

THE IMPACT OF THE ACCREDITED SOCIAL HEALTH ACTIVISTS (ASHA) PROGRAM IN
INDIA ON THE UTILIZATION OF MATERNITY SERVICES FROM THE ANTEPARTUM TO
THE POSTPARTUM PERIOD

Smisha Agarwal Kaysin

A dissertation submitted to the faculty at the University of North Carolina at Chapel Hill in
partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department
of Maternal and Child Health in the Gillings School of Global Public Health.

Chapel Hill
2017

Approved by:

Siân Curtis

Gustavo Angeles

Ilene Speizer

Kavita Singh Ongechi

Jim Thomas

©2017
Smisha Agarwal Kaysin
ALL RIGHTS RESERVED

ABSTRACT

Smisha Agarwal Kaysin: The Impact of the Accredited Social Health Activists (ASHA) Program in India on the Utilization of Maternity Services from the Antepartum to the Postpartum Period
(Under the direction of Siân L. Curtis)

India's Community Health Worker program- called the Accredited Social Health Activist (ASHA) program- is the largest among all countries, with nearly one million ASHA trained nationally. In 2006, the Government of India launched the ASHA program with the goal to connect communities to the healthcare system and improve maternity health outcomes. The aim of this dissertation is to evaluate the effects of the ASHA program on the utilization of maternity services.

In paper 1, we examine the association between exposure to ASHA and retention in the continuum of maternity care from the antepartum to the post-partum period, using the 2011-2012 Indian Human Development Survey (IHDS). We use a multinomial logistic regression model to show that exposure to ASHA accounts for a 12 percentage point increase in women receiving at least some of the services, and an nine percentage point decrease in women receiving no services. However, exposure to ASHA does not increase the likelihood of women utilizing all the services along the continuum.

In paper 2, we assess the characteristics associated with the utilization of ASHA services, and the effect of the ASHA program on individual maternity services- —namely, at least one antenatal care (ANC) visits, four or more ANC visits, presence of a skilled attendant at the time of birth (SBA), and delivery in a health facility. Our study finds that poor women and those belonging to marginalized castes were more likely to report ASHA services. Exposure to ASHA

services was associated with a 19% (95% CI 11.5-26.4) increase in ANC-1, 7% increase in four or more ANC visits (95% CI -0.4 – 14.6), 28% increase in SBA (95% CI 20.8-35.4), and 26% increase (95% CI 19.5-33.1) in facility births. Sensitivity analysis suggests that conditional cash transfer schemes drive the increase in SBA and facility births.

The ASHA program is successfully connecting marginalized communities to maternity health services. The study highlights the need to improve the coverage of four or more ANC visits. Given the potential of the ASHA in impacting service utilization, we emphasize the need to strengthen strategies to recruit, train, incentivize and retain ASHA workers.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor Sian Curtis for her constant guidance, well-balanced advice and tireless commitment to supporting me through the short years of my doctoral work despite a demanding work and travel schedule. I have been fortunate to have a dissertation committee that has been so invested in my growth as a researcher- Gustavo Angeles' open door policy to discuss analytical approaches, and patience in going over complex models helped advance the rigor of this work; Jim Thomas' sage advice to have a plan B has ensured that I can keep moving forward despite several roadblocks, and has been a worthwhile life lesson; I could always count on Ilene Speizer for her prompt and insightful feedback no matter the time of the day and on Kavita Singh Ongechi for her time to refine the ideas. I thank you for your generosity in sharing your time and knowledge.

My doctoral experience would not have been the same without Kelly L'Engle who has truly been a friend, mentor and guide through this journey, while I was at FHI360 and afterwards. Thank you for always encouraging my ideas, no matter how "creative." A big thanks to my colleagues- Alain Labrique and Amnesty Lefevre from Johns Hopkins Bloomberg School of Public Health for supporting my professional growth during this time and keeping me grounded in the application of our trade. Our work together has fueled my enthusiasm and inspired me to push the boundaries on what is attainable during these years. I am so grateful for Peggy Bentley's persuasive encouragement to become a Tarheel and for patiently guiding my path here, often on short notice.

Several faculty and staff in the Department of Maternal and Child Health have contributed to making this journey so memorable- Carolyn Halpern, Sandy Martin and Jon Hussey have modelled for me what academic mentorship should look like; Carrie Aldrich's timely administrative support has been critical in seeing me to the finish line. I am grateful to the Carolina Population Center and NIH/NICHD for training support, for the opportunity to work among a rich community of interdisciplinary population health researchers, for office space and logistical support. I cannot thank Cathy Zimmer enough for the many meetings of brainstorming ways to approach this work, and for her warm words of encouragement. I would also like to thank the principal investigators of the IHDS surveys— Sonalde Desai and Reeve Vanneman of the University of Maryland and the National Economic Council of Applied Economic Research, New Delhi for making the use of the rich Indian Human Development Surveys (IHDS) possible. I have much gratitude for colleagues at Population Reference Bureau who have pushed me to think about the policy application of my work, and encouraged me to see my work through both as a scientist and an advocate.

My dearest friends and fellow doctoral students have been a constant source of comfort and encouragement. Ashwini Kulkarni, Abha Saxena, Anish Chandak- thank you for your loving companionship and scrumptious meals; Kashika Sahay, Katie Barrett, Ipsita Das- thank you for long walks, conversations and laughs that made this such an enjoyable ride. I have tremendous gratitude for Ikeda Sensei and my dearest fellow SGI members for making every place feel like a home away from home, and instilling me with a sense of purpose beyond the completion of a degree.

My family's commitment to education is the reason I was able to complete this degree. From shanties in Mumbai city to elite academic institutions around the world, our family has demonstrated that nothing is impossible with grit and gumption. It must've been my dad's

relentless discussions about hydrostatic force when pouring ketchup at the breakfast table, and methods of heat transfer and precipitation when we complained about the weather in Mumbai, that instilled in me a curiosity for science and learning. I cherish my mum for volunteering to fly down from Mumbai to North Carolina in a heartbeat, if I sound any less upbeat than usual on the phone. My siblings, Shruti and Scot have been trailblazers and have led by example; Saurabh has made sure we don't take ourselves too seriously and pause to celebrate occasions big and small. Akruti and Anisha have kept me connected to, and longing for my country. Alex, my partner in all things, shared and fueled my passion for community health, and ensured that I don't lose sight of our shared goals as I transitioned from the messy trenches of remote village life to the shiny halls of the Academy.

Lastly, I thank the Aroles- Raj, Ravi, Shobha and the most wonderful community health workers of Jamkhed. Every time I am in a professional deadlock, I hear the songs of love, hope and inspiration that we sung so regularly in the village play in my head- they continually rejuvenate me and remind me of why I do what I do.

TABLE OF CONTENTS

LIST OF TABLES.....	xi
LIST OF FIGURES.....	xii
LIST OF ABBREVIATIONS.....	xiii
CHAPTER 1: INTRODUCTION	1
Theoretical framework/conceptual model	2
Specific aims.....	5
Organization of the dissertation.....	6
CHAPTER 2: MATERNAL HEALTH SERVICES	7
Antenatal care.....	9
Skilled birth attendance and facility deliveries.....	11
Postnatal care	14
CHAPTER 3: ROLE OF COMMUNITY HEALTH WORKER PROGRAMS IN ADVANCING THE HEALTH OF WOMEN AND CHILDREN	16
Role of community-based interventions along the continuum of care	18
Evidence on effectiveness of CHW programs.....	19
CHAPTER 4: ARE COMMUNITY HEALTH WORKERS EFFECTIVE IN RETAINING WOMEN IN THE MATERNITY CARE CONTINUUM? EVIDENCE FROM INDIA	21
Overview	21
Background	22
Methods.....	24
Study measures	25
Analysis	26

Results.....	27
Trends in the utilization of maternity services along the continuum of care	27
Cascade of maternity services received by ASHA exposure status.....	28
Association between exposure to ASHA and number of services.....	28
Discussion	29
Tables and figures	33
CHAPTER 5: THE IMPACT OF INDIA’S ACCREDITED SOCIAL HEALTH ACTIVIST (ASHA) PROGRAM ON THE UTILIZATION OF MATERNITY SERVICES.....	40
Overview	40
Introduction	41
Methods.....	43
Measurement of program exposure and outcomes.....	44
Characteristics of the women who report receipt of ASHA services	45
Association between exposure to ASHA and maternal service utilization outcomes.....	46
Results.....	47
Discussion	49
Tables and figures	53
CHAPTER 6: SUMMARY AND CONCLUSIONS.....	61
Programmatic implications for India	62
Policy and programmatic implications for other countries	63
Relevance for donor agencies	65
Future research directions.....	66
APPENDIX A: DEMOGRAPHIC CHARACTERISTICS OF THE STUDY SAMPLE IN IHDS-1 (2005) AND IHDS-II (2012) SURVEYS.....	68

APPENDIX B: ASSOCIATION BETWEEN CLUSTER-LEVEL EXPOSURE TO ASHA MEASURED AS “INTENSITY OF EXPOSURE” AND MATERNITY SERVICE UTILIZATION OUTCOMES USING A LINEAR PROBABILITY MODEL WITH FIXED EFFECTS AT THE CLUSTER LEVEL.....	69
APPENDIX C: ANALYSIS OF HOUSEHOLDS THAT WERE LOST TO FOLLOW UP IN IHDS-II	71
REFERENCES	73

LIST OF TABLES

Table 1: Demographic characteristics of sample population of women	33
Table 2: Weighted percentages of women who received each combination of services along the continuum of care	34
Table 3: Association between individual exposure to ASHA and number of services utilized, using a multinomial logistic regression model ^a	37
Table 4: Association between cluster-level ASHA intensity and number of services utilized, using a multinomial logistic regression model ^a	38
Table 5: Training and responsibilities of ASHA to promote the health of mothers and children.....	53
Table 6: Analysis of association between receipt of ASHA services for the most recent birth and individual characteristics using logistic regression and 2011-2012 IHDS survey	56
Table 7: Association between intensity of exposure to the ASHA programme and maternity service utilization outcomes using a linear probability model	58
Table 8: Characteristics of households that were lost to follow up in IHDS-II compared to households that were interviewed in both rounds	71
Table 9: Study outcomes among eligible women (with a live birth in the five years preceding the interviews) from households that were lost to follow up in IHDS-II compared to women from households that were interviewed in both rounds	72

LIST OF FIGURES

Figure 1: Factors affecting utilization of antenatal care, skilled birth attendance, and postnatal care	4
Figure 2: Cascade of maternity services received by individual ASHA exposure status	35
Figure 3: Cascade of maternity services by cluster-level ASHA exposure intensity adjusted for demographic variables	36
Figure 4: Marginal effects of individual ASHA exposure on number of maternity services	39
Figure 5: Marginal effects of cluster-level ASHA exposure intensity on number of maternity services	39
Figure 6: Percentage of women reporting receiving services from an ASHA among all women who had a live birth since 2005	54
Figure 7: Percentage of women reporting receipt of ASHA services among all women who gave birth from 2005-2011.....	55
Figure 8: Sensitivity analysis for association between exposure to ASHA and utilization of maternity services using a linear probability model.....	59
Figure 9: Marginal effect of ASHA exposure on the facility deliveries and skilled birth attendance, using a multinomial logistic model	60

