + \cdots + \beta_n X_{nijklm} + \gamma T_{ijklm} + \theta_l + \mu_{kl} + \eta_{jkl} + \varepsilon_{ijkl} + \rho_{ijklm}$$

where Y_{ijklm} is the outcome for birth i (level 1) for woman j (level 2) within cluster k (level 3) within PSU l (level 4) within governorate m (level 5). α is a constant; X_{1ijklm} .... X_{nijklm} are the explanatory variables at individual and household levels (table 4) with β_1 ...... βn as their coefficients; T_{ijklm} is a binary variable where it is 1 for the "after" sample and 0 otherwise with γ as its coefficient; θ_l, μ_{kl}, η_{jkl}, ε_{ijkl}, ρ_{ijklm} are the error terms at governorate, PSU, cluster, woman and birth levels respectively.

Due to the binary nature of the outcome variables, multilevel analysis included logistic regressions. MLM regressions were conducted by adjusting for the following covariates: mother's age, education, residence, wealth index, current working status, gender of child and birth order. As the DHS applies sampling weights for national representativeness, these weights were accounted for in the multilevel regressions.[61] Sampling weights were rescaled since including raw weights without scaling in an MLM leads to biased parameters and standard errors.[71,72] In this study, weights were scaled so that the new weights summed to the effective cluster size.[106]

Sensitivity checks on alterations to model specification were checked in two ways. First, changing the levels of analysis (5-level versus 4-level model). Second, applying sampling weights (no weights versus weighted unscaled versus weighted rescaled).

Results

Sample characteristics for women (most recent birth)

The analysis included 3,468 births, from 1,734 women in 992 clusters who delivered in both pre-conflict and peri-conflict phases (Table 28). Regarding age, 46% were aged 25-29, 23% were aged 30-34, while 19% and 11% were below age 25 and above age 35 respectively. Regarding education, 62% were educated to secondary or above, 19% to primary level, while 19% did not have any education. Regarding geography, most women were rural residents (71.4%). Gender of the last-born (most recent) child was almost equally male and female for these women. There were no notable differences in household wealth status, with approximately 20% each in poorest, poorer, and richer quintiles, while 24% were in the middle quintile and nearly 14% in the richest quintile. The majority (88%) were not working at the time of survey. Around 97% were Muslim and the rest were Christian.

Table 28. Sub-sample characteristics

Characteristics	(n)	(%)
Age group		
< 25	330	19.0
25-29	798	46.0
30-34	409	23.6
>35	197	11.4
Education		
No education	326	18.8
Primary	333	19.2
Secondary and above	1075	62.0
Residence		
Urban	496	28.6
Rural	1238	71.4
Gender of child		
Male	886	51.1
Female	848	48.9
Wealth index		

Poorest	353	20.3
Poorer	375	21.6
Middle	415	23.9
Richer	341	19.7
Richest	250	14.4
Currently working		
No	1526	88.0
Yes	208	12.0
Birth order		
2 -3	1313	75.7
4 - 5	354	20.4
6 and above	67	3.9
Religion		
Muslim	1683	97.1
Christian	51	3.0

N=1734 women

Association between conflict and maternal care usage for the sub-sample

Table 29 shows both adjusted and unadjusted estimates of the association between conflict and delivery service usage for the sub-sample. The unadjusted estimates show that during conflict, the odds of institutional delivery declined by 3% (OR 0.97; 95% CI 0.96-0.98; p<0.001). The odds increased: of any ANC visits by 17% (OR 1.17; 95% CI 1.13-1.20; p<0.001); of SBA by 18% (OR 1.18; 95% CI 1.15 – 1.22; p<0.001); of physician-assisted delivery by 18% (OR 1.18; 95% CI 1.14 – 1.22; p<0.001); and of delivery in a private institution by 14% (OR 1.14; 95% CI 1.10 – 1.17; p<0.001).

Adjusted estimates, accounting for respondent age, education, residence, working status, household wealth index, child gender, and birth order, showed changes in the odds of specific indicators as follows. During conflict compared to pre-conflict, the odds increased of having any ANC visit by 22% (OR 1.22; 95% CI 1.17 – 1.27; p<0.001), of SBA by 23% (OR 1.23; 95% CI 1.19–1.28; p<0.001), of physician-assisted delivery by 23% (OR 1.23; 95% CI 1.18 – 1.28; p<0.001), and of delivery in a private institution by 19% (OR 1.19; 95% CI 1.13 – 1.24; p<0.001).

Table 29. Association of conflict with maternal service usage for the sub-sample (multilevel modelling estimates)

	Means		Odds ratio (95% CI)	
	Pre-conflict	Peri-conflict	Unadjusted	Adjusted#
Had any ANC visit	71.2	86.6	1.17***(1.13-1.20)	1.22***(1.17-1.27)
Had four or more ANC visits	90.4	90.0	0.99(0.98-1.01)	1.02(0.99 - 1.05)
ANC received from government provider	17.1	16.3	0.93(0.98-1.01)	0.99(0.97 - 1.02)
ANC received from a doctor	66.3	65.4	0.99(0.98-1.01)	0.98(0.96 - 1.01)
Delivery by skilled provider	72.1	89.0	1.18***(1.15-1.22)	1.23***(1.19-1.28)
Delivery by doctor	69.5	86.0	1.18***(1.14-1.22)	1.23***(1.18-1.28)
Delivery in an institution	87.5	84.4	0.97***(0.96-0.98)	0.99(0.97-1.01)
Delivery in a private institution	43.5	56.2	1.14***(1.10-1.17)	1.19***(1.13-1.24)

 # Multilevel modelling estimates adjusted for age, education, residence, child gender, wealth index, currently working status and birth order; * <0.05; ** <0.01; *** <0.001; sample size 1734

Sensitivity analysis

Table 30 shows that when only four levels were included (i.e. excluding governorates) in the MLM analysis, effect sizes and the strength of association between conflict and maternal care indicators did not change from the final five-level analysis model.

Table 30. Effect of conflict on maternal services by levels of analysis

	Four levels$ Odds ratio (95% CI)	Five levels# (Final model) Odds ratio (95% CI)
Had any ANC visit	1.22**(1.17 - 1.26)	1.22***(1.17 - 1.27)
ANC from government provider	0.99(0.97 - 1.02)	0.99(0.97 - 1.02)
ANC received from a doctor	0.98(0.96 - 1.01)	0.98(0.96 - 1.01)
Delivery by skilled provider	1.23***(1.19 - 1.27)	1.23***(1.19 - 1.28)
Delivery by doctor	1.23***(1.19 - 1.27)	1.23***(1.18 - 1.28)
Delivery in an institution	0.99(0.97 - 1.01)	0.99(0.97 - 1.01)
Delivery in a private institution	1.19***(1.15 - 1.23)	1.19***(1.13 - 1.24)

 # Multilevel modelling estimates adjusted for age, education, residence, child gender, wealth index, currently working status and birth order; * <0.05; ** <0.01; *** <0.001

Similarly, Table 31 shows that the unweighted model and the weighted unscaled model did not provide different effect size or strength of association than the final weighted rescaled model.

Table 31. Effect of conflict on maternal services by sample weighting

	Unweighted	Weighted unscaled	Weighted rescaled (Final model)
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Had any ANC visit	1.22***(1.17-.26)	1.20***(1.16-1.26)	1.22***(1.17-1.27)
Had four or more ANC visits	1.02(0.99 - 1.06)	1.04(0.99 - 1.08)	1.02(0.99-1.05)
ANC from government provider	0.99(0.96 - 1.03)	0.98(0.96 - 1.00)	0.99(0.97-1.02)
ANC received from a doctor	0.98(0.94 - 1.03)	0.97*(0.95 - 0.99)	0.98(0.96-1.01)
Delivery by skilled provider	1.23***(1.19-1.27)	1.22***(1.18-1.27)	1.23***(1.19-1.28)
Delivery by doctor	1.23***(1.19-1.27)	1.22***(1.17-1.28)	1.23***(1.18-1.28)
Delivery in an institution	0.99(0.96 - 1.02)	0.98(0.97-1.00)	0.99(0.97-1.01)
Delivery in a private institution	1.19***(1.14-1.23)	1.19***(1.14-1.25)	1.19***(1.13-1.24)

Discussion

This chapter shows the effect of the acute conflict on maternal care use for the sub-sample of women who gave birth in both pre-conflict and peri-conflict periods, using both unadjusted and adjusted MLM estimates. Results for this sub-sample were generally similar to those for the full sample shown in chapter 4. Differences included unadjusted estimates for the sub-sample, which showed a decline in the odds of institutional delivery during conflict. For the full sample, both adjusted and unadjusted estimates showed a slight increase in the odds of institutional delivery, SBA, and completing four or more ANC visits. It is worth noting that for both full-sample and sub-sample, there was a slight increase in the odds of private sector and physician-assisted deliveries during conflict. In agreement with the main analytic model, the alternate analytic models also showed similar effect sizes and strength of association between conflict and maternal care use for the sub-sample. As in the full-sample, patterns of maternal care usage in the peri-conflict period were similar to the usual maternal care patterns in the country in recent times.