LIST OF ABBREVIATIONS

ANC	antenatal care
ASHA	accredited social health activist
CHW	community health worker
EPMM	Ending Preventable Maternal Mortality
FIGO	International Federation of Gynecology and Obstetrics
GoI	Government of India
LHW	lay health worker
ICM	International Federation of Midwives
IHDS	Indian Human Development Survey
MoHFW	Ministry of Health and Family Welfare
NFHS	National Family Health Survey
NCAER	National Council of Applied Economic Research
NICHD	National Institutes of Child Health and Human Development
NRHM	National Rural Health Mission
OBC	other backward caste
PCA	principal components analysis
PHC	primary health care
PNC	postnatal care
SBA	skilled birth attendance
SC	scheduled caste
SDGs	sustainable development goals

ST	scheduled tribe
STI	sexually transmitted infections
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

Women worldwide have a varied healthcare experience during pregnancy and childbirth. It is estimated that the lifetime risk of death due to pregnancy is 1 in 180 in developing countries.(1) The majority of the deaths are caused by hemorrhage, hypertensive disorders and sepsis, all of which can largely be prevented through the timely provision of antenatal, skilled birth attendance and postnatal care.(2,3) Structural barriers to accessing care, scarcity of skilled providers, substandard quality of care, and high costs of maternity services limit the utilization of maternal health services.(4) A number of primary healthcare services, if provided at the community-level, can improve the utilization of these services. Pregnancy education, screening for pregnancy-related danger signs, triage and facility referrals can be effectively provided at the community level by health workers with limited training. Therefore, in resource poor settings, local women from the community are trained in maternity care services and can serve as community health workers (CHWs). Their role may include provision of education and primary care services along the continuum of care from early pregnancy to the post-partum period. Additional services could include screening for pregnancy, provision of antenatal and post-partum care, encouraging facility-based delivery, and promoting breastfeeding and immunization services.(5) CHW programs across several parts of the developing world have experienced varying levels of success in improving the access to and quality of maternity services.(5)

A number of studies have demonstrated the positive impact of CHW programs on the promotion of reproductive health services and family planning, appropriate care seeking,

antenatal care during pregnancy, and skilled care for childbirth. (6–9) Such successes provide a powerful argument for continued investments in supporting CHW programs. However, there have also been several concerns about the performance and accountability of CHW programs, especially in programs scaled beyond the efficacy settings (i.e. ideal circumstances).(10) To date, most of the studies on the effectiveness of CHW programs have been small-scale randomized trials with interventions delivered under controlled settings; limited evidence exists on the effectiveness of national-level CHW programs. To address this gap in evidence, we aim to assess the impact of India’s national-level CHW program – the Accredited Social Health Activist program – on key high-impact interventions delivered along the continuum of maternity care.

THEORETICAL FRAMEWORK/CONCEPTUAL MODEL

The theoretical approach for the proposed study can be explained based on Anderson’s Behavioral Model of Healthcare Services.(11) This model was developed in the late 1960s to understand why families use health services- It proposed that people’s use of health services is determined by their predisposition to use services, factors which enable or impede use, and their perceived need for care. Figure 1 identifies these factors at the individual and community level, and depicts their association with retention in the continuity of maternity care.

Factors that predispose the use of healthcare services include demographic factors such as age and gender, social structure measured by factors that determine an individual’s status in the community, and health beliefs. Education, religion, and caste may be considered as measures of an individual’s status in the community. A woman and her family’s attitude, values and knowledge about maternal health care and services would influence their perceived need and use of health services.

Anderson proposed that both community and personal resources must be available for individuals to use health services. Urban or rural location serve as a proxy for ease of accessing

health services at the community level. Distance from the nearest health facility would also determine the likelihood of one using the health facilities. Community-level knowledge and use of health services would also influence an individual's decision to seek health services.

Predisposing factors and enabling resources both contribute to a woman's perceived need for health services during pregnancy. Experience with a prior birth may contribute to the perceived need for care in a subsequent birth. Similarly, experience during the first ANC visit will be associated with the likelihood of the woman going for another ANC visit and continuing to engage with the health services throughout her pregnancy.

In his discussion, Anderson discusses the idea of mutability of factors- the idea that factors with a high degree of mutability (i.e. can be relatively easily changed), can be targeted through changes in policy. For example, predisposing demographic characteristics can be quite difficult to change; however, programs targeted at enabling factors such as decreasing the effect of large distances from health facilities, may have a more direct short-term effect on the utilization of services. CHW programs intersect with the mutable concepts in Anderson's model, by directly influencing enabling factors and the need for services. Community-level health education by a CHW may increase overall community awareness of available health services, and perceived needs for care. The availability of CHW within the community makes some healthcare services and governments incentives (such as cash transfers for facility deliveries) more accessible to the communities. Early identification of possible birth-related complications by a CHW may further emphasize the actual need to receive services at the health facility.

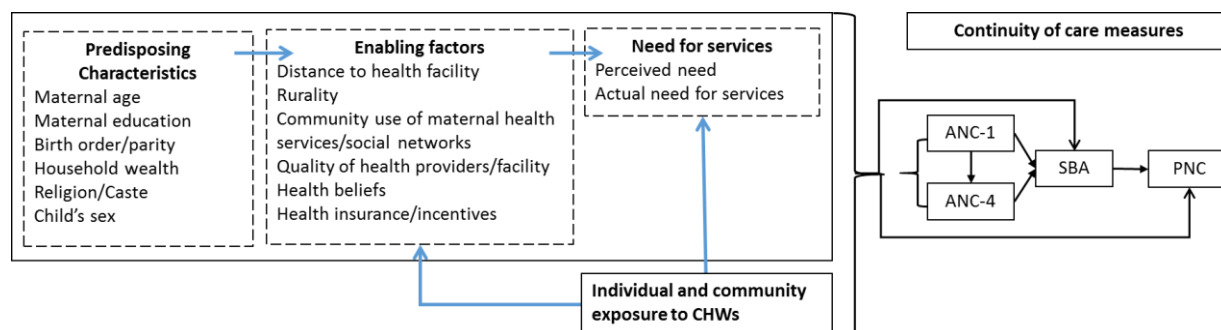


Figure 1: Factors affecting utilization of antenatal care, skilled birth attendance, and postnatal care

Specific aims

What is the effect of the national-level ASHA program in India on women's retention in the maternity continuum of care and on the number of antenatal visits (ANC), facility delivery and skilled birth attendance (SBA)?

a. Retention in the continuum of maternal and child healthcare

H1: Completion of the maternity continuum of care (defined as receiving at least one ANC visit, four or more ANC visits, SBA and post-natal care for mother or child), will be greater for women who are exposed to an ASHA compared to those who are not.

b. Characteristics of women who receive services from ASHA

This sub-aim will describe the individual demographic characteristics of women who report the receipt of services from ASHA.

H2: More educated women, and women from high SES will be more likely to report receiving services from ASHA in areas that have an active ASHA

H3: Women who belong to upper castes will be more likely to receive services from ASHA compared to other women who live in an area with an active ASHA.

c. Association between ASHA exposure and maternal health services utilization

H4: Pregnant women living in communities with an active ASHA are more likely to have ANC-1 and ANC-4 compared to women living in communities without an ASHA.

H5: Pregnant women living in communities with an active ASHA are more likely to deliver in health care facilities/have skilled attendance at the time of birth compared to women living in communities without an ASHA

ORGANIZATION OF THE DISSERTATION

This dissertation is presented in 6 chapters. Chapter 1 introduces the background, theoretical framework and specific aims of the research. Chapters 2 and 3 provide a review of the literature. Chapter 2 covers the state of maternal health, trends in and factors affecting the utilization of antenatal care, having a skilled attendant at the time of birth, giving birth in a health facility, and post-natal care for the mother and child. Chapter 3 describes the role of community health workers in advancing the health of women and children.

Chapters 4 and 5 present two substantive research papers – Chapter 4 focuses on the cross-sectional associations between exposure to ASHA and retention in the maternity continuum of care; Chapter 5 explores the factors associated with receipt of ASHA services, and the impact of the ASHA program on utilization of maternity health services. The final Chapter synthesizes overall conclusions, and programmatic and policy implications.

CHAPTER 2: MATERNAL HEALTH SERVICES

Over the past three decades, the worldwide maternal mortality ratio (MMR- measured as maternal deaths/100,000 live births) has reduced by half. There has been a remarkable improvement in the global lifetime risk of maternal deaths from 1 in 73 in 1990 to 1 in 180 in 2015.(12) Despite these survival gains, much progress is left. South Asia has the second highest number of maternal deaths with a lifetime risk of 1 in 43 (66,000 maternal deaths), after sub-Saharan Africa (lifetime risk of one in 16). India, alone accounts for nearly 15% of the maternal deaths worldwide with approximately 45,000 maternal deaths annually.(12)

Most maternal deaths occur between the third trimester of pregnancy and the first week after birth. In the region of Matlab in Bangladesh, data suggests that MMR is greatest in the first day after delivery than in any other postpartum period.(13) This provides support for prioritizing professional care during the intrapartum period. Three-quarters of all maternal deaths in 2003-2007 were due to direct causes such as hemorrhage, hypertensive disorders, abortion and pregnancy-related sepsis.(3) Early identification of these conditions during the antenatal or postpartum period can prevent an adverse pregnancy outcome for the mother and child. Indirect causes such as HIV, malaria, tuberculosis and anemia account for the remaining 25% of the deaths.(3) These conditions are likewise highly preventable and treatable with adequate monitoring of the mother during pregnancy, intrapartum and postpartum periods.

Several factors contribute to a woman's decision to seek maternal health services, and the quality of maternal health services she receives. Thaddeus *et al.* identify socio-economic and cultural factors, accessibility of facilities, and quality of care as the three key factors that affect

utilization of health services. (14,15) Individual factors such as the mother's age, marital status, parity/birth order, religious beliefs, family support for healthcare seeking, recognition and perceived severity of complications also play into the decision to seek care.(16,17) Maternal mortality is also high where the education and status of women is low. In several cultures, childbirth is viewed as a normal process for which medical intervention is not perceived as necessary.(16) Geographic distance from health facilities and costs around childbirth negatively affect access to care.(13) Affordability and the fear of anticipated costs may deter the use of health services.(18,19) Supply side factors, such as availability of health facilities equipped with supplies and healthcare workers, as well as the perceived quality of these services also play a critical role in the decision to seek care.(2) Several inequities are observed in healthcare seeking and outcomes. A systematic review of inequities in utilization of maternal health services suggests some common trends in inequities in most developing countries. Women in rural areas, from a lower socioeconomic strata, and those in marginalized communities (e.g. the scheduled castes in India) tend to have worse healthcare utilization across the continuum of maternity care, and subsequently worse health outcomes.(16)

The Sustainable Development Goals (SDG) build on the momentum in improving maternal health laid out by the Millennium Development Goals. SDG 3.1 aims to reduce global MMR to less than 70 deaths per 100,000 live births by 2030, worldwide.(12) A recent World Health Organization (WHO) publication, *The Strategies Towards Ending Preventable Maternal Mortality* (EPMM) lays out five strategic objectives for improving maternal health. This includes addressing inequities in access and quality of reproductive health services, ensuring universal coverage, addressing causes of maternal mortality, strengthening health systems and ensuring accountability to improve quality and equity of care.(20) Specific indicators such as antenatal care (ANC), skilled attendance at birth (SBA), and post-natal care (PNC) can be used as

“tracers” of progress towards universal health coverage by measuring the coverage of specific component interventions. Antenatal and early postpartum care provide opportunities to identify and address problems along the continuum of care. In effect, they not only improve maternal survival but also reduce the overwhelming burden of neonatal deaths.(18) The following sections describe the evidence on the effectiveness of timely antenatal care, skilled attendance and facility births, and timely post-natal care on maternal and infant health, specifically in India.

ANTENATAL CARE

Antenatal care (ANC) has long been considered a core component of maternal and child health services. It involves a combination of strategies to screen and detect early pregnancy related risk factors, delivery of health education as well as timely intervention. In 2001, a WHO led multi-country randomized control trial (21) and systematic review (22) concluded that the delivery of essential ANC interventions can occur over 4 ANC visits at specified times in women with no other medical complications (about 75% of all women).(23) The ensuing recommendations by the WHO were to have the first ANC visits as early as possible, preferably in the first trimester, and the last visit near the expected date of birth or at 37 weeks.(24,25) Having ANC early enough in the pregnancy can allow for sufficient time to diagnose and treat diseases like anemia and sexually transmitted infections (STI's), which may result in an adverse pregnancy outcome.

Timely and appropriate ANC has benefits for both the mother and the newborn. Several studies have shown an association between delayed initiation of ANC or less than 4 ANC visits and preterm birth or low birthweight.(26,27) ANC interventions alone do not result in a direct reduction of maternal mortality as they do not address the complications arising during labor, which are the leading cause of maternal deaths.(23) However, ANC interventions focus on

maternal health and present opportunities to reach the mothers with a number of interventions, connecting mothers to the health facility, and consequently affecting improvements in the survival of mothers and infants. Critical ANC components such as tetanus immunizations, treatment of malaria and STIs/HIV during pregnancy, and interventions to improve women's nutritional status can result in direct benefits for the mother and child.(23)

While the number and timing of ANC visits can be measured and monitored, several challenges exist in assessing the quality of ANC. The delivery of individual components of ANC may vary by the type of provider and location. For example, the scope of services provided by health workers in community-based ANC is typically different from what is feasible in a facility. A number of community-based ANC programs refer women to facilities for specific tests. The depth and accuracy of screening methods and counselling during ANC is also dependent on the training and knowledge of the provider. Several studies have noted the poor quality of antenatal care and highlighted the need for an emphasis on not only the number but the quality of ANC.(28-32) Despite these criticisms of the value of ANC, it continues to be recommended as one of the most critical determinants of maternal and child health.

The coverage of ANC, defined as at least one ANC visit, is estimated at 71% worldwide.(25) However, the coverage of all four recommended ANC visits drops to 44% with large variations by geographic areas (urban and rural) and socio-economic status.(24) For example, in Africa, 80% of women in the richest quintile receive three or more ANC visits compared to only 48% of women in the lowest wealth quintile.(24) South Asian countries are notable for their relatively low use of ANC. For example, in Nepal, less than 10% of women have four or more ANC visits.(23) Overall trends in ANC tend to mask the urban/rural and socio-economic variations. Urban women are twice as likely than rural women to have more than four ANC visits.(23) A third of all rural women, and two-thirds of women with no

schooling or primary schooling do not receive any ANC.(23) In most countries, outside of sub-Saharan Africa, there is a steep decline in the use ANC after the first child.

In India, one in five women do not receive any ANC. Women in the state of Uttar Pradesh are the least likely to receive ANC from a doctor compared to all other states, but most likely to receive care from an auxiliary nurse midwife (ANM), nurse, midwife or lady health visitor.(33) The coverage of ANC visits sharply declines after the first visit in India. Only 37% of women have the recommended 4 ANC visits.(33) Among women seeking ANC, only 44% had the first ANC visit in the first trimester; the median timing of first ANC overall is 3.8 months of gestation (4 in rural areas and 3.3. in urban areas). Women who do not receive ANC tend to be disproportionately older, with higher birth orders, poorer and less educated.(33,34) Additional differences are seen by caste; women from scheduled tribes (historically disadvantaged indigenous tribes) are least likely to receive ANC.

SKILLED BIRTH ATTENDANCE AND FACILITY DELIVERIES

The risk of maternal death is highest in the post-partum period immediately after childbirth and within 24-48 hours. Therefore, the presence of skilled attendance during childbirth is important for both, the health of the mother and the baby. Estimates suggest that skilled attendance at birth can prevent 16 to 33% of maternal deaths worldwide.(35) Skilled attendance and institutional deliveries also affect neonatal outcomes; both these measures are lowest in countries with the highest neonatal mortality rates.(36) In 2004, the WHO, the International Federation of Midwives (ICM) and the International Federation of Gynecology and Obstetrics (FIGO) emphasized the pivotal role of skilled attendance at birth in improving health outcomes for mothers and newborns.(37,38) The 2005 Lancet Maternal Survival series described childbirth in health facilities as the single most likely strategy to prevent maternal deaths.(18) Recommendations for facility-based deliveries promote the idea of maintaining

normality of the birthing process, with timely watchfulness for complications and primary prevention, when necessary.(28)

A skilled attendant is “an accredited health professional- such as a midwife, doctor, or nurse- who has been educated and trained in proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth, and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns.”(38) A skilled attendant is central to the continuum of care, and works with other providers in the community (such as traditional birth attendants) to develop strong linkages from the community to the health facility. While skilled attendants such as doctors are most likely available only in health facilities, attempts have been made to make skilled delivery available at the community level by training nurses, midwives, community health workers and traditional birth attendants in childbirth.(39) Some argue that an emphasis on home-based birth with a skilled attendant (as opposed to facility births) can increase the coverage of skilled attendance, especially in communities where few health facilities cover large geographic areas. Though this approach is preferred over the absence of any skilled attendants at birth, it falls short of the optimal standards since a community skilled attendant may not have any back-up from healthcare professionals in a health facility or hospital to deal with unexpected complications. Therefore, home-based care with prompt referral and emergency transport capability along with facility-based emergency obstetric services are recommended.(28,38)

Over the last two decades, there has been a slow but sure trend towards professionalization of childbirth, with a notable increase in doctor-assisted childbirth.(4) Similarly, there has been an upward trend in facility births, since professional maternity services are most likely available in facilities. Despite these improving trends, millions of women are still left without any skilled attendance at birth. Less than 40% of women in sub-

Saharan Africa, and less than 30% of women in south Asia have skilled attendance at birth.(36) Progress in skilled provider-assisted childbirth has been higher in urban areas compared to rural areas. In sub-Saharan Africa and south and southeast Asia, where a large majority of the population is rural, professional coverage at birth increased by just 10 percentage points between 1992 and 2005 in rural areas.(4) More than half of all births in sub-Saharan Africa and Asia are still delivered at home.(37)

Women may be deterred from seeking care at the facility due to barriers such as distance from the health facility, lack of transportation, costs, cultural or religious acceptability, restrictions on leaving the house and the perceived quality of interpersonal and quality treatment upon reaching the health facility.(28) Women may prefer home birth with a skilled attendant to avoid costs and maintain the normality of birth. Another key barrier is the availability of trained providers and quality of health services.(4) Several studies have shown that the quality of facility-based maternal services is poor, often with poor knowledge of providers and inappropriate management of complications.(4,40) Studies have also reported poor, disrespectful, and exploitative treatment of women by facility health workers.(4) Most developing countries show that the poorest groups are least likely to access skilled delivery care.(4,41,42)

In India, more than 60% of all births take place at home- 51 percent of all births more take place at the woman's own home, and 9% at the parent's home. Substantial variations are observed by rurality; two-thirds of births in urban areas, and less than a third of deliveries in rural areas take place in health facilities.(33) Only 18% of women in scheduled tribes (ST) deliver in health facilities. Institutional delivery is greatest (75%) among women who received four or more ANC visits, and least (10%) among women who did not receive any ANC. Mother's education and higher household wealth are positively correlated with facility

deliveries. Thirty-five percent of births are assisted by a doctor, and 10% by an ANM, nurse, midwife or LHV. More than a third of all births are assisted by a traditional birth attendant; 16% by friends and families.(33)

POSTNATAL CARE

The importance of postnatal care has only recently come to light. In 2013, a WHO steering group formulated recommendations for optimal postnatal care in low and middle income countries based on evidence in its support. For an uncomplicated vaginal birth in a health facility, mothers and newborns should receive care for at least 24 hours. For home births, the first postnatal contact should be within 24 hours following birth, with at least three additional postnatal contacts on day 3 (48-72 hours post birth), between days 7-14, and six weeks after birth. Home visits are recommended for the mother and infant in the first week after birth (43) Several life-threatening disorders may emerge immediately post-partum for the mother and child. Postnatal checkups provide an opportunity to assess and treat any pregnancy-related complications, and counsel the mother on caring for herself and the newborns. The risk of death decreases steadily by postpartum days two.(28) The recommended content of postnatal care includes assessment of the mother (i.e. vaginal bleeding, blood pressure, fundal height, uterine involution, psychological well-being etc.) and baby (i.e. feeding history, signs of fever, rapid breathing, jaundice etc.), counselling on exclusive breastfeeding, cord care and other postnatal care for the newborn, iron and folic acid supplementation, prophylactic antibiotics if appropriate, and counselling on hygiene, nutrition and birth spacing.(43) The adoption of the term “postnatal” was recommended to avoid the interchangeable use of “postpartum” referring to issues pertaining to the mother, and “postnatal” for issues pertaining to the newborn.(44) Therefore, “postnatal” is used here for all issues pertaining to the mother and baby up to 42 days (6 weeks) after birth.

Postnatal care is among the weakest of all maternal and child health programs worldwide with universally low coverage rates.(45) Women who deliver in a health facility are more likely to receive a postnatal checkup within two days of birth compared to women who deliver at home.(46) Home births, especially those without any skilled attendance, place the responsibility of a postnatal checkup on the mother. Studies in South Asia suggest that even in places where postnatal services are available, mothers may perceive postnatal check-up to be of little value.(47) Evidence suggests that 7 out of 10 women who do not give birth in healthcare facilities do not receive any postnatal care.(4) In four countries in South Asia (Bangladesh, India, Nepal and Pakistan), only 15-28% of women who give birth at home receive any postnatal care.(46) Similar to ANC and SBA, mother's age at birth, birth order, urban/rural residence, mother's education, and household wealth are key determinants of PNC.

As per the 2008 National Family Health Survey (NFHS)-India data, 58% of women do not receive any postnatal check-up, and only 37% receive post-natal care with the first two days of birth.(33) Among women who deliver at home, only 15% receive any postnatal check-up. Similar to other coverage parameters, the likelihood of postnatal check-up within the first two days are positively correlated with mother's education and household wealth index.