During conflict, women in the sub-sample had slightly increased odds of having any ANC. The percentage of pregnant women accessing any ANC service improved in Egypt in the last few years, increased from 71% in 2005 to 90% in 2014.[61] Given the fact that the conflict did not include high numbers of fatalities or prolonged use of heavy weaponry, women could still have attended ANC. In Nepal, the use of any ANC service was 85% among conflict-affected women.[130] Qualitative findings demonstrate that the use of ANC service during conflict greatly

depends on prevailing ANC patterns in a setting.[10,22] However, refugee camps are exceptions, as they can motivate women to use health service more frequently, especially maternal care.[18]

As in the full-sample, women in this sub-sample had a higher chance of delivering in private institutions during the conflict. This relatively greater preference for private institutions for delivery services appears to be an emerging trend in Egypt.[129] However, evidence elsewhere shows a mixed trend in choosing the type of provider for delivery in acute conflicts.[11,57,130,131] Sometimes, women may be more concerned about accessibility and safety than trust in the provider.[10] Limited capacity within public institutions is one of the reported reasons for choosing private providers in Egypt irrespective of conflict.[164] This preference for private institutions would have naturally increased the possibility of doctor-assisted deliveries.[62] Greater use of physicians in maternal care is also a trend in Egypt, mainly attributed to the dependence on the private sector.[62,66,148]

Egypt has a relatively higher rate of SBA among Middle-Eastern countries, with more than a third of its childbirths assisted by skilled professionals.[173] During the acute conflict, this trend continued, as shown by the adjusted estimates for the sub-sample in this study. However, the literature gives a mixed picture on SBA during acute and/or low-intensity conflicts.[44] During the acute Lebanon war, an increased demand for home deliveries was reported due to poor quality of services.[17] An examination of maternal care in multiple sub-Saharan African countries, indicated SBA declined during conflicts.[69] Liberian displaced women in Buduburam refugee camp in Ghana reported a decline in usage of essential maternal care services due to lower prioritisation for reproductive health services in the camps.[174] Conversely, research in Nepal indicated increased usage of SBA and institutional deliveries during conflict.[130]

Limitations
This sub-study only assessed the association between conflict usage of maternal services in the sub-sample, while the determinants of care-seeking and usage were not analysed. Exploration of the determinants of service usage, especially qualitative findings may have identified key causal pathways of conflict impacting maternal care consumption.

Conclusions

This study observed that the acute Egyptian conflict of 2011-2012 was associated positively and negatively with some aspects of maternal care use for the women who gave birth in both periods. Examining the maternal care usage for the same group of women in pre-conflict and peri-conflict periods is a unique aspect of this study. Such a pre-post exploration on the same sample may provide more reliable evidence while using a secondary data source such as the DHS data.

Chapter 7. Discussion

This study was a unique attempt to measure the association between the Egyptian acute conflict of 2011-2012 and use and quality of maternal care, by analysing 2014 EDHS data using multi-level modelling regression. The level of association was measured as a comparison between the pre-conflict and peri-conflict periods. This study also assessed the association between conflict and use of maternal care among different socioeconomic, demographic and geographic groups to observe vertical equity. To measure the association of the conflict with maternal care use, this study considered two different samples: 1) the full-sample, in which women who had given birth in either the pre-conflict or peri-conflict period were included, and 2) the sub-sample, in which only women who had given birth in both the pre-conflict and peri-conflict periods were included. Analysis of the sub-sample was intended to reduce confounding while attributing the influence of the conflict on level of maternal care.

Primary findings

Descriptive results for objectives 1 and 2 (full-sample)

During the pre-conflict period, a third of births each were to women in older age groups (30-34 years and >35 years), educated to secondary level or above (58.2%), living in rural settings (65.1%), middle wealth quintile (23.8%), non-working (84.9%) and Muslim (97%). Slightly above half (55%) delivered boys in the last birth. Most peri-conflict births were to women aged 25-29 years (36.9%), educated secondary level or above (61.7%), living in rural settings (69.2%), middle quintile (25.1%), non-working women (86.7%) and Muslim (97%). Slightly above half (69.2%) delivered boys in the last birth.

Descriptive results for objective 3 (sub-sample)

Most women were in the 25-29 age group (46%), educated to secondary and above (62%), rural residents (71.4%), non-working (88%) and Muslim (97%). Gender of the last-born child was almost equally male and female. Around 20% each belonged to the poorest, poorer and richer quintiles. There were 23% women in the middle-quintile and nearly 15% in the richest quintile.

Association between conflict and maternal care use among full-sample women (objective 1)
After adjusting for key socio-economic variables, this study did not find any association of conflict with ANC service usage. Conflict was associated with slight increases in the odds of institutional delivery (2%), doctor-assisted delivery (2%), and deliveries in private institutions (3%), and doctor-assisted PNC (2%). However, conflict was also associated with slight reductions in the odds of delivery in public institutions (1%), post-delivery stay for at least 24 hours (8%), and institutional PNC (1%). Alternate models in the sensitivity analysis showed similar effect sizes and strength of association as in the main analytical model.

Association between conflict and maternal care use among socioeconomic demographic and geographic groups (objective 2)
Compared to respective reference groups, conflict was associated with increased odds of doctor-assisted delivery for oldest women (3%); SBA usage for rural women (2%), educated to primary level (4%), employed (4%), less poor quintiles (3%) and middle quintiles (2%); physician-assisted delivery for rural women (3%), educated to primary level (5%), employed (4%), less poor and middle quintiles (3% each) and richest quintiles (2%); and decreased odds of receiving PNC among women ages 25-29 (8%).

Association between conflict and maternal care use among sub-sample women (objective 3)
Conflict was associated with increased odds of any ANC visit (22%), SBA usage (23%), physician assisted deliveries (23%) and deliveries in private institutions (19%) among women who delivered both pre-conflict and peri-conflict. No major differences were found in sensitivity analysis.

In short, this study found that the Egyptian conflict of 2011-2012 had minimal associations with maternal care use and differences were largest in the sub-sample of women who delivered both before and during conflict. With respect to equity, this study found that socioeconomically disadvantaged groups had marginally higher odds of using maternal care during conflict compared to their more advantaged counterparts. This finding counters recent trends in Egypt and the prevailing notion that socioeconomically disadvantaged groups typically become worse off during conflicts.[44]

Findings reinforce the existing body of evidence that conflict, irrespective of duration and severity, has the potential to impact maternal care use. Findings also appear to support the literature suggesting the direction and magnitude of the association depend on the nature, severity, duration, and geographical spread of conflict.[45,50] In this study, the strength of association was minimal, probably because the 2011 conflict was not severe according to conflict severity indices.[9] Recent trends in maternal services usage may continue during an acute conflict, unless the conflict is particularly severe and life-threatening.[1] Findings indicate that the recent trends in maternal care in Egypt continued during the acute conflict except for some use by women from different socioeconomic, demographic and geographic groups.

As per the literature, if the existing healthcare system is well-developed with adequate financial risk-protection measures, the risk of conflict adversely impacting maternal care and equity can be reduced.[44] Study findings largely support this hypothesis, as conflict did not adversely affect urban women's maternal care, despite media reports suggesting conflict was most severe in urban areas.[62] It should be noted that the conflict was not life-threatening for most Egyptians and was not associated with substantial positive change in maternal services use among urban women. However, conflict was associated with increased maternal care usage among rural women.[3] The Egyptian healthcare system is better developed in urban areas, but these areas still experience systemic challenges with service delivery, especially availability of supplies, staff, funding, and quality of care.[62]

Study findings support the literature that the effect of conflict on equity can be unpredictable, as socioeconomically disadvantaged groups were not additionally negatively impacted by the conflict.[68] This contradicts the accepted notion that conflict affects disadvantaged groups more adversely and widens prevailing inequalities.[44] Study findings cannot affirm that socio-cultural barriers do not affect maternal care during conflicts. Rural areas with strong socio-cultural barriers were not adversely affected, potentially due to the relative lack of severity of the conflict. Evidence elsewhere shows a deeper effect of socio-cultural barriers on maternal care during conflicts than in normal times.[68] However, this study did not investigate contextual determinants to distil the role of socio-cultural barriers in maternal care during the acute conflict.