CHAPTER 3: ROLE OF COMMUNITY HEALTH WORKER PROGRAMS IN ADVANCING THE HEALTH OF WOMEN AND CHILDREN

In 1978, Primary Health Care (PHC) was proposed as a means for achieving 'Health for All' through the Alma Ata Declaration. PHC took a holistic view of improving the health of poor populations and emphasized health as not just the result of biomedical interventions, but an outcome of social determinants, community participation and empowerment.(48) Alma-Ata emphasized the delegation of tasks for maternity care to a cadre of community of workers. Consequently, community health worker (CHW) programs became the cornerstone for rapidly expanding healthcare services for poor populations.(49) The term CHW may be used for different types of "volunteer, salaried, professional or lay health worker whose level of training, competencies, scope of practice and integration in the health system vary widely".(50)

Following the Alma Ata Declaration, the focus of training health workers shifted from training in large teaching hospitals towards emphasis on preventive health and bringing care closer to the community, with an emphasis on achieving equity.(51) Community volunteers were trained as traditional birth attendants and CHWs to provide maternal and child health services.(51)

Over the 1980's and 1990's, several pilot CHW programs reported substantial improvements in healthcare outcomes, demonstrating the potential contribution of CHWs.(52,53) However, most national level CHW programs were variably implemented and reported several challenges that limited the effectiveness of these programs.(54-56) Scaled CHW programs had high levels of attrition and overall reduced quality of care. It was argued that the poor performance of these national level programs was not due to the failure of the concept of CHWs, but the lack of ongoing training, supervision, logistical and financial support, as well as weaker linkages to the

health system.(51) Often CHWs were unpaid volunteers and were not accountable to the health system. Where strategies to expand care through CHWs was employed as an alternative rather than a complement to professional care, the results were poor.(57) Several debates about selective versus comprehensive PHC approaches ensued.(56) In the 1990's, the WHO reversed its policy, discouraging the use of traditional birth attendants and promoted facility births with the presence of skilled attendants.(51)

In 2006, the World Health Report addressed the acute shortage of human resources in healthcare in low and middle income countries. It reported a critical shortage of health care workers in 57 countries with a global deficit of 2.4 million doctors, nurses, and midwives.(58) It proposed that this crisis can be tackled by getting the “right workers with the right skills in the right place doing the right things.” In 2008, on the 30th anniversary of Alma Ata, the WHO endorsed the need for a renewed focus on PHC and a themed issue on PHC ensued in the Lancet.(51) The World Health Report entitled “Primary Health Care- Now More Than Ever” emphasized four principles for a renewed focus on PHC- universal coverage of essential healthcare services, people-centered services, health integrated across all public policies and leadership that can steer health systems to be more equitable and efficient.(57) Community participation and ownership were highlighted as the weakest realized aspects of PHC.(51) Revitalization of PHC and recognition of the acute shortage of healthcare workers, shifted the focus again on developing strong CHW programs where CHWs are adequately trained, and linked to primary healthcare facilities and first-referral services.(51,59) There was consensus that a midway approach involving linking communities and facilities along the continuum of care is more effective in improving maternal and newborn health.(51,60) Community participation, a central tenet of PHC, is more difficult to implement than some of the technical aspects of maternity care, which are easier to scale. However, advocates of PHC suggested that

interactions between families and CHWs are key to facilitating community participation and ownership.(51)

ROLE OF COMMUNITY-BASED INTERVENTIONS ALONG THE CONTINUUM OF CARE

A CHW can provide the first line of care for mothers and children, and promote adoption of existing government programs in the community. A number of interventions in the ANC package can be safely delivered by healthcare workers such as auxiliary nurses/ midwives, CHWs and other primary healthcare workers.(23) They can identify pregnant women, counsel them, support birth planning, and identify complications during the antenatal period.(24) Families may incur significant financial and opportunity costs in travelling to health facilities to receive ANC. CHW's are often present within the community and are able to make home visits. Bhutta et al. conducted a systematic review of evidence to recommend several behavioral and promotional interventions which can be effectively delivered by CHWs with limited training or trained CHWs along the continuum of maternal health care. These include the promotion of reproductive health services and family planning, appropriate care seeking and antenatal care during pregnancy, and skilled care for childbirth.(61) Additionally, CHWs can play a critical role in several preventive and treatment interventions to support adequate maternal and child nutrition and vitamin supplementation, identification of high-risk pregnancies and childhood illnesses, and early management of preterm labor, malaria in pregnancy, infections and malnutrition in children.(61) The exact role of CHWs varies by the type of CHW cadre and by country.

EVIDENCE ON EFFECTIVENESS OF CHW PROGRAMS

Recent cluster randomized trials (6,7,62) and controlled trials (9,52) have assessed the impact of CHWs on maternal and child healthcare outcomes. Although the exact nature of the approaches differed, community engagement and participation with a link to the health system was a common thread between the studies. In addition to significant reductions in maternal or neonatal mortality, some studies also reported on intermediate coverage outcomes. In Nepal, a study comparing women who were engaged in a community-based participatory intervention to those who were not, reported significantly higher odds of any antenatal care (OR: 2.82; 95% CI: 1.41-5.62), institutional delivery (OR: 3.55, 95% CI: 1.56-8.05), and birth attended by a trained provider (OR: 3.53, 95% CI: 1.54-8.10).⁽⁶³⁾ Similarly, a study assessing the impact of lady health workers and traditional birth attendants in Pakistan reported an increase in the proportion of facility-based deliveries from 18% to 30%, and a decrease in home births from 79% to 65% over a two-year program period.⁽⁹⁾

In 2010, a Cochrane review was conducted to assess the effects of lay health worker (LHW) interventions in primary and community health care settings on maternal and child health outcomes.⁽⁶⁴⁾ LHWs were defined as “any health worker carrying out functions related to healthcare delivery, trained in some way in the context of the intervention, and having no formal professional or paraprofessional certificate or tertiary education degree.” The review indicated promising benefits of LHWs on promoting immunization uptake, initiation of breastfeeding, and exclusive breastfeeding. Limited quality evidence reported on the effectiveness of LHWs in reducing child mortality, neonatal mortality, and improving care-seeking for childhood illnesses. Insufficient evidence was found on other maternal health outcomes to allow statistical pooling. While over 60% of the studies included in this review

were from high-income countries, the results were not much different from a similar Cochrane review conducted in 2005 that focused only on low and middle income countries.(65)

Concerns around inadequate performance of health workers are widespread. (66) The evidence on quality of care offered by community or lower cadre health workers versus facility and upper cadre health workers is mixed. A study by Arifeen et al. in rural Bangladesh showed that in 19 health facilities and catchment areas, lower cadre health workers (family welfare visitors) were more likely to correctly classify sick children compared to higher-level workers. The lower cadre workers also provided correct information on home care.(67) Haines et al. have identified several determinants that determine the success of CHW programs.(5) Consistent national political support is critical to ensuring that policies and funds are in place to support CHWs and their integration into the larger health system. Checks and balances need to be in place to ensure that CHWs are perceived as an integral part of the healthcare system by the community and particularly by health professionals in facilities. Additional mechanisms should ensure that CHWs are adequately compensated and any financial incentives for improved performance are delivered. Opportunities for ongoing training and supportive supervision may further improve the performance of CHWs.(5,68)

In conclusion, the success of small scale, often non-governmental, experimental CHW programs is evident. It is much less clear whether large-scale national-level CHW programs can be effective in improving the health of mothers and children.(69)

CHAPTER 4: ARE COMMUNITY HEALTH WORKERS EFFECTIVE IN RETAINING WOMEN IN THE MATERNITY CARE CONTINUUM? EVIDENCE FROM INDIA

OVERVIEW

Background: Despite the recognized importance of adopting a continuum of care perspective in addressing the care of mothers and newborns, evidence on specific interventions to enhance engagement of women along the maternity care continuum has been limited. We use the example of the Accredited Social Health Activist (ASHA) program in India, to understand the role of community health workers (CHWs) in retaining women in the maternity care continuum.

Methods: We assess the association between individual and cluster-level exposure to ASHA and four key components along the continuum of care- at least one antenatal care (ANC) visit, four or more ANC visits, presence of a skilled attendant at the time of birth (SBA), and post-natal care for the mother or child within 48 hours of birth. To understand which of these services experience maximum drop-out along the continuum, we use a linear probability model to calculate the weighted percentages of using each service. We assess the association between exposure to ASHA and number of services utilized using a multinomial logistic regression model adjusted for a range of confounding variables and survey weights.

Results: Our study indicates that exposure to the ASHA is associated with an increased probability of women receiving at least one ANC and SBA. In terms of numbers of services, exposure to ASHA accounts for a 12 (95% CI: 9.1-15.1) percent increase in women receiving at least some of the services, and an 8.8 (95% CI: -10.2- -7.4) percent decrease in women receiving

no services. However, exposure to ASHA does not increase the likelihood of women utilizing all the services along the continuum.

Conclusions: While ASHA are effective in supporting women to initiate and continue care along the continuum, they do not significantly affect the completion of all services along the continuum.

BACKGROUND

The continuum of care is an essential principle of programs targeting improvements in maternal, newborn, and child health. Between 1990 and 2015, the maternal mortality ratio has halved globally, however progress has been patchy. Nearly 26 countries have made no progress, and in 12 countries, the maternal mortality ratio has increased.⁽¹²⁾ Since 1990, while rapid progress has been made in reducing deaths of children under 5 years of age, slower gains have been made in newborn deaths and stillbirths,⁽⁷⁰⁾ with an estimated 2.6 million third trimester stillbirths in 2015.⁽⁷¹⁾ Integrated services that address the entire continuum from the antepartum to the postnatal period have emerged as a key factor to influence gains in maternal and child survival.^(28,70,72,73) The continuum of care is defined along two dimensions- throughout the life cycle including adolescence, pregnancy, childbirth, postnatal period and childhood, and across the levels of care from the household to the health facility.⁽⁶⁰⁾ The continuity of care lens recognizes the intergenerational gains for the mother and child achieved from intervening earlier during the adolescent and antepartum periods.

For most women in low-income countries, the first point of entry into the maternity care continuum is typically during pregnancy. Timely and appropriate antenatal care (ANC) affects not just the health of the mother but also the newborn.^(23,24,37) Delayed initiation of ANC or fewer than four ANC visits is associated with preterm birth or low birth weight.^(26,27) There is a consistent link between ANC and skilled birth attendance (SBA)/facility-based delivery;^{(74–}

76) SBA is at least six times more likely among women who have had at least one ANC visit compared to women with no ANC.(23) Globally, studies have shown a strong relationship between more than four ANC visits and delivering in a health facility. Similarly, a strong correlation exists between ANC and PNC, and SBA and PNC. Women who have four or more ANC visits or deliver with a skilled birth attendant are more likely to receive PNC.(46) Timely and appropriate PNC also has significant benefits for both the mother and the child.(6,77)

More recently, studies have specifically adopted a continuum of care lens to identify demographic factors associated with the engagement of women along the maternity continuum. (74,75,78) Though the studies have slight variations in the components comprising the continuum, including family planning, one or more ANC visits, four ANC visits, SBA, facility births and PNC measured at 24 hours, 48 hours, two weeks and six weeks, common themes have emerged. Women who are wealthier, more educated and have greater autonomy are more likely to receive a greater number of health services. (74,75,78) Less than one quarter of women in the three South Asian countries and 15 percent in six sub-Saharan African countries receive all the elements along the continuum.(75) All three studies emphasized the need for increased attention and research to understand factors that may improve retention along the continuum of maternity care.

One approach that has often been used to enhance engagement along the continuum involves training community health workers (CHWs) to engage with pregnant and postpartum women.(5,79,80) However, this approach has not been empirically tested. CHWs can undertake a variety of tasks at the community level, including providing maternity stage-appropriate health education, connecting women to health care facilities, and providing home-based primary health care services, including several components of ANC and PNC.(5,61) Globally, there has been a renewed interest in investing in CHWs programs for their potential impact on

strengthening primary health care linkages for women and children. Several south Asian and African countries, including India, Bangladesh, Ethiopia, Kenya, Uganda, Ghana, and South Africa, are investing in training and deploying cadres of CHWs to focus on maternal, newborn, and child health.(5,68,81) Given their scale and the investments, it is important to assess the evidence on the effectiveness of these programs.

Our study evaluates the role of CHWs in retaining women in the maternity care continuum, using the example of the Accredited Social Health Activist (ASHA) program in India. The ASHA program in India is the largest CHW program, with nearly one million ASHA's operating nationally. The ASHA play a critical role at each point along the continuum-- counsel pregnant women on birth preparedness, safe delivery, feeding practices, immunization and family planning; accompany mothers and their families to the health facility; and provide care and referrals for newborn and childhood ailments.(82) We quantitatively assess the association between exposure to the ASHA program and four key components along the continuum of care—at least one ANC visit, four or more ANC visits, presence of a skilled attendant at the time of birth, and post-natal care for the mother or child within 48 hours of birth; and explore how exposure to ASHA may influence the number of services utilized along the continuum.

METHODS

Data for this study come from the nationally representative Indian Human Development Survey (IHDS), funded by the National Institutes of Child Health and Human Development (NICHD), and produced by the National Council of Applied Economic Research (NCAER), New Delhi and the University of Maryland. The study uses IHDS-II data from interviews with ever-married women aged 15-49 years, regarding health, education, fertility and family planning, collected in 2011-2012.(83) IHDS-II comprises of data from 42,152 households, across

33 states and union territories, 384 districts, 1420 villages, and 1042 urban blocks located in 276 towns and cities. The rural sample was drawn using stratified random sampling, and the urban sample was a stratified sample of towns and cities within states, selected using probability proportional to the population size. Our study focused on data from 13,705 women with a live birth since 2005.(83)

Study measures

The key outcome measures for this analysis were receipt of at least one antenatal care visit (ANC-1), receipt of four or more ANC visits (ANC-4), having a skilled attendant at birth (SBA), and receipt of postnatal care either for the mother or the child within 48 hours after birth (PNC). Medical doctors, nurses, and auxiliary skilled birth attendants are considered as skilled birth attendants.(84)

A woman was considered exposed to an ASHA if she responded that an ASHA assisted her in response to at least one of the following questions- “Where did you get a pregnancy card made?”; “Did you get help from anyone for making a pregnancy card/registration?”; “Who visited you when you were pregnant?”; “Who facilitated or motivated you to go to a health facility for delivery?”; and “Who arranged the transportation to take you to the health facility for delivery?”. In addition to individual reports of exposure to ASHA, we sought to understand how community-level exposure to ASHA may affect individual health-seeking. The mean cluster exposure value was calculated as the number of women who reported exposure to an ASHA in a cluster during the last birth divided by the total number of eligible women who had a birth in the 6 years preceding the survey in the cluster. This measure value ranges from 0 to 1 and can be interpreted as the ‘intensity’ of cluster-level exposure. This intensity of exposure was further categorized as “no exposure”, medium exposure (exposure values $>0 < 0.50$), and high exposure (exposure values $\geq 0.50 <= 1$).

Analysis

A number of descriptive approaches were used to assess the association between the utilization of individual services comprising the continuum and exposure to ASHA, and to identify the elements of the continuum that are most frequently missed. First, we used a matrix to assess which combination of services is frequently observed in the sample population. In the matrix, we categorize each service individually, and sum the number of services as “none”, “some” (any 1, 2 or 3 services) and “all” services. Utilization of “some” services signifies service initiation and continuation along the continuum, and utilization of “all” services signifies completion of the continuum of services. We calculate the unadjusted weighted percentages of each of the individual services comprising the continuum by individual ASHA exposure, and by cluster-level ASHA intensity. Finally, we use a linear probability model to generate probabilities of utilizing maternity services by individual and cluster-level ASHA exposure intensity, adjusted for confounding variables. Enrollment and retention within the continuum is not a sequential process. Some women may drop out of the continuum in the earlier stages (e.g. at ANC-4), and may enter the continuum at a later stage (e.g. for SBA). These descriptive analyses help us assess where significant drop-outs from services occurred, the effect of increasing ASHA intensity on the outcomes, and the change in the relationship between ASHA exposure and the outcomes when women’s demographic characteristics are accounted for.

In order to understand how exposure to ASHA influences the utilization of services across the continuum, we examined the relationship between exposure to ASHA and receipt of maternity services in two ways: 1) We modelled the outcomes categorized as “none”, “some”, and “all” with the two exposure specifications of individual ASHA exposure, and cluster -level ASHA exposure intensity using a multinomial logistic regression model; 2) To look more closely at the association between exposure to ASHA and number of services, we fitted a

multinomial logistic regression model with the number of services categorized as 0, 1, 2, 3, and 4 as the outcome with the two ASHA exposure specifications. Predicted probabilities, marginal effects and confidence intervals were calculated across each level of the outcome using the *margins* command in Stata. *Margins* uses the delta method to estimate the standard errors of the marginal effect.⁽⁸⁵⁾¹ All analyses, conducted using Stata 14.1 (Stata Corp LP, College Station, Texas), are restricted to clusters with two or more women and accounts for survey weights.

We controlled for a number of potentially confounding variables. These included socio-demographic characteristics of the women- including maternal age (15-19, 20-24, 25-29, 30-34, 35-39, 40-49 years), maternal education (1-5 years, secondary 6-11 years, 12 years or more of education), maternal caste (upper/forward caste, scheduled caste (SC), scheduled tribe (ST), other backward caste (OBC)), religion (Hindu, Muslim, other religions), parity, and household wealth index. OBC, SC and ST are official Government of India caste classifications for groups of historically disadvantaged people. We used polychoric principal components analysis (PCA) to estimate household wealth quintiles with information about household asset ownership and household characteristics from the IHDS household surveys.⁽⁸⁶⁾

RESULTS

Trends in the utilization of maternity services along the continuum of care

Over 60 percent of the women were under 30 years of age (Table 1). One third of the women had no formal education. Over 50 percent of the sample is from high-focus states, 43 percent from other states, and 4 percent from northeastern states. Seventy-one percent of the

¹ Our initial plan was to model this relationship using ordered logistic regression; however, our model rejected the Lagrange multiplier test for proportional odds, which assumes that the relationship between each pair of the outcome groups is the same.⁽¹²⁶⁾ We explored the use of a partial proportional odds model, which relaxes the proportional odds assumption for some variables while maintaining it for others.⁽¹²⁷⁾ However, the estimates obtained using this model approximated the multinomial logistic model, and the later was used in the final models for easier interpretability.

sample is rural (Table 1). Twenty-five percent of the women in the sample reported exposure to ASHA. Measured as cluster-level intensity, 41 percent women lived in clusters where no ASHA services were reported, 36 percent lived in clusters where a “medium” intensity of ASHA services were reported, and 23 percent lived in clusters where “high” ASHA intensity was reported.

Most women (71.38%) utilized between 1-3 services along the maternity continuum, 8.5 percent utilized no services, and 20 percent utilized all the four services (Table 2). For women receiving 1-3 services, the most frequently observed combination was ANC-1, ANC-4 and facility birth. Fourteen percent of the women received only one ANC and then went on to have a facility birth and postnatal care; and 16 percent women received only one ANC and then went on to have a facility birth. Less than 5 percent of the women, who did not have a facility birth, went on to receive post-natal care.

Cascade of maternity services received by ASHA exposure status

Women who report ASHA services had significantly higher reported use of ANC-1 and SBA, after accounting for women’s demographic characteristics (Figure 2). ANC-4 and PNC were the two services along the continuum that were most frequently missed. We also explored the relationship between cluster-level ASHA exposure intensity and outcomes (Figure 3). We observe no significant differences in the use of services across the different levels of exposure intensity, after accounting for demographic characteristics. Similar to Figure 2, a drop in the utilization of ANC-4 and PNC is observed.

Association between exposure to ASHA and number of services

Exposure to ASHA was associated with an 8.8 percentage point (95% CI: -0.102- -0.074) reduction in receiving no maternity services, a 12 percentage point (95% CI: 0.091-0.151) increase in receiving some services, and no effect on receiving all the services.

Medium to high cluster-level ASHA exposure intensity is associated with a decrease in women receiving no services (Two percentage points decrease for medium exposure, and six percentage points decrease for high exposure), and increase in women receiving some services (7.1 percentage points increase for medium exposure, and 12.7 percentage points increase for high exposure), compared to no ASHA exposure. However, a negative association is seen between ASHA exposure and women receiving all services. Exposure to ASHA is thus strongly associated with the service initiation and continuation along the maternity continuum (i.e. receiving some services), but not associated with the completion of service utilization along the continuum.

To further understand the effect of ASHA exposure on the number of services, we break down the “some” category into the exact number of services. Exposure to ASHA is associated with an nine percent (95% CI: -0.102 – -0.074) reduction in women receiving no services, and a six percent (95% CI: -0.080 – -0.039) reduction in women receiving only one service. A significant increase of six percent (95% CI: 0.027 – 0.095) and 12 percent (95% CI: 0.090 – 0.156) is seen in women receiving two and three services, respectively (Figures 4 and 5). Similar to the results reported in Table 3, the marginal effect of ASHA exposure on women receiving all the four services is negligible.

DISCUSSION

Community health workers such as the ASHA are in a unique position to bring women who may not typically use formal health services, into the healthcare system. Our study indicates that exposure to the ASHA is associated with an increased probability of women receiving at least one ANC and SBA. In terms of number of services, exposure to ASHA accounts for a 12 percent increase in women receiving at least some of the services, and a nine

percent decrease in women receiving no services. However, exposure to ASHA does not increase the likelihood of women using all the services along the continuum.

We further explore why the presence of an ASHA, though effective in women initiating and continuing along the maternity continuum, does not result in the completion of services along the continuum. When women have 2 or 3 services, ANC-4 and PNC are most likely to be missed out (Table 2). A number of social, economic, and cultural barriers, as well as cognitive and supply-side factors may limit the use of four or more ANC visits.(87,88) Women may not understand the importance of ANC, especially if they have a low-risk pregnancy. An initial ANC visit typically involves a general check-up; women may not perceive this as important and assume that their health situation will remain unchanged until the time of delivery. Women may also not have a positive experience during their first ANC visit due to a variety of service provision reasons such as long waiting times, provider attitudes and quality of services; this in turn will affect their willingness to return.(87) Additionally, women may forget when it is time for them to go back to the provider, as in the case for other health conditions that require ongoing follow-up care.(88) Furthermore, a variety of cultural and economic factors such as family support and ability to pay might dictate a woman's ability to return for ANC. Arguably, ASHA can play an important role in addressing several of these factors to encourage women, at the community-level, to go for ANC visits. Training ASHA to recognize and address these barriers is important to improving the coverage of ANC-4.

PNC is only recently receiving focus as a key maternal and newborn health intervention and the factors affecting its uptake are not well understood.(45) High levels of drop-outs at the level of post-natal care observed in our study, have also been reported by studies conducted in other countries.(75) Women who deliver in a health facility are more likely to receive a postnatal checkup within two days of giving birth compared to women who deliver at

home;(46) home births, especially those without any skilled attendance, place the responsibility of a postnatal checkup on the mother. In our study, over thirty percent of women who have a skilled attendant do not go on to receive any PNC. To understand the factors affecting this drop-out, we need to closely examine who the providers of skilled birth attendance and PNC are and where these services are being delivered. Some country programs are training CHWs to conduct PNC checks at home. The WHO endorses this strategy in areas where there are shortages of formal health workers.(89) Another important factor to consider in interpreting results about PNC coverage is the manner in which questions about a postnatal health check-up and its timing are asked and interpreted by the women. Possibly, women and newborns with complications may be separated after birth, women may not recall having a health check-up immediately after giving birth, or may not consider it noteworthy.

We observed a dose-response relationship between the “intensity” of ASHA exposure and the number of services utilized. Medium exposure to ASHA was associated with a seven percent increase in women utilizing some of the services, compared to a thirteen percent increase associated with high ASHA exposure. This finding may be interpreted in a few ways: (1) Increased ASHA activity (measured as “intensity” of exposure) may result in improved service utilization; (2) There is an indirect community-effect resulting from a higher percentage of pregnant women having access to health information. Positive behavior change among some women in the community influences other women to improve their health seeking behaviors; and (3) Greater ASHA exposure may be reported in areas where community health infrastructure is stronger, and therefore more women are likely to use health services compared to areas that have poor health infrastructure.