Implications for policy

Given the limited availability of quality maternal care, inequities in service delivery and regressive health financing in Egypt, maternal policy could include specific in-built equity strategies to address equity and the unpredictable effect of conflict on equity. In considering ways to mitigate the effects of future conflict on maternal services, existing evidence indicates that the nature and severity of conflict may be potential drivers of inequity.[3] Based on contextual factors and people's relative vulnerability, not implementing remedial measures can challenge equity.[7,143]

Active participation of civil society, including international NGOs and community groups could be useful to meet varying needs of people during periods of both conflict and peace. Such groups have improved routine ANC and PNC usage during conflicts. Active participation of civil society in policy-making may inspire maternal health policies to be more people-centred and equity-focused.[25] Given the financial and technical constraint with the public health system, development partners and private sector can considerably leverage funding and technical capacity to implement efficient and equitable maternal care strategies.[58] Policy intervention may improve post-delivery stay. Again, active participation of civil society and NGOs may help safety of mothers post-partum.[163] For example, a policy that promotes a solid coordination of community-based networks with primary health facilities may encourage women to access services in a timely manner and in bringing women to health centres safely.[36] If mothers feel staying back post-delivery at health centres is risky during acute conflict, this community-based networks can regularly monitor the health of mothers and babies at homes or communities to avoid health risks.[101] Such involvement may reduce the risk from shorter post-delivery stays. Women's maternal care choices are often shaped by social networks that convey behavioural norms, health information, social support, and other resources that impact women's social capital.[55] Community-level support systems and women's groups accentuated meeting maternal health objectives in conflict-affected Myanmar, Pakistan, Sri Lanka and the Philippines.[9,10,38,138] In Egypt itself, a recent community-based experiment involving local grass root level entities and NGOs on educating pregnant women has shown promising results on women's knowledge and attitude towards appropriate maternal care.[137]

The Egyptian health system devolves authority locally.[65] Local authorities need adequate autonomy and capacity to implement remedial measures that also address maternal care during

emergencies.[22] During conflicts in the region, national governments have reportedly had limited scope and governance capacity to address maternal needs.[62] Further, problem-solving to address maternal health needs can be more feasible locally than nationally during conflicts, as shown in Myanmar, Nepal, the Occupied Palestinian Territories, and Pakistan.[10,13,17,132]

Implications for research

More research is needed to establish how larger conflicts affect maternal health status, usage, and equity. Application of robust statistical methods can establish the cause-effect relationship between conflict and maternal care, but require good quality data. In Egypt, further quantitative research could identify the effects of larger conflicts, e.g. on post-delivery stay.

In-depth qualitative research is needed to explore how pre-existing and emerging contextual factors influence maternal services usage and equity during conflict in health systems in conflict-prone countries. Such exploration may also identify how best to address cultural barriers and potential policy and system-level preparedness.[163,175,176] In-depth research may help in exploring the underlying drivers of equity in maternal care during conflict in Egypt.

Additional research could also provide evidence on the differential association of conflict and quality of maternal care used by different groups. Assessing the equity dimension in quality of maternal care would help to understand conflict's potential effect on maternal health status.[52] For example, more detailed disaggregation of out-of-pocket expenditure for maternal care among different socioeconomic groups would be useful, both during peace and conflicts. Egypt possesses a higher proportion of out-of-pocket expenditure, at more than 70%, while its financial risk-protection measures are still evolving.[76] User fees and lack of pre-payment systems are known limitations in the Egyptian health system.[57,166] During conflicts, financial access to care typically deteriorates due to collapsing livelihoods and healthcare delivery services.[7] Thus, there could be a possibility of financial catastrophe and deeper adverse economic impacts later, especially among poorer groups.[64,167–169]

Limitations

This research was one of the first attempts to quantitatively assess association between conflict and maternal healthcare use through multi-level modelling. As such, limitations in relation to design, location, model choice, and data quality should be considered. The most important limitations arguably relate to choice of conflict, choice of model and related lack of granularity, and choice of secondary dataset (and related potential biases and measurement errors).[111] Table 32 summarises the main study limitations and some of their potential effects on results.

Table 32. Study limitations and potential implications

Limitations	Potential effects and implications
Study design	
Choice of model	As the model required a binary exposure variable, this limited the possibility of using a more granular continuous exposure variable to account for differences in exposure to conflict events throughout the country.
Lack of location and magnitude granularity over time	Related to model choice, this could have underestimated or overestimated associations, e.g. 1. women residing closer to conflict may have had fewer institutional deliveries than found (possible under-estimation); 2. women with lower socio-economic status may have had institutional deliveries overestimated as their conflict exposure was not assessed.
Manual selection of conflict cut-off	A single time-point cut-off for the whole country could underestimate or overestimate associations, e.g. 1. possible underestimation of non-institutional delivery for women in locations where conflict began earlier than cut-off. 2. possible overestimation of non-institutional delivery for women in locations where conflict began later than cut-off. However, sensitivity analysis did not show different results.
Unmeasured confounders, e.g. maternal care trends, cultural barriers	Excluding potential confounders could have led to underestimating or overestimating associations, depending on the effect of the confounder.
Multiple hypothesis testing error	Multiple hypothesis testing might have introduced false-positive associations, i.e. demonstrating association when there is none.
Lack of primary or qualitative data	Inclusion of additional primary qualitative or quantitative research data could have helped in triangulating what factors drove study results.
Lack of supply-side determinants (e.g. care availability, quality)	Inclusion of elements such as service availability and quality would have helped inform interpretation of results.
Study country	
Choice of relatively mild conflict	As the Egyptian conflict was not very large or long-lasting, effect sizes may have been smaller and less significant than if data from a more significant conflict could have been used.
DHS data	
Discrepancy in birth rate between pre-conflict and peri-conflict phases, potentially due to: • Recall bias in self-reporting of births in DHS.	This unexplained increase of the birth rate in the peri-conflict phase (whether due to under-reporting for the pre-conflict phase or over-reporting for the peri-conflict phase) could be due to three main reasons: 1) some true births in the pre-conflict period were not reported; 2) some true births in the pre-conflict period were erroneously reported as births in the peri-conflict period (i.e. misclassification); 3) some reported births in the peri-conflict were fictitious.

• Errors enumerating or administering questionnaires.	• If the under-reporting or misclassification of births in the pre-conflict phase was random (i.e. non-differential with respect to the outcome), it would probably accentuate associations towards the null. If such misclassification was non-random, it could have driven results in either direction;
	 • Similarly, over-reporting due to fictitious births in the peri-conflict phase could have occurred randomly or non-randomly. Random reporting could have accentuated associations towards the null, while non-random reporting could have driven results in either direction with respect to specific population groups, e.g.:
	    o if birth rate was under-reported for rural women, the study could have under-estimated conflict's association with rural maternal care;
	    o if birth rate was over-reported for rural women, the study could have over-estimated conflict's association with rural maternal care.

Other bias (e.g. sampling, information, social desirability, recall)	These could lead to under-estimation or over-estimation of associations.
Omission of Sinai regions	As the Sinai regions experience protracted ongoing conflict, they are not directly comparable to the rest of the country. As this research examined the association of acute conflict with maternal care use, excluding Sinai avoided potential bias.
DHS wealth index compatibility for rural households	The wealth index used in DHS provides insufficient classification of rural income quintiles, which could have strengthened or weakened associations for rural women, e.g.: 1. the rural poorest quintile could have had more non-institutional deliveries than shown in the study; 2. the rural wealthiest quintile could have had more postnatal care than shown in the study.

This research used data from the acute Egyptian conflict, which was considered a moderately severe conflict. Examining a more severe conflict could have provided stronger associations and enabled broader generalisability. However, major data quality concerns (e.g. of Afghanistan DHS data) would likely have negated these advantages. Similarly, the Egyptian conflict continued for a longer period, but a shorter study period was selected due to data reliability. A longer study period could have provided clearer associations between conflict and maternal care, which could have improved internal validity. Research relied on secondary data, which meant the model had to be fitted to the dataset available. This study included only quantitative data. Incorporating qualitative data could have allowed contextual factors to inform results. This research predominantly considered demand-side factors (e.g. household wealth, age, education) and omitted supply-side factors (e.g. availability of staff and drugs, quality) that could have provided additional insight into findings.

The study model required a binary exposure variable to enable a pre-post comparison, which limited granularity. The conflict exposure variable selected was temporality rather than location or magnitude of conflict events, which prevented comparison of outcomes by level/degree of conflict severity. However, this appeared to be the most relevant dimension to

include as the Egyptian conflict was not severe overall, and in the acute phase it spread across the country without major variations in event frequency and magnitude,[63] which limited the benefits of including location and magnitude dimensions.[44] Thus, this study considered all women to be equally exposed to conflict and its geographical distribution, intensity (e.g. peak and fall), and continuity could have confounded model estimates. In other words, this could have led to either overestimation or underestimation of associations. For example, women near specific conflict events could have had fewer institutional deliveries. Similarly, this study found relatively better maternal care among low socioeconomic groups (e.g. rural and unemployed women), which could have been overestimated due to omission of conflict location and magnitude. This non-differential misclassification of exposure by locations would generally have led to an attenuation towards the null of estimated associations.[177] Thus, true associations of conflict with maternal care could have been missed. This limits internal validity and necessities a cautious interpretation of study findings.

This study used a single manual conflict cut-off, as the acute phase of the conflict began and ended at approximately the same time across the country. Sensitivity analysis showed study results and thus conclusions were not sensitive to the cut-off selected. However, this single cut-off could possibly underestimate associations for some women. For example, for women in locations where conflict began earlier than the study cut-off, any events in the period between conflict beginning in this location and the study cut-off would have been erroneously assigned to a non-conflict period. Thus, if there was an effect of conflict on the behaviour of these women, the estimated association would be underestimated (closer to the null) relative to the true (non-misclassification-affected) association.[177]

Unmeasured confounders, such as underlying temporal trends or cultural barriers, might have affected associations. However, the period under consideration (i.e. two years each in the pre-conflict and peri-conflict phases) was probably too short for a large temporal trend to influence the level of maternal care. However, misclassification would probably not differ by outcome status and would thus be non-differential.[177] In this setting, non-differential misclassification of exposure would lead towards the null of estimated associations. This is generally preferable to the alternatives (e.g. non-differential misclassification) as it means estimates were conservative and findings not over-stated.[177] Therefore, given the largely null results, it is possible that true associations were missed.

This study assessed the effect of acute conflict on several outcomes simultaneously and multiple statistical tests were performed. The tests were not adjusted for multiple hypothesis testing. Inclusion of multiple hypothesis testing might have introduced false-positive associations, i.e. demonstrating association when there really was none.[99]

In addition to country selection and study design issues discussed above, limitations related to reliance on DHS data, e.g. data quality, should be considered. The most obvious concern is the difference in birth cohort size between pre-conflict and peri-conflict groups. This research exclusively relied on DHS birth-rate data and empirical assessment of DHS data collection and birth-rates were beyond its scope. EDHS 2014 reflected an unusual increment in birth rate from 2011.[61] As per UNFPA and the Egypt population department, the total fertility rate (TFR) increased from 3.0 to 3.5 during 2009 to 2013.[86] This increase in TFR of less than 20% could not double birth rates in 2011-2012. Other sources indicated a population boom around the conflict period.[178] For example, a post-DHS validation study reconstructed fertility rates for single years from 1990–2013 and examined patterns of childbearing in five-year birth cohorts of women.[139] This validation exercise was based on birth histories from seven rounds of EDHS (1992–2014). It validated a sudden increase in fertility from 2007 and a major increase in birth rates from early 2012, and indicated this rise was driven by higher fertility rates among younger (i.e. below 25 years) and more educated women (i.e. secondary and above). Another recent study attributed increased fertility in Egypt to women having inadequate labour opportunities.[178] However, these validation studies could not fully explain the doubling of birth rate in the peri-conflict period in this research.

The unusual doubling of birth rate in the study period could be due to DHS design features. For instance, DHS surveys are based on self-reporting of births by women and there are concerns about accuracy of birth dates reported in DHS.[139] It is possible that recall bias could have led to under-reporting for the pre-conflict period or over-reporting for the peri-conflict period. Although DHS tries to reduce errors in enumeration and administration of questionnaires, such unpredictable errors cannot be fully eliminated.[139] A recent USAID study compared fertility rates from DHS with similar nationally-representative household surveys in LMICs.[179] TFR estimates in DHS were 10% different from other surveys.[179] However, this comparative assessment could not prove which TFR estimation was closer to reality.

The discrepancy in the birth cohort could thus be due to two reasons: (1) under-reporting in the pre-conflict-phase; or (2) over-reporting in the peri-conflict phase. The relatively lower number of pre-conflict births, could have been due to at least three possible explanations: (1) some true births in the pre-conflict period were not reported; (2) some true births in the pre-conflict period were erroneously reported as births in the peri-conflict period (i.e. misclassification); and (3) some reported births in the peri-conflict were completely fictitious, though this scenario seems less likely.[177] If such misclassification was random (i.e. non-differential with respect to the outcome), it would probably have attenuated associations towards the null. For example, if some true pre-conflict births were reported as peri-conflict births, then they would exhibit the properties of the former. If peri-conflict births were truly less likely to involve maternal care than pre-conflict births, this would likely lead to an underestimation of the difference in maternal care use between pre-conflict and peri-conflict periods. If such misclassification was differential with respect to the outcome, then it could have biased the observed associations in either direction. If some over-reported births in the peri-conflict phase were completely fictitious[177] and such over-reporting was random, it would probably have reduced associations towards the null. If the over-reporting was non-random, e.g. specific to some population sub-groups, it could have under-estimated or over-estimated associations for such groups. For instance, if birth rates for rural women were under-reported this study could have under-estimated the association between conflict and their maternal care. Similarly, if the birth rate was over-reported for rural women, this study could have over-estimated the association between conflict and their maternal care. In short, these discrepancies in the birth cohort could have either over-estimated or under-estimated results.

Secondly, DHS data are known for potential recall bias due to self-reporting for the previous five years.[61] [140,141] Recall bias could have particularly affected data in the pre-conflict period. It is difficult to say in which direction recall bias would affect modelling estimates.[141,180] Recall bias typically leads to information bias, specifically false reporting of healthcare coverage. Sometimes, women may wrongly judge timing of healthcare visits and may even falsely report their chance of receiving care. As mentioned earlier, recall bias could have led to under-reporting births for the pre-conflict period. However, studies reported chances of both over-reporting and under-reporting of healthcare due to recall bias.[141] DHS social desirability bias

was also possible as it includes details of individual maternal care. Thus, internal validity may be an issue and study findings need to be interpreted cautiously.

Finally, DHS adopts stratified random sampling to select respondents.[61] Studies in LMICs have validated moderate to high sensitivity and moderate validity for self-reported coverage of maternal care and DHS sampling.[140,141] DHS employs standardised procedures to ensure data quality and tools are well-tested across time. However, possibility of sampling errors cannot be ignored in DHS surveys.[181] Thus, there could have been a chance of selecting women with better or worse maternal care patterns in either or both of the study periods. Although it is difficult to judge the direction of this possible effect, this study cannot rule out such a potential bias driving estimates in either direction. Therefore, DHS birth cohort results may have been due to misreporting or mis-recording, though we cannot completely rule out the possibility that 2011-2012 had a higher TFR compared to other years. Therefore, birth cohort numbers must be interpreted cautiously.

The DHS survey did not cover North and South Sinai governorates due to their ongoing political instability.[61]These regions experience protracted conflict and selecting a pre-post time cut-off could have been impossible for them. As this study focused on acute conflict with a defined time period, exclusion of these chronically conflict-affected regions should not have affected study outcomes. On the contrary, as these governorates were not comparable with the rest of Egypt their inclusion would have biased study findings.

As DHS data were not specifically collected to assess conflict impact, customising the DHS data led to omitting relevant variables such as quality of ANC and certain PNC variables (e.g. receipt of at least two PNC, timing of first PNC), while assessing objectives 2 and 3. The 2014 EDHS limited its sampling frame to households and excluded homeless and institutionalised women.[61] Exploring how conflict affected maternal care among such marginalised women would have strengthened assessment on vertical equity (i.e. objective 3).

The Wealth index from the 2014 EDHS was possibly biased in including more items (e.g. electrical appliances) suiting the urban population.[171] Therefore, the wealth index classification used in this study might provide a biased classification of rural women's economic status or in other words, a misclassification of rural women into different income quintiles.[66] This

misclassification of income quintiles for rural women would have possibly driven the study results in a positive or negative direction. In other words, the study would have possibly either underestimated or overestimated the maternal care use for a particular income quintile actually. For instance, the rural poorest quintile could have had a higher non-institutionalized delivery than was presented in the study. Similarly, the rural highest quintile could have had a higher postnatal care than was presented in the study. Therefore, maternal care patterns on different rural income quintiles need to be carefully judged.

The EDHS 2014 sampling involved selecting PSUs from governorates, clusters from PSUs, households from clusters and women from households. Thus, there were four levels of sampling. This study considered a three level model (i.e. births within clusters, clusters within PSUs and PSUs within governorates) for objectives 1 and 2. However, the sensitivity analysis by altering the levels of sampling to four level did not change the results. Therefore, excluding the household level from the analysis would not have affected the study results considerably.

It is difficult to postulate, for two reasons, that measurement errors would have driven results in a particular direction only. First, study findings were similar to recent maternal care-seeking patterns in Egypt.[61] Second, several sources indicated that healthcare generally, and maternal care specifically, were not particularly affected by conflict-related violence in Egypt.[3,62,64,182] The major cited reasons were: (1) Egypt performs reasonably well on maternal care usage with an approximately 85% usage for key maternal care services; (2) Egypt possess a fairly well-structured healthcare delivery system and a reasonable service provision; (3) the conflict was not severe and did not pose significant threat to human lives, health services, or communication channels; and (4) the conflict was largely revolutionary, involving mass protests against the government rather than public goods and health service delivery. Existing literature indicates that severe armed conflict is more likely to impact maternal care than is civil unrest.[13,183,184] Similarly, intensity of conflict is a key determinant of maternal care. The literature indicates that as maternal care is prioritized among healthcare needs, women generally do not neglect maternal care during low-level conflicts.[117,132,185] Status of the healthcare system and service delivery also have a direct relationship with maternal care, particularly in less severe conflicts.[132,185] If the healthcare system is robust or services are available, the chance of maternal care is less compromised during less intense conflicts.[132] Thus, measurement errors

could have driven results in either direction, i.e. over-estimation or under-estimation of effect sizes.