This analysis is an advance over other studies in that it is based on a nationally representative sample population. The survey provides data on a range of demographic

variables, which allowed us to control for potential confounders. This is the first study to assess the association between a national-level CHW program and women's retention in the maternity continuum. However, our findings must be interpreted within the context of the study design. As a cross-sectional study, our findings are descriptive and highlight important associations that should be further investigated using more robust designs and qualitative studies. Additionally, as has been noted by other studies, measuring the coverage of services, while important, does not capture the quality of service provision.(72,90,91) For example, global coverage of births with a skilled birth attendant has increased from 57% to 74%, of at least one ANC from 65 to 83%, and of four or more ANC visits from 37 to 64%. However, several countries with high coverage continue to have poor maternal and child survival.(91) .

The role of CHWs is critical, especially in the current global health ecosystem where skilled human resources for health are a glaring challenge in most low-income countries. Our study suggests that the presence of an ASHA in a community encourages positive health-care seeking behaviors along the continuum of maternity care. Effective strategies to strengthen such community health worker programs warrant further evaluation.

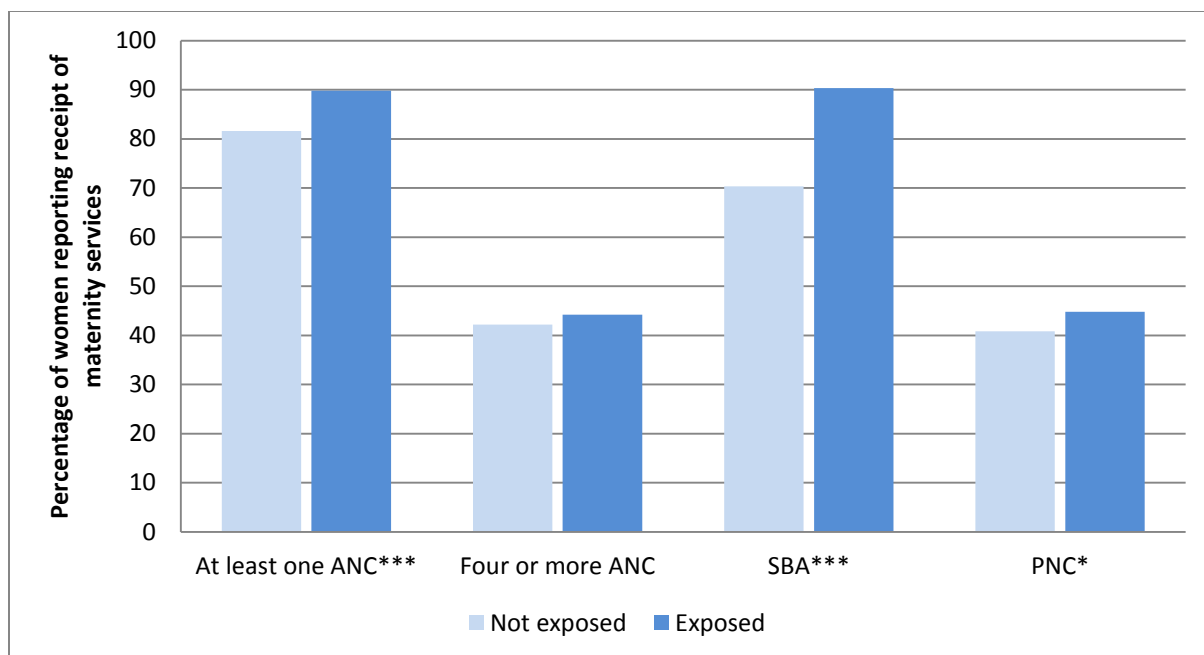
TABLES AND FIGURES

Table 1: Demographic characteristics of sample population of women

Characteristic	N= 13,705(%)
Maternal Age (yrs)	
15-19	297 (2.17)
20-24	3,133 (22.86)
25-29	4,986(36.38)
30-34	3,151(22.99)
35-39	1,434(10.46)
>=40	703(5.13)
Education	
No education	4,590(33.49)
1-5 years	2,009(14.66)
6-11 years	5,022(36.64)
12 years or more	2,076(15.15)
Missing	8(0.06)
Caste	
Forward caste	3,459(25.24)
Other backward castes	5,858(42.74)
Scheduled Castes	3,180(23.20)
Scheduled Tribes	1,181(8.62)
Missing	27(0.20)
Religion	
Hindu	11,011(80.34)
Muslim	2,094(15.28)
Others religions	600(4.38)
States	
-	-
Other States	5,930(43.27)
High-focus states	7,260(52.97)
Northeast states	515(3.76)
Urban/Rural	
Rural	9,757(71.19)
Urban	3,948(28.81)
Wealth quintile	
Lowest	3,747(27.34)
Lower	2,900(21.16)
Middle	2,524(18.42)
Richer	2,375(17.33)
Richest	2,159(15.57)
Parity (Mean(SD))	2.589(1.68)

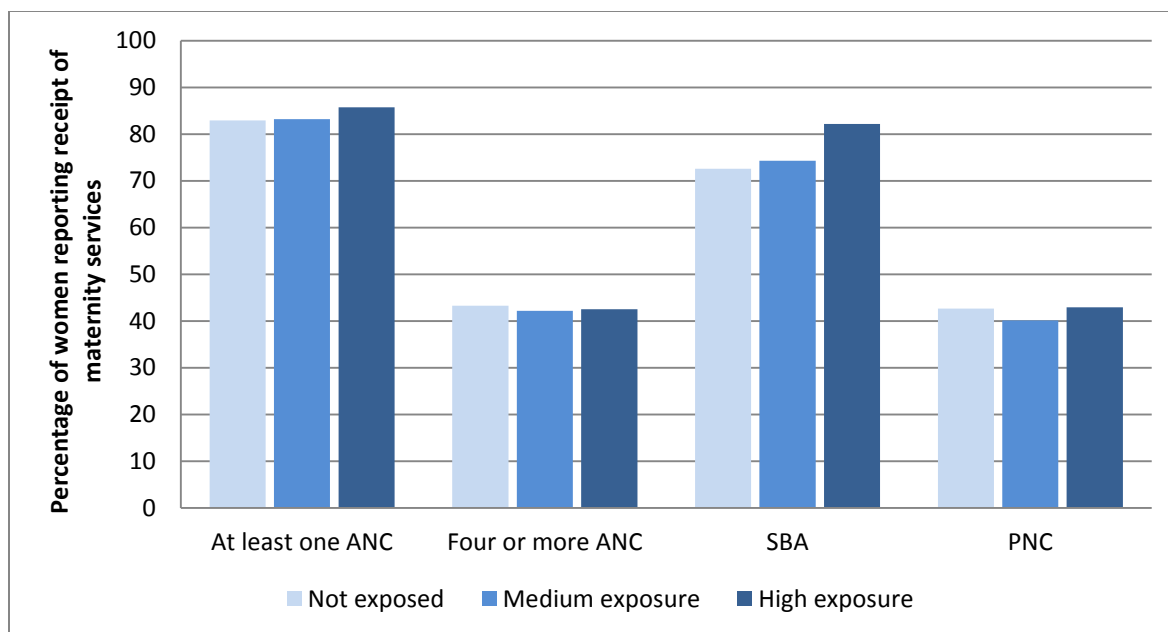
Table 2: Weighted percentages of women who received each combination of services along the continuum of care

No. of services	No. of services	ANC-1	ANC-4	SBA	PNC	Weighted %	Weighted % (by no. of services)	N=13705
0	None					8.56	8.56	1173
1	Some	X				8.11	12.77	1111
				X		3.53		484
					X	1.13		155
2		X	X			3.02	25.28	414
		X		X		16.43		2252
		X			X	2.7		370
				X	X	3.13		429
3		X	X	X		18.59	33.33	2548
		X		X	X	13.7		1878
		X	X		X	1.04		143
4	All	X	X	X	X	20.06	20.06	2749



Note: *significant at $p < 0.10$; **significant at $p < 0.05$; ***significant at $p < 0.01$ Percentages were estimated using a linear probability model to control for the following confounding variables: maternal education, maternal age, caste, religion, parity, household wealth quintile, state and rurality

Figure 2: Cascade of maternity services received by individual ASHA exposure status



Note: *significant at $p < 0.10$; **significant at $p < 0.05$; ***significant at $p < 0.01$; Percentages were estimated using a linear probability model to control for the following confounding variables: maternal education, maternal age, caste, religion, parity, household wealth quintile, state and rurality

Figure 3: Cascade of maternity services by cluster-level ASHA exposure intensity adjusted for demographic variables

Table 3: Association between individual exposure to ASHA and number of services utilized, using a multinomial logistic regression model ^a

	Predicted probability (95% CI)		Marginal effects (95% CI)
	ASHA exposure	No ASHA exposure	ASHA versus no ASHA
No services	0.03 (0.016-0.034)	0.11 (0.099-0.127)	-0.088 (-0.102- -0.074)**
Some services	0.80 (0.776-0.826)	0.68 (0.661-0.698)	0.121 (0.091-0.151)**
All services	0.17 (0.149-0.198)	0.21 (0.190-0.224)	-0.033 (-0.062- -0.005)*

*significant at 0.05; **significant at p<0.01

^a: Model controls for the following confounding variables: maternal education, maternal age, caste, religion, parity, household wealth quintile, state and rurality

Table 4: Association between cluster-level ASHA intensity and number of services utilized, using a multinomial logistic regression model^a

No. of services	Exposure intensity	Predicted probability (95% CI)		ME(95% CI)	
No services	No ASHA exp.	0.113	(0.091-0.135)	<i>(Ref)</i>	
	Some ASHA exp.	0.090	(0.073-0.105)	-0.024	(-0.049- -0.002)*
	High ASHA exp.	0.053	(0.041-0.066)	-0.060	(-0.085- -0.034)***
Some services	No ASHA exp.	0.659	(0.629-0.690)	<i>(Ref)</i>	
	Some ASHA exp.	0.730	(0.709-0.751)	0.071	(0.032-0.109)***
	High ASHA exp.	0.786	(0.756-0.817)	0.127	(0.082-0.172)***
All services	No ASHA exp.	0.228	(0.203-0.252)	<i>(Ref)</i>	
	Some ASHA exp.	0.180	(0.160-0.200)	-0.047	(-0.078- -0.016)***
	High ASHA exp.	0.160	(0.131-0.189)	-0.067	(-0.106- -0.028)**

*significant at p<0.10; **significant at p<0.05;***significant at p<0.01

^a: Model controls for the following confounding variables: maternal education, maternal age, caste, religion, parity, household wealth quintile, state and rurality