To conclude, study limitations could have led to overestimation or underestimation of estimates of association, although attenuation toward the null is likeliest for most issues. While these limitations reduce internal validity and require that findings are cautiously interpreted, most increase the conservatism of estimates indicating that actual associations between conflict and maternal care use are probably greater than found in this study. Additionally, as this study was not a causal analysis, findings should not be generalised to other settings.

Conclusions

This study found that the association of the Egyptian acute conflict (2011-2012) with maternal care use was minimal. Peri-conflict period showed positive vertical equity with higher odds of receiving maternal care among socioeconomically disadvantaged groups and relatively unchanged odds among socioeconomically advantaged groups. Policy intervention could improve conflict-related outcomes (e.g. post-delivery stay). Future qualitative and quantitative research may help identify associations of a larger conflict with maternal services usage and contextual determinants among different groups.

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Annexes

Part A: Univariable Analyses showing association between key outcome variables and explanatory variables

Tables A.1 to A.3 show results of multi-level logistic regression performed separately for each explanatory variable with key outcome variables

Table A.1: Association between 4+ ANC visits and explanatory variables

Characteristics	Odds ratio	P value	95% confidence interval	
Age group				
< 25	Reference			
25-29	1.25	0.124	0.94	1.66
30-34	1.10	0.519	0.82	1.47
>35	0.99	0.962	0.74	1.34
Education				
No education	Reference			
Primary	1.56	0.001	1.19	2.04
Secondary and above	2.89	<0.001	2.30	3.64
Residence				
Urban	Reference			
Rural	0.53	<0.001	0.43	0.65
Gender of child				
Male	Reference			
Female	0.89	0.233	0.74	1.08
Wealth index				
Poorest	Reference			
Poorer	1.42	0.009	1.09	1.86
Middle	1.97	<0.001	1.49	2.59
Richer	3.04	<0.001	2.24	4.12
Richest	5.04	<0.001	3.57	7.12
Currently working				
No	Reference			
Yes	1.30	0.081	0.97	1.74
Birth order				
1	Reference			
2 -3	0.49	<0.001	0.36	0.67
4 - 5	0.34	<0.001	0.24	0.48
6 and above	0.30	<0.001	0.18	0.48

Table A.2: Association between post-delivery stay and explanatory variables

Characteristics	Odds ratio	P value	95% confidence interval	
Age group				
< 25	Reference			
25-29	0.97	0.949	0.33	2.79
30-34	1.40	0.583	0.42	4.58
>35	1.17	0.801	0.35	3.83
Education				
No education	Reference			
Primary	2.12	0.121	0.82	5.50
Secondary and above	4.89	<0.001	2.07	11.56
Residence				
Urban	Reference			
Rural	0.49	0.090	0.22	1.12
Gender of child				
Male	Reference			
Female	1.01	0.988	0.48	2.12
Wealth index				
Poorest	Reference			
Poorer	2.41	0.075	0.91	6.38
Middle	5.69	0.007	1.62	20.02
Richer	18.66	0.005	2.44	142.95
Richest	4.23	0.006	1.50	11.90
Currently working				
No	Reference			
Yes	1.01	0.991	0.35	2.91
Birth order				
1	Reference			
2 -3	0.95	0.919	0.34	2.64
4 - 5	0.91	0.884	0.26	3.16
6 and above	0.22	0.025	0.06	0.83

Table A.3: Association between post-partum care from a doctor and explanatory variables

Characteristics	Odds ratio	P value	95% confidence interval	
Age group				
< 25	Reference			
25-29	1.06	0.873	0.53	2.10
30-34	0.99	0.977	0.49	2.01
>35	0.80	0.526	0.39	1.61
Education				
No education	Reference			
Primary	1.02	0.953	0.47	2.22
Secondary and above	1.05	0.886	0.55	1.99
Residence				
Urban	Reference			
Rural	0.93	0.758	0.59	1.47
Gender of child				
Male	Reference			
Female	0.84	0.438	0.53	1.31
Wealth index				
Poorest	Reference			
Poorer	0.85	0.739	0.33	2.18
Middle	0.41	0.031	0.18	0.92
Richer	0.61	0.256	0.26	1.43
Richest	0.69	0.392	0.30	1.61
Currently working				
No	Reference			
Yes	0.74	0.293	0.42	1.30
Birth order				
1	Reference			
2 -3	0.93	0.826	0.51	1.70
4 - 5	0.73	0.383	0.36	1.47
6 and above	0.74	0.593	0.24	2.27

Part B: Household questionnaire
(Only relevant sections for wealth index are included)

HOUSEHOLD ENVIRONMENT AND POSSESSIONS

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
101	What type of dwelling does your household live in?	APARTMENT . . . . 1 FREE STANDING HOUSE . . . . 2 OTHER _____ 6 (SPECIFY)	
102	Is your dwelling owned or rented by your household? IF OWNED: Is it owned solely by your household or jointly with someone else?	OWNED . . . . 1 OWNED JOINTLY . . . . 2 RENTED . . . . 3 OTHER _____ 6 (SPECIFY)	
103	What kind of toilet facility do members of your household usually use? IF FLUSH OR POUR FLUSH, PROBE: Where does it flush to?	**FLUSH OR POUR FLUSH TOILET** FLUSH TO PIPED SEWER SYSTEM . . . . 11 FLUSH TO VAULT (BAYARA) . . . 12 FLUSH TO SEPTIC SYSTE . . . . 13 FLUSH TO PIPE CONNECTED TO CANAL . . . . 14 FLUSH TO PIPE CONNECTED TO GROUND WATER . . . . 15 FLUSH TO SOMEWHERE ELSE 16 FLUSH, DON'T KNOW WHER . . . . 17 **PIT TOILET/LATRINE TOILET** VENTILATED IMPROVED PIT LATRINE . . . . 21 PIT LATRINE WITH SLAE . . . . . . 22 PIT LATRINE WITHOUT SLAB/ OPEN PIT . . . . 23 **COMPOSTING TOILE** . . . . 31 **BUCKET TOILET** . . . . 41 **HANGING TOILET/HANGING** LATRINE . . . . 51 **NO FACILITY/FIEL[** . . . . 61 OTHER _____ 96 (SPECIFY)	 →106
104	Do you share this facility with other households?	YES . . . . 1 NO 2	 →106
105	How many households use this toilet?	NO. OF HOUSEHOLDS IF LESS THAN 10 . . . . [0][ ] 10 OR MORE HOUSEHOLDS . . . 95 DON'T KNOW 98	
106	What is the main source of drinking water for members of your household?	**PIPED WATER** PIPED INTO DWELLING . . . . 11 PIPED TO YARD/PLOT . . . . 12 PUBLIC TAP/STANDPIPE . . . . . 13 **TUBE WELL OR BOREHOLE** . . . . . 21 **DUG WELL** PROTECTED WELL . . . . 31 UNPROTECTED WELL . . . . 32 **WATER FROM SPRING** PROTECTED SPRING . . . . 41 UNPROTECTED SPRING . . . . . 42 **TANKER TRUCK** . . . . 61 **CART WITH SMALL TANK** . . . . . 71 **SURFACE WATER** (RIVER/DAM/ LAKE/POND/STREAM/CANAL/ IRRIGATION CHANNEL) . . . . . 81 **BOTTLED WATER** . . . . 91 OTHER _____ 96 (SPECIFY)	→109

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
107	Where is (SOURCE IN 106) located?	IN OWN DWELLING . . . . 1 IN OWN YARD/PLOT . . . . 2 ELSEWHERE 3	→ 109
108	How long does it take to go there, get water, and come back?	MINUTES . . . . ☐☐☐ DON'T KNOW 998	
109	Do you treat your water in any way to make it safer to drink?	YES . . . . 1 NO . . . . 2 DON'T KNOW 8	→ 111

110	What do you usually do to the water to make it safer to drink?
	
	PROBE:
	Anything else?
	