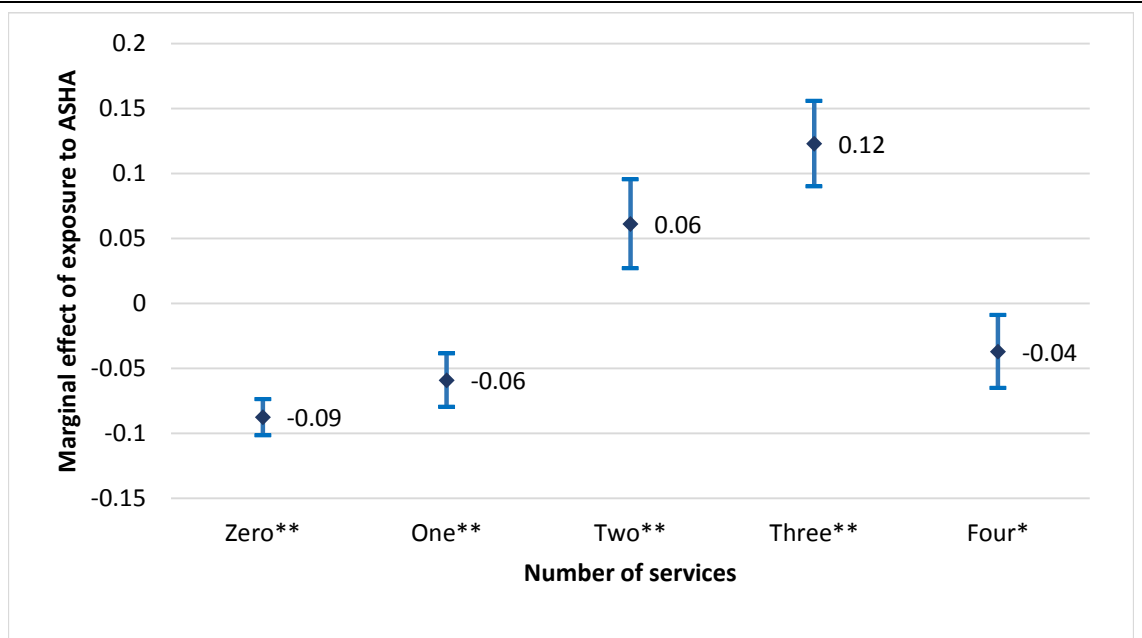


Figure 4: Marginal effects of individual ASHA exposure on number of maternity services

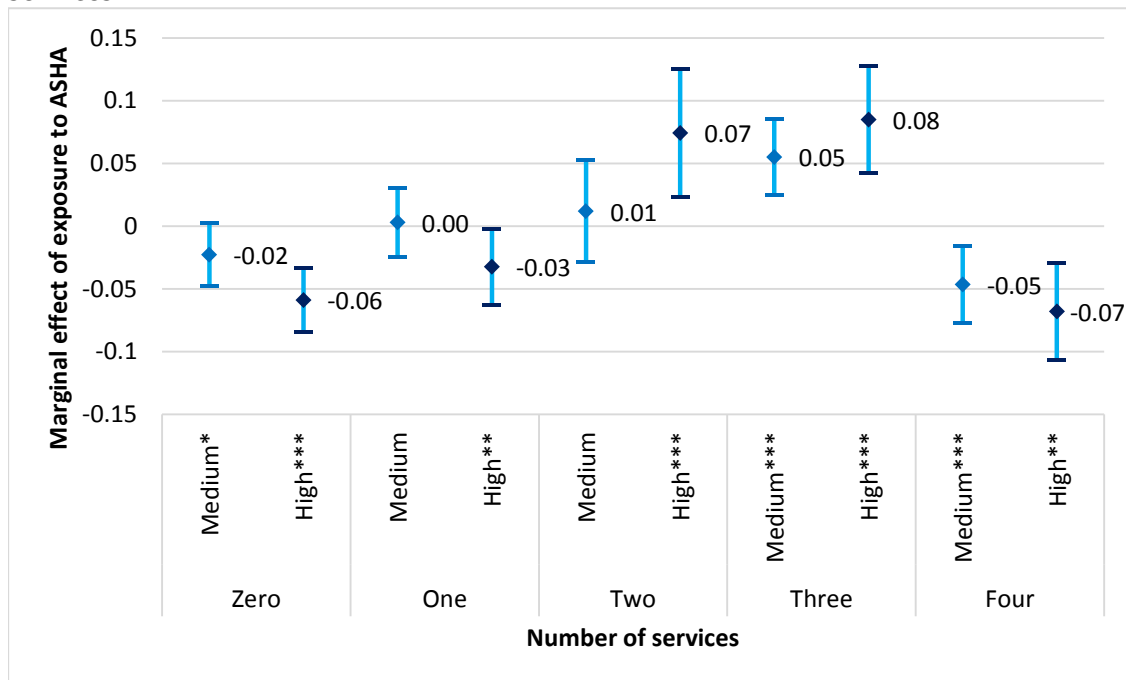


Figure 5: Marginal effects of cluster-level ASHA exposure intensity on number of maternity services

CHAPTER 5: THE IMPACT OF INDIA'S ACCREDITED SOCIAL HEALTH ACTIVIST (ASHA) PROGRAM ON THE UTILIZATION OF MATERNITY SERVICES

OVERVIEW

Background: In 2006, the Government of India launched a community health worker programme called the Accredited Social Health Activist (ASHA) programme, with the goal to connect marginalized communities to the healthcare system and improve maternity health outcomes. We assessed the effect of the ASHA programme on the utilization of maternity services.

Methods: We used data from Indian Human Development Surveys done in 2004-2005, and in 2011-2012 to assess demographic and socio-economic factors associated with the receipt of ASHA services; and used difference-in-difference analysis with cluster-level fixed effects to assess the effect of the ASHA programme on the utilization of at least one antenatal care (ANC) visit, four or more ANC visits, skilled attendance at birth (SBA) and delivery at a health facility.

Findings: Substantial variations in the receipt of ASHA services were reported with 66% of women in northeastern states, 30% in high-focus states, and 16% of women in other states. In areas where active ASHA activity was reported, the poorest women, and women belonging to scheduled castes and other backwards castes, had the highest odds of receiving ASHA services. Exposure to ASHA services was associated with a 19% (95% CI 11.5-26.4) increase in ANC-1, 7% increase in four or more ANC visits (95% CI -0.4 – 14.6), 28% increase in SBA (95% CI 20.8-35.4), and 28% increase (95% CI 19.5-33.1) in facility births.

Interpretation: Our results suggest that the ASHA programme is successfully connecting poor communities to maternity health services. The study highlights the need improve the coverage of four or more ANC visits, and target programmatic activities to women belonging to other backward castes, scheduled castes and scheduled tribes. Given the potential of the ASHA in impacting service utilization, we emphasize the need to strengthen strategies to recruit, train, incentivize and retain ASHAs.

INTRODUCTION

In 2015, India accounted for approximately 45,000 (range 36,000 to 56,000) pregnancy-related maternal deaths, making it one of two countries that account for one-third of all maternal deaths globally.⁽¹²⁾ Between 1990 and 2015, the maternal mortality ratio (measured as a pregnancy-related deaths per 100,000 live births) declined by 68 percent.⁽¹²⁾ While some progress was made to achieve the Millennium Development Goal of a two-thirds reduction in maternal mortality, the target was not met and progress varied substantially across states.⁽⁹²⁾ Between 2002-04 to 2007-08, the coverage of at least one antenatal care visit increased from 73.6 to 75.3 percent, three or more ANC visits increased marginally from 50.4 to 51 percent, institutional deliveries increased from 40.9 to 47 percent, and percentage of births with a skilled attendant increased from 48 to 52.6 percent.⁽⁹³⁾

In response to the relatively slow progress to strengthen maternal and child health, the Government of India (GoI) launched the National Rural Health Mission (NRHM) in April 2005. The NRHM is an ambitious effort to strengthen the national health systems and healthcare delivery, with a special focus on improving health care outcomes amongst the poorest populations.⁽⁹⁴⁾ The Accredited Social Health Activist (ASHA) programme, considered vital to the success of the NRHM, aims to increase community engagement with the health system and support access to public health services.^(95,96) The ASHA programme was first launched in

2006 in 18 high-focus states – including 10 high focus states (Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh, Uttarakhand, Orissa, and Rajasthan), and 8 northeastern high-focus states (Arunachal Pradesh, Manipur, Assam, Nagaland, Meghalaya, Tripura, Mizoram, Sikkim). Within 2 years, over 300,000 ASHA were trained and deployed at a ratio of one ASHA to 1000 population in rural areas. In 2009, the programme was expanded to the rest of the country.⁽⁹⁷⁾ As of December 2015, there were 937,595 ASHAs operating nationally. Of these, 544,074 ASHA are in high focus states, 56,104 in the Northeastern states, and 337,417 in other non-high focus states.^(98,99) Although variations exist across states in the recruitment, training, responsibilities, incentives and supervision systems for the ASHA, there are some common guiding tenets. Table 5 summarizes their training,⁽¹⁰⁰⁾ responsibilities specific to promoting the health of mothers and children, ^(97,101) and compensation structure.^(102,103)

The ASHA programme is the largest community health worker (CHW) programme in the world, in terms of the number of CHWs trained. As such, an assessment of the ASHA programme has relevance not only for the GoI, but also for other countries investing in similar programmes. Over the last decade, the ASHA programme has been scaled nationally, with a budget allocation ranging from 80 million rupees (~\$1.2 million) to 1.05 billion rupees (~\$15.5 million) per state, between 2005 and 2010 alone.^(97,104) Furthermore, governments in other South Asian and African countries such as Ethiopia, Bangladesh, Kenya, Uganda, Ghana and South Africa are in various stages of training and deploying cadres of CHWs to fill critical gaps in delivering health services to women and children.⁽⁶⁸⁾ Despite the importance of such programmes, the evidence on their effectiveness, especially at scale, is limited.

Previous assessments of the effect of the ASHA programme on maternity care have been descriptive,⁽¹⁰⁵⁾ limited to certain states,⁽⁹⁷⁾ or limited to assessing the performance of the

ASHA(94,106) and not the impact of the ASHA programme on health care outcomes. In this study, we investigate whether the ASHA program is reaching its target populations; and assess whether the receipt of ASHA services is associated with an increase in the utilization of maternity care services.

METHODS

We used data from two rounds of the nationally representative, longitudinal, Indian Human Development Surveys (IHDS). The surveys were funded by the National Institutes of Child Health and Human Development (NICHD) and were produced jointly by the National Council of Applied Economic Research (NCAER), New Delhi, and the University of Maryland. IHDS-1 (2004-05) was administered to 41,554 households- 27,010 rural and 13,126 urban households. The rural sample was drawn using stratified random sampling of defined units. In urban areas, a stratified sample of towns and cities within states was selected by probability proportional to population size.(83,107) Eighty-three percent of the households interviewed in 2004-05, were re-interviewed in IHDS-2 (2011-12), and an additional replacement sample of 2,134 households was added.² The IHDS-II survey was administered to 42,152 households in 33 states and union territories, 384 districts (of 612 districts), 1503 villages and 971 urban areas.

Both rounds of the IHDS survey include a household interview with information about household asset ownership; and an interview with ever-married women of reproductive ages (15-49 years) with information about birth history, reproductive health, and antenatal and delivery care for the most recent birth. IHDS-I recorded 11,670 births, and IHDS-2 recorded 13,881 births (demographic characteristics presented in Appendix A). The implementation of

² Appendix C presents an analysis of households that were not interviewed in IHDS-II and were lost to follow-up.

the ASHA program started in April 2005. IHDS-I covers births from 2000 to 2005, and IHDS-II covers a six year period (2005-2011) after the implementation of the ASHA program.