	RECORD ALL MENTIONED.
		BOIL . . . . A
		ADD BLEACH/CHLORINE . . . . B
		STRAIN THROUGH A CLOTH/COTTON C
		USE WATER FILTER (CERAMIC/
		   SAND/COMPOSITE/ETC.) . . . . D
		SOLAR DISINFECTION . . . . E
		LET IT STAND AND SETTLE . . . . F
		
		OTHER _____ X
		         (SPECIFY)
		DON'T KNOW . . . . Z	

111	Does your household have: Electricity? A radio with cassette recorder? A color television? A black and white television? A video or DVD player? A smart phone, i.e., a phone on which the internet can be accessed? Other mobile phone? A telephone (land line)? A personal home computer (laptop, notebook. tablet, etc.)? A sewing machine? An electric fan? An air conditioner?	ELECTRICITY . . . . 1 2 RADIO . . . . 1 2 COLOR TV . . . . 1 2 BLACK AND WHITE TV . . . 1 2 VIDEO/DVD . . . . 1 2 SMART PHONE . . . . 1 2 OTHER MOBILE PHONE . . . 1 2 NON-MOBILE TELEPHONE . . . 1 2 COMPUTER . . . . 1 2 SEWING MACHINE . . . . 1 2 ELECTRIC FAN . . . . 1 2 AIR CONDITIONER 1 2	
112	Does your household own a satellite dish? IF NO: In your home, are you connected to satellite from elsewhere?	YES, OWNS DISH . . . . 1 NO, CONNECTED ONLY . . . . 2 NO 3	

113	How does your household mainly dispose of kitchen waste and trash?
	
	   RECORD MAIN METHOD OF DISPOSAL ONLY.
	   IF TWO OR MORE METHODS ARE USED EQUALLY,
	   RECORD THE METHOD HIGHEST ON THE LIST.
		COLLECTED
		   FROM HOME 11
		   FROM CONTAINER IN STREET . . . 12
		DUMPED
		   INTO STREET/EMPTY PLOT 21
		   INTO CANAL/DRAINAGE 22
		BURNED 31
		FED TO ANIMALS 41
		OTHER _____ 96
		         (SPECIFY)	

148

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
114	Does your household have: A refrigerator? A freezer? A water heater? A dishwasher? An automatic washing machine? Any other washing machine? A bed? A sofa? A hanging lamp (yellow with no cover)? A table? A tablia (very low round table)? A chair? Kolla/Zeer (a container for reserving water)?	YES NO REFRIGERATOR .... 1 2 FREEZER .... 1 2 WATER HEATER .... 1 2 DISHWASHER............. 1 2 AUTOMATIC WASHER ..... 1 2 OTHER WASHER .... 1 2 BED .... 1 2 SOFA .... 1 2 HANGING LAMP .... 1 2 TABLE .... 1 2 TABLIA .... 1 2 CHAIR .... 1 2 KOLLA/ZEER 1 2	
115	How many rooms does your household use for sleeping?	ROOMS .... ☐☐	

116	MAIN MATERIAL OF THE FLOOR.
	
	    RECORD OBSERVATION.
		NATURAL FLOOR
		   EARTH/SAND 11
		RUDIMENTARY FLOOR
		   WOOD PLANKS 21
		FINISHED FLOOR
		   PARQUET OR POLISHED
		      WOOD 31
		   CERAMIC/MARBLE TILES 32
		   CEMENT TILES 33
		   CEMENT 34
		   WALL-TO-WALL CARPET 35
		   VINYL 36
		OTHER _____ 96
		       (SPECIFY)	

117	Does any member of this household own: A watch? A bicycle? A motorcycle or motor scooter? An animal-drawn cart? A car or truck?	YES NO WATCH .... 1 2 BICYCLE .... 1 2 MOTORCYCLE/SCOOTER ... 1 2 ANIMAL-DRAWN CART ..... 1 2 CAR/TRUCK 1 2	
118	Does any member of your household have an account in a bank or any saving institution?	YES .... 1 NO 2	
119	Does any member of this household own any land that can be used for agriculture?	YES .... 1 NO 2	→ 121
120	How many feddans or kirates of agricultural land do members of this household own? IF MORE THAN 95 FEDDAN, ENTER '99.95'.	FEDDAN KIRATE LAND AREA ☐☐.☐☐ DON'T KNOW 99.98	
121	Does your household own any livestock, herds, or farm animals?	YES .... 1 NO 2	→ 123

122	How many of the following does your household own?
	
	  Cattle (buffalo, calf)?
	
	  Milk cows or bulls?
	
	  Horses, donkeys, or mules?
	
	  Goats?
	
	  Sheep?
	
	IF NONE, ENTER '00'.
	IF MORE THAN 95, ENTER '95'.
	IF UNKNOWN, ENTER '98'.
		CATTLE .... ☐☐
		
		COWS/BULLS .... ☐☐
		
		HORSES/DONKEYS/MULES . ☐☐
		
		GOATS .... ☐☐
		
		SHEEP .... ☐☐	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
123	Does your household own any poultry or birds?	YES . . . . 1 NO 2	→ 125
124	How many of the following does your household have: Chickens? Geese? Ducks? Pigeons? Quail? Turkey? Ornamental/song birds? Any other birds? IF NONE, ENTER '00'. IF MORE THAN 95, ENTER '95'. IF UNKNOWN, ENTER '98'.	CHICKENS . . . . GEESE . . . . DUCKS . . . . PIGEONS . . . . QUAIL . . . . TURKEY . . . . ORNAMENTAL/SONG BIRDS OTHER	
125	How often does anyone smoke inside your house? Would you say daily, weekly, monthly, less than monthly, or never?	DAILY . . . . 1 WEEKLY . . . . 2 MONTHLY . . . . 3 LESS THAN MONTHLY . . . . 4 NEVER 5	
126	Please show me where members of your household most often wash their hands.	OBSERVED . . . . 1 NOT OBSERVED, NOT IN DWELLING/YARD/PLOT . . . 2 NOT OBSERVED, NO PERMISSION TO SEE . . . . 3 NOT OBSERVED, OTHER REASON . . 4	→ 129

150

Part C: Woman questionnaire

(only child birth related sections are included)

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
101	RECORD THE TIME.	HOUR . . . . [ ][ ] MINUTES . . . . [ ][ ]	
102	In what month and year were you born?	MONTH . . . . [ ][ ] DON'T KNOW MONTH . . . . 98 YEAR . . . . [ ][ ][ ][ ] DON'T KNOW YEAR 9998	
103	How old were you at your last birthday? COMPARE AND CORRECT 102 AND/OR 103 IF INCONSISTENT.	AGE IN COMPLETED YEARS [ ][ ]	

501	CHECK 224:				
	ONE OR MORE BIRTHS IN 2009 OR LATER ☐		NO BIRTHS IN 2009 OR LATER ☐		→ 704

502	CHECK 215: ENTER IN THE TABLE THE BIRTH HISTORY NUMBER, NAME, AND SURVIVAL STATUS OF EACH BIRTH IN 2009 OR LATER. ASK THE QUESTIONS ABOUT ALL OF THESE BIRTHS. BEGIN WITH THE LAST BIRTH. (IF THERE ARE MORE THAN 3 BIRTHS, USE LAST 2 COLUMNS OF ADDITIONAL QUESTIONNAIRES).
	Now I would like to ask some questions about your children born in the last five years. (We will talk about each separately.)

503	BIRTH HISTORY NUMBER FROM 212 IN BIRTH HISTORY	LAST BIRTH BIRTH HISTORY NUMBER ☐☐	NEXT-TO-LAST BIRTH BIRTH HISTORY NUMBER ☐☐	SECOND-FROM-LAST BIRTH BIRTH HISTORY NUMBER ☐☐
504	FROM 212 AND 216	NAME _____ LIVING ☐ DEAD ☐	NAME _____ LIVING ☐ DEAD ☐	NAME _____ LIVING ☐ DEAD ☐
505	When you got pregnant with (NAME), did you want to get pregnant at that time?	YES . . . . 1 (SKIP TO 508)◄┘ NO 2	YES . . . . 1 (SKIP TO 508)◄┘ NO 2	YES . . . . 1 (SKIP TO 508)◄┘ NO 2
506	Did you want to have a baby later on, or did you not want any (more) children?	LATER . . . . 1 NO MORE . . . . 2 (SKIP TO 508)◄┘	LATER . . . . 1 NO MORE . . . . 2 (SKIP TO 508)◄┘	LATER . . . . 1 NO MORE . . . . 2 (SKIP TO 508)◄┘
507	How much longer did you want to wait?	MONTHS . . 1 ☐☐ YEARS . . 2 ☐☐ DON'T KNOW . . . 998	MONTHS . . 1 ☐☐ YEARS . . 2 ☐☐ DON'T KNOW . . . 998	MONTHS . . 1 ☐☐ YEARS . . 2 ☐☐ DON'T KNOW . . . 998
508	Did you see anyone for antenatal care for this pregnancy?	YES . . . . 1 NO . . . . 2 (SKIP TO 515)◄┘	YES . . . . 1 NO . . . . 2 (SKIP TO 524)◄┘	YES . . . . 1 NO . . . . 2 (SKIP TO 524)◄┘
509	Whom did you see? Anyone else? PROBE TO IDENTIFY EACH TYPE OF PERSON AND RECORD ALL MENTIONED.	HEALTH PERSONNEL DOCTOR . . . . A NURSE/MIDWIFE B OTHER PERSON DAYA . . . . C OTHER X (SPECIFY)	HEALTH PERSONNEL DOCTOR . . . . A NURSE/MIDWIFE B OTHER PERSON DAYA . . . . C OTHER X (SPECIFY)	HEALTH PERSONNEL DOCTOR . . . . A NURSE/MIDWIFE B OTHER PERSON DAYA . . . . C OTHER X (SPECIFY)

NO.	QUESTIONS AND FILTERS	LAST BIRTH NAME _____	NEXT-TO-LAST BIRTH NAME _____	SECOND-FROM-LAST BIRTH NAME _____
510	Where did you receive antenatal care for this pregnancy? Anywhere else? PROBE TO IDENTIFY EACH TYPE OF SOURCE. IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE. _____ (NAME OF PLACE(S))	**HOME** YOUR HOME . . . . . A OTHER HOME . . . . . B **GOVERNMENT** URBAN HOSPITAL (GNRL/DSTRCT) . C URBAN H'LTH UNIT . D HEALTH OFFICE . . . E RURAL HOSPITAL (CENTRAL) . . . . . F RURAL HEALITH UNIT . . . . G MCH CENTER . . . . . H OTHER GOV'T _____ . I (SPECIFY) **NONGOVERNMENTAL** EGYPTIAN FP ASSOC . . . . J CSI PROJECT . . . . . K OTHER NGO _____ . L (SPECIFY) **PRIVATE MEDICAL** PVT. HOSPITAL/ CLINIC . . . . M PVT. DOCTOR . . . N OTHER PVT. MED. _____ . P **OTHER NON-MEDICAL** X	**HOME** YOUR HOME . . . . . A OTHER HOME . . . . . B **GOVERNMENT** URBAN HOSPITAL (GNRL/DSTRCT) . C URBAN H'LTH UNIT . D HEALTH OFFICE . . . E RURAL HOSPITAL (CENTRAL) . . . . . F RURAL HEALITH UNIT . . . . G MCH CENTER . . . . . H OTHER GOV'T _____ . I (SPECIFY) **NONGOVERNMENTAL** EGYPTIAN FP ASSOC . . . . J CSI PROJECT . . . . . K OTHER NGO _____ . L (SPECIFY) **PRIVATE MEDICAL** PVT. HOSPITAL/ CLINIC . . . . M PVT. DOCTOR . . . N OTHER PVT. MED. _____ . P **OTHER NON-MEDICAL** X	**HOME** YOUR HOME . . . . . A OTHER HOME . . . . . B **GOVERNMENT** URBAN HOSPITAL (GNRL/DSTRCT) . C URBAN H'LTH UNIT . D HEALTH OFFICE . . . E RURAL HOSPITAL (CENTRAL) . . . . . F RURAL HEALITH UNIT . . . . G MCH CENTER . . . . . H OTHER GOV'T _____ . I (SPECIFY) **NONGOVERNMENTAL** EGYPTIAN FP ASSOC . . . . J CSI PROJECT . . . . . K OTHER NGO _____ . L (SPECIFY) **PRIVATE MEDICAL** PVT. HOSPITAL/ CLINIC . . . . M PVT. DOCTOR . . . N OTHER PVT. MED. _____ . P **OTHER NON-MEDICAL** X
511	How many times did you receive antenatal care during this pregnancy?	NUMBER OF TIMES [ ][ ] DON'T KNOW 98	NUMBER OF TIMES [ ][ ] DON'T KNOW 98	NUMBER OF TIMES [ ][ ] DON'T KNOW 98
512	How many months pregnant were you when you first received antenatal care for this pregnancy?	MONTHS . . . [ ][ ] DON'T KNOW 98		
513	As part of your antenatal care during this pregnancy, were any of the following done at least once: Were you weighed? Was your blood pressure measured? Did you give a urine sample? Did you give a blood sample?	YES NO WEIGHED . . 1 2 BP . . . . 1 2 URINE . . . . . 1 2 BLOOD . . . 1 2		
514	During (any of) your antenatal care visit(s), were you told about things to look out for that might suggest problems with the pregnancy?	YES . . . . 1 NO . . . . 2 DON'T KNOW 8		
515	During this pregnancy, were you given an injection in the arm to prevent the baby from getting tetanus, that is, convulsions after birth?	YES . . . . 1 NO . . . . 2 (SKIP TO 518) ←┐ DON'T KNOW 8		

NO.	QUESTIONS AND FILTERS	LAST BIRTH NAME _____	NEXT-TO-LAST BIRTH NAME _____	SECOND-FROM-LAST BIRTH NAME _____
515A	CHECK 508:	NO ANC ☐ HAD ANC ☐ ↓ (SKIP TO 516)		
515B	Did any of the persons you saw for the tetanus injection(s) advise you that you should go for antenatal care?	YES . . . . 1 NO . . . . 2 DON'T KNOW 8		
516	During this pregnancy, how many times did you get a tetanus injection?	TIMES . . . . ☐ DON'T KNOW 8		
517	CHECK 516:	2 OR MORE OTHER TIMES ☐ ☐ (SKIP TO 521) ↓		
518	At any time before this pregnancy, did you receive any tetanus injections?	YES . . . . 1 NO . . . . 2 (SKIP TO 521) ←┘ DON'T KNOW . . . 8		
519	Before this pregnancy, how many times did you receive a tetanus injection? IF 7 OR MORE TIMES, RECORD '7'.	TIMES . . . . ☐ DON'T KNOW 8		
520	How many years ago did you receive the last tetanus injection before this pregnancy?	YEARS AGO . . . . . ☐☐		
521	During this pregnancy, were you given or did you buy any iron tablets or iron syrup? SHOW TABLETS/SYRUP.	YES . . . . 1 NO . . . . 2 (SKIP TO 523) ←┘ DON'T KNOW 8		
522	During the whole pregnancy, for how many days did you take the tablets or syrup? IF ANSWER IS NOT NUMERIC, PROBE FOR APPROXIMATE NUMBER OF DAYS.	DAYS ☐☐☐ DON'T KNOW . . . 998		
523	During this pregnancy, did you take any drug for intestinal worms?	YES . . . . 1 NO . . . . 2 DON'T KNOW 8		

NO.	QUESTIONS AND FILTERS	LAST BIRTH NAME _____	NEXT-TO-LAST BIRTH NAME _____	SECOND-FROM-LAST BIRTH NAME _____

524	When (NAME) was born, was he/she very large, larger than average, average, smaller than average, or very small?	VERY LARGE 1
		LARGER THAN
		  AVERAGE 2
		AVERAGE 3
		SMALLER THAN
		  AVERAGE 4
		VERY SMALL 5
		DON'T KNOW 8
			VERY LARGE 1
			LARGER THAN
			  AVERAGE 2
			AVERAGE 3
			SMALLER THAN
			  AVERAGE 4
			VERY SMALL 5
			DON'T KNOW 8
				VERY LARGE 1
				LARGER THAN
				  AVERAGE 2
				AVERAGE 3
				SMALLER THAN
				  AVERAGE 4
				VERY SMALL 5
				DON'T KNOW 8

525	Was (NAME) weighed at birth?	YES 1
		
		NO 2
		  (SKIP TO 527) ←
		DON'T KNOW 8
			YES 1
			
			NO 2
			  (SKIP TO 527) ←
			DON'T KNOW 8
				YES 1
				
				NO 2
				  (SKIP TO 527) ←
				DON'T KNOW 8

526	How much did (NAME) weigh? RECORD WEIGHT IN KILOGRAMS FROM HEALTH CARD, IF AVAILABLE.	KG FROM CARD 1 ☐.☐☐☐ KG FROM RECALL 2 ☐.☐☐☐ DON'T KNOW .. 99.998	KG FROM CARD 1 ☐.☐☐☐ KG FROM RECALL 2 ☐.☐☐☐ DON'T KNOW .. 99.998	KG FROM CARD 1 ☐.☐☐☐ KG FROM RECALL 2 ☐.☐☐☐ DON'T KNOW .. 99.998

527	Who assisted with the delivery of (NAME)?
	
	Anyone else?
	
	PROBE FOR THE TYPE(S) OF PERSON(S) AND RECORD ALL PERSONS ASSISTING.
	
	IF RESPONDENT SAYS NO ONE ASSISTED, PROBE TO DETERMINE WHETHER ANY ADULTS WERE PRESENT AT THE DELIVERY.
		HEALTH PERSONNEL
		  DOCTOR ..... A
		  NURSE/MIDWIFE B
		OTHER PERSON
		  DAYA C
		  RELATIVE/FRIEND .E
		OTHER
		  _____ X
		  (SPECIFY)
		
		NO ONE ASSISTED Y
			HEALTH PERSONNEL
			  DOCTOR ..... A
			  NURSE/MIDWIFE B
			OTHER PERSON
			  DAYA C
			  RELATIVE/FRIEND .E
			OTHER
			  _____ X
			  (SPECIFY)
			
			NO ONE ASSISTED Y
				HEALTH PERSONNEL
				  DOCTOR ..... A
				  NURSE/MIDWIFE B
				OTHER PERSON
				  DAYA C
				  RELATIVE/FRIEND .E
				OTHER
				  _____ X
				  (SPECIFY)
				
				NO ONE ASSISTED Y

NO.	QUESTIONS AND FILTERS	LAST BIRTH NAME _____	NEXT-TO-LAST BIRTH NAME _____	SECOND-FROM-LAST BIRTH NAME _____

528	Where did you give birth to (NAME)?
	
	IF SOURCE IS HOSPITAL, HEALTH UNIT, OR CLINIC, WRITE THE NAME OF THE PLACE. PROBE TO IDENTIFY THE TYPE OF SOURCE AND CIRCLE THE APPROPRIATE CODE.
	
	(1) _____
	
	_____
	(NAME OF PLACE(S))
	
	(2) _____
	
	_____
	(NAME OF PLACE(S))
	
	(3) _____
	
	_____
	(NAME OF PLACE(S))
		HOME
		  YOUR HOME . . . 11
		  (SKIP TO 533) ←
		  OTHER HOME . . . 12
		
		GOVERNMENT
		  URBAN HOSPITAL
		  (GNRAL/DSTRCT) 21
		  URBAN HLTH UNIT 22
		  HEALTH OFFICE . 23
		  RURAL HOSPITAL
		  (CENTRAL) 24
		  RURAL HLTH UNIT 25
		  MCH CENTER . . . 26
		  OTHER GOV'T
		               27
		  (SPECIFY)
		NONGOVERNMENTAL
		  EGYPTIAN FP
		    ASSOC 31
		  CSI PROJECT . . . 32
		  OTHER NGO
		              36
		  (SPECIFY)
		PRIVATE MEDICAL
		  PVT. HOSPITAL/
		    CLINIC 41
		  PVT. DOCTOR . 42
		  OTHER PVT.
		    MED. 46
		  (SPECIFY)
		PRIVATE NON-MEDICAL
		          96
		  (SPECIFY)
		  (SKIP TO 533) ←
			HOME
			  YOUR HOME . . . 11
			  (SKIP TO 546) ←
			  OTHER HOME . . . 12
			
			GOVERNMENT
			  URBAN HOSPITAL 21
			  (GNRAL/DSTRCT)
			  URBAN HLTH UNIT 22
			  HEALTH OFFICE . 23
			  RURAL HOSPITAL 24
			  (CENTRAL) 24
			  RURAL HLTH UNIT 25
			  MCH CENTER . . . 26
			  OTHER GOV'T
			               27
			  (SPECIFY)
			NONGOVERNMENTAL
			  EGYPTIAN FP
			    ASSOC 31
			  CSI PROJECT . . . 32
			  OTHER NGO
			              36
			  (SPECIFY)
			PRIVATE MEDICAL
			  PVT. HOSPITAL/
			    CLINIC 41
			  PVT. DOCTOR . 42
			  OTHER PVT.
			    MED. 46
			  (SPECIFY)
			PRIVATE NON-MEDICAL
			          96
			  (SPECIFY)
			  (SKIP TO 546) ←
				HOME
				  YOUR HOME . . . 11
				  (SKIP TO 546) ←
				  OTHER HOME . . . 12
				
				GOVERNMENT
				  URBAN HOSPITAL 21
				  (GNRAL/DSTRCT)
				  URBAN HLTH UNIT 22
				  HEALTH OFFICE . 23
				  RURAL HOSPITAL 24
				  (CENTRAL) 24
				  RURAL HLTH UNIT 25
				  MCH CENTER . . . 26
				  OTHER GOV'T
				               27
				  (SPECIFY)
				NONGOVERNMENTAL
				  EGYPTIAN FP
				    ASSOC 31
				  CSI PROJECT . . . 32
				  OTHER NGO
				              36
				  (SPECIFY)
				PRIVATE MEDICAL
				  PVT. HOSPITAL/
				    CLINIC 41
				  PVT. DOCTOR . 42
				  OTHER PVT.
				    MED. 46
				  (SPECIFY)
				PRIVATE NON-MEDICAL
				          96
				  (SPECIFY)
				  (SKIP TO 546) ←

529	How long after (NAME) was delivered did you stay there? IF LESS THAN ONE DAY, RECORD HOURS. IF LESS THAN ONE WEEK, RECORD DAYS.	HOURS 1 ☐☐ DAYS 2 ☐☐ WEEKS 3 ☐☐ DON'T KNOW . . . 998		
530	Was (NAME) delivered by caesarean, that is, did they cut your belly open to take the baby out?	YES . . . . 1 NO 2	YES . . . . 1 NO 2	YES . . . . 1 NO 2
531	I would like to talk to you about checks on your health after delivery, for example, someone asking you questions about your health or examining you. Did anyone check on your health while you were still in the facility?	YES . . . . 1 (SKIP TO 534) ← NO 2		

532	Did anyone check on your health after you left the facility?	YES 1
		  (SKIP TO 534) ←
		NO 2
		  (SKIP TO 536) ←		

NO.	QUESTIONS AND FILTERS	LAST BIRTH NAME _____	NEXT-TO-LAST BIRTH NAME _____	SECOND-FROM-LAST BIRTH NAME _____
533	I would like to talk to you about checks on your health after delivery, for example, someone asking you questions about your health or examining you. Did anyone check on your health after you gave birth to (NAME)?	YES . . . . 1 NO . . . . 2 (SKIP TO 536) ⟵		

534	Who checked on your health at that time?
	
	PROBE FOR MOST QUALIFIED PERSON.
		HEALTH PERSONNEL
		  DOCTOR 11
		  NURSE/MIDWI . . . 12
		OTHER PERSON
		  DAYA 21
		  OTHER _____ 96
		    (SPECIFY)		

535	How long after delivery did the first check take place? IF LESS THAN ONE DAY, RECORD HOURS. IF LESS THAN ONE WEEK, RECORD DAYS.	HOURS 1 DAYS 2 WEEKS 3 DON'T KNOW . . . 998		
536	At any time during the two months after (NAME)'s delivery, did a doctor or nurse/midwife ever visit your home to check on your health?	YES . . . . 1 NO . . . . 2 (SKIP TO 538) ⟵ DON'T KNOW . . . 8		
537	How many times after delivery did a health professional visit your home to check on your health?	NUMBER OF TIMES DON'T KNOW . 98		
538	In the two months after (NAME) was born, did any health care provider or a traditional birth attendant check on his/her health?	YES . . . . 1 NO . . . . 2 (SKIP TO 542) ⟵ DON'T KNOW 8		
539	How many hours, days or weeks after the birth of (NAME) did the first check take place? IF LESS THAN ONE DAY, RECORD HOURS. IF LESS THAN ONE WEEK, RECORD DAYS.	HRS AFTER BIRTH . . 1 DAYS AFTER BIRTH . . 2 WKS AFTER BIRTH . . 3 DON'T KNOW . . . 998		

540	Who checked on (NAME)'s health at that time?
	
	PROBE FOR MOST QUALIFIED PERSON.
		HEALTH PERSONNEL
		  DOCTOR 11
		  NURSE/MIDWIFE 12
		OTHER PERSON
		  DAYA 21
		  OTHER _____ 96
		    (SPECIFY)		

NO.	QUESTIONS AND FILTERS	LAST BIRTH NAME _____	NEXT-TO-LAST BIRTH NAME _____	SECOND-FROM-LAST BIRTH NAME _____

541	Where did this first check of (NAME) take place?
	
	PROBE TO IDENTIFY THE TYPE OF SOURCE AND CIRCLE THE APPROPRIATE CODE.
	
	IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, WRITE THE NAME OF THE PLACE.
	
	_____
	(NAME OF PLACE)
		HOME
		  YOUR HOME ... 11
		  OTHER HOME ... 12
		
		GOVERNMENT
		  URBAN HOSPITAL
		   (GNRL/DSTRCT). . 21
		  URBAN HLTH UNIT 22
		  HEALTH OFFICE . 23
		  RURAL HOSPITAL
		   (CENTRAL) 24
		  RURAL HLTH UNIT 25
		  MCH CENTER ... 26
		  OTHER GOV'T
		   _____ 27
		   (SPECIFY)
		NONGOVERNMENT
		  EGYPTIAN FP
		   ASSOC 31
		  CSI PROJECT ... 32
		  OTHER NGO
		   _____ 36
		   (SPECIFY)
		PRIVATE MEDICAL
		  PVT. HOSPITAL/
		   CLINIC 41
		  PVT. DOCTOR . 42
		  OTHER PVT.
		   MED. _____ 46
		   (SPECIFY)
		OTHER NON-MEDICAL
		  _____ 96
		  (SPECIFY)		

542	During the two weeks after birth, was a blood sample taken from (NAME'S) heel?	YES .... 1 NO .... 2 (SKIP TO 544) ←┐ DON'T KNOW 8		
543	How many days after birth was the blood sample taken from (NAME"S) heel?	NUMBER OF DAYS . [ ][ ] DON'T KNOW 98		
544	In the first two months after delivery, did you receive a vitamin A dose like (this/any of these)? SHOW COMMON TYPES OF AMPULES/CAPSULES/SYRUPS.	YES .... 1 NO .... 2 DON'T KNOW 8		

545	Has your menstrual period returned since the birth of (NAME)?	YES 1
		  (SKIP TO 547) ←┘
		NO 2
		  (SKIP TO 548) ←┘		