Measurement of program exposure and outcomes

We estimated the effect of the ASHA program on four outcomes: (1) whether the respondent received at least one ANC visit, (2) had 4 or more ANC visits, (3) delivered in a health facility and (4) had a skilled attendant present at the time of birth. Following 2008 WHO recommendations, we considered medical doctors, nurses and auxiliary nurse midwives (ANMs) as skilled birth attendants.⁽⁸⁴⁾

IHDS-2 survey gathered information on the type of health care provider seen by women at any point during their last pregnancy. A woman was considered exposed to an ASHA if she reported that an ASHA assisted her in response to at least one of the following questions- “Where did you get a pregnancy card made?”; “Did you get help from anyone for making a pregnancy card/registration?”; “Who visited you when you were pregnant?”; “Who facilitated or motivated you to go to a health facility for delivery?”; and “Who arranged the transportation to take you to the health facility for delivery?”. We explored three specifications for defining the exposure: (S1) Cluster-level “intensity” of ASHA exposure was calculated as number of women who reported exposure to an ASHA in a cluster during the last birth divided by the total number of eligible women who had a birth in 6 years preceding the survey in the cluster. This measure takes a value between 0 and 1 and captures direct individual exposure to an ASHA, as well as indirect effect that may result from the presence of an ASHA within the community; (S2.) All women in clusters in which at least one woman reported seeing an ASHA received a value of “exposed” (i.e. 1); (S3) Women received a value of either 0 or 1 depending on their individual reported exposure.

Characteristics of the women who report receipt of ASHA services

To understand whether the ASHA programme is reaching its target population, we calculated the uptake of the program nationally, disaggregated by demographic characteristics, based on self-reported ASHA exposure (S3) using IHDS-2 data. To understand whether ASHA are differentially used by individuals belonging to a certain demographic in areas where the ASHA program is active, we restricted the analysis to only those clusters where ASHA services were reported. We used logistic regression to investigate the association between a range of individual and household characteristics and receipt of ASHA services in clusters where an ASHA has been reported. We estimated this model at the national level, and separately for rural areas and high-focus states.

The logistic models account for socio-demographic characteristics of the women- including maternal age (15-19, 20-24, 25-29, 30-34, 35-39, 40-49 years), maternal education (1-5 years, secondary 6-11 years, 12 years or more of education), maternal caste (upper/ forward caste, scheduled caste (SC), scheduled tribe (ST), other backward caste(OBC)), religion (Hindu, Muslim, other religions), parity, and household wealth index. OBC, SC and ST are official Government of India caste classifications for groups of historically disadvantaged people. We used polychoric principal component analysis (PCA) to estimate household wealth using information about household asset ownership (bicycle, sewing machine, generator, mixer, motorcycle, television, air cooler, clock, fan, chair/ table, cot, telephone, mobile phone) and household characteristics (type of cooking place, type of toilet, availability of electricity, type of *chulha* (hearth), water source, wall type, roof type, floor type) from the IHDS household surveys. The polychoric procedure, unlike the standard PCA, retains ordinal variables without breaking them into dummy variables.(86) The first component of the polychoric PCA was used to create wealth quintiles, explaining 27% of the variance for the 2005, and 30% for 2012 data.

Association between exposure to ASHA and maternal service utilization outcomes

We assessed the effect of exposure to ASHA, measured as cluster-level exposure intensity (S1), on the outcomes, using multivariate difference-in-differences models fitted using ordinary least squares regression.(108) The difference-in-differences approach assesses the effect of the ASHA program by controlling for baseline differences between exposed and unexposed populations, and for temporal differences that may have resulted from underlying changes over time.(109) We used fixed effects at the cluster-level to control for baseline differences between clusters and any unmeasured time-invariant factors that may have resulted in selective uptake or targeting of the ASHA program. The models controlled for individual and household characteristics: maternal age, maternal education, household wealth index, birth order, maternal caste and religion. All regression models were adjusted for survey design features using cluster-level sample weights, and standard errors were corrected for correlation across individuals in the same cluster using robust standard errors.

We tested the sensitivity of our findings to various model specifications. We estimated the models separately for rural areas, and for high-focus states (results not presented). About 30 percent of the clusters had 3 or fewer eligible women. Since ASHA exposure is defined as the cluster average, we tested the robustness of the results to cluster sizes greater than two and greater than three. Additionally, we also used the three different specifications for exposure to the ASHA program for further robustness checks. Around 2005, a national cash assistance program called *Janani Surakshna Yojana* was launched to incentivize women living below poverty line to deliver in health facilities or with a skilled attendant.(110) The ASHA play a vital role in rolling out this programme. We could not control for cash assistance in the above models for SBA and facility birth, as data on cash transfer were only available for women who delivered in a health facility. To disentangle the effect of the cash transfer on SBA and facility

births from the effect of the ASHA programme alone, we tested a multinomial logistic model with SBA and facility birth coded as three-level categorical outcomes. Facility births were coded as birth at home, birth in a health facility without any financial incentive, birth in a health facility with a financial incentive; and SBA was categorized as no SBA, SBA without financial incentive, and SBA with financial incentive.

RESULTS

Nationally, 25% of women who had a live birth since 2005 reported receiving one or more ASHA services during their last pregnancy (measured as proportion of women who reported receiving ASHA services during their last pregnancy, among all women who had a live birth since 2005). Fifty-nine percent of women interviewed in IHDS-II live in clusters where an ASHA has been reported. Substantial variations in the receipt of ASHA services were reported at the state-level (Figure 6). Sixty-six percent of women in northeastern states, 30% of women from high-focus states, and 16% of women in other states reported receipt of ASHA services (Figure 7). Over 30% of all rural women reported ASHA services, compared to less than 10% of urban women.

To understand whether ASHA were differentially targeting any demographic groups within clusters where they are active, we restricted the analysis to only those 59 percent (n=7972) of the clusters that reported an ASHA (Table 6). Compared to the youngest women ages 15-19 years, women in age groups 30-34, 35-39, and >40, were significantly less likely to report ASHA services. Within clusters with an active ASHA, odds of reporting ASHA services declined steadily with increasing wealth status- nationally, in rural areas and in high focus states. No significant differences in the receipt of ASHA services were reported by caste or religion across all groups. This pattern was observed nationally, as well as when the sample is restricted to rural areas and to high focus states.

Between 2005 and 2012, the use of at least one antenatal care increased from 74% to 84%, the use of a skilled attendant at birth increased from 53% to 75%, and the use of health facilities for delivery increased from 43% to 66%. Table 7 presents three models to assess the relationship between exposure to ASHA (exposure S1) and utilization of maternity services using a difference-in difference model- A crude model (M1) without any confounders, model (M2) with confounding covariates, and model (M3) with confounding covariates and cluster-level fixed effects. Across all four outcomes, the crude model suggests that exposure to ASHA is associated with a decrease in the use of the maternity services. However, this relationship is reversed, and a positive association is seen when the confounding variables are accounted for in M2; the positive relationship is further strengthened when cluster-level fixed effects are accounted for in M3. The reversal of the association may be explained by the results in Table 6 that show that receipt of ASHA services are more likely to be reported by the most marginalized women - women who are also least likely to have care-seeking behaviors.

Exposure to ASHA is associated with a 19% increase in the utilization of at least one antenatal care visit, a 7% increase in the utilization of 4 or more antenatal care visits, a 28% increase in SBA and a 26% increase in delivery in a health facility (Table 7). This implies that for every 10 women receiving ASHA services, one or two additional women would receive at least one ANC visits, and additional two or three women would give birth in a health facility or with a skilled birth attendant outside a facility. High maternal education and household wealth, upper castes, and lower parity were associated with increased probability of having ANC, SBA and a facility delivery (Results presented Appendix B). The association between exposure to ASHA and maternity outcomes was robust to variations in cluster size and exposure specifications. While the magnitude of the association varies for the different exposure

specifications, the results still suggest a significant association between receipt of ASHA services and the outcomes. (Figure 8)

We attempted to understand the role of conditional cash transfers in motivating women to go to health facilities for birth and have a skilled attendant at the time of birth. Exposure to ASHA is significantly associated with a reduction in home births, and births without a skilled attendant (Figure 9). Exposure to ASHA with financial incentives was significantly associated with a 12% and 15% increase in health facility births and skilled birth attendance, respectively.

DISCUSSION

Exposure to ASHA was strongly correlated with the utilization of maternity services. Even the most conservative assumptions for specifying exposure to ASHA suggest that the ASHA program is associated with improved utilization of at least one antenatal care visit, skilled birth attendance, and health facility delivery. The intent of the ASHA program was to reach marginalized communities – to connect communities that do not typically avail of services in health facilities to health care services at the community level. Our results suggest that the ASHA programme is meeting these objectives as few programmes have successfully done in the past.

Nationally, though the coverage of any (i.e. at least one) ANC visits has increased over the last decade, the increase in four or more ANC visits has been limited. Our study suggests that ASHA services do not appear to be strongly correlated with four or more ANC visits. This is especially concerning given the recent paradigm shift in WHO recommendations to improve quality of ANC by increasing the minimal number of contacts from four to eight during the antenatal period.⁽¹¹¹⁾ During the early phase of the ASHA program, the national recommendation was to provide pregnant women with three ANC visits; this might explain the limited impact of the ASHA program on 4 ANC visits. A closer look at the performance-based

financial incentive systems for ASHA to encourage women to go for four ANC visits might also be helpful. Each State has some flexibility in determining the ASHA services that should be compensated. The largest compensations (~INR 200/ USD 3) are given to the ASHA for accompanying women to health facilities for delivery; compensation is much smaller for other services such as ANC. For example, in West Bengal, ASHA are compensated an equal amount for encouraging a facility birth and for the combined package of services including registering all pregnant women, providing or encouraging three antenatal care visits and two postnatal care visits.(102) In order to prioritize at least 4 ANC visits, it is important to assess the feasibility of separating the compensation for four ANC visits from the broader package of services.

While the ASHA programme had the highest reach in the poorest populations, it does not address the disparities in the utilization of services across women from different socioeconomic and caste groups. Historically, women belonging to scheduled castes and scheduled tribes have minimal utilization of health services. For example- the National Family Health Survey (NFHS) reports facility-based delivery at 18 percent among scheduled tribes, compared to 33 percent among scheduled castes, and 51 percent among forward castes.(33) Our study indicates that utilization of maternity services continues to be the lowest among scheduled tribes, even after accounting for receipt of ASHA services. The tribal nature of these communities makes linkages to the health care system challenging, and warrants further programming that is responsive to tribal customs around childbirth.

Prior process evaluations of the ASHA programme highlighted several operational challenges – In several areas, the ASHA do not receive timely payments for their services, which affects their performance; (102) studies conducted at the district or state level have reported that ASHA may not be motivated in their role due to poor financial compensation;(82,106) others have reported that ASHA activities in some states are hindered

due to poor supportive supervision and mentoring structures.(112) Given our findings about the potential impact of the ASHA programme on the utilization of services, especially for the marginalized, it is even more vital that these operational challenges are better understood and addressed. First, for the ASHA program to be sustainable, recruiting and training new ASHAs is as important as continued investments to ensure that the existing ASHA have the institutional support and ongoing education needed to deliver the ever-expanding set of services expected of them. The effectiveness of large scale mobile programs such as Mobile Academy for training of ASHA should be robustly evaluated, and if effective, should serve as an adjunct instead of replacement for face-to-face instruction. Second, further research is needed to understand how the different implementation approaches, incentive systems and support structures adopted by individual states have influenced the uptake and functioning of the ASHA programme.

Seventeen percent of the households that were lost to follow-up in the IHDS-II survey were mostly urban, overall better-off households with higher levels of service utilization compared to the households that were part of both IHDS surveys. This limits the external validity of our findings. As with any non-experimental evaluation, our analysis is limited by unobserved factors associated with selective uptake of the ASHA program. We accounted for targeting of the program by employing fixed effects methods at the cluster level, as well as controlling for a range of demographic and contextual factors. We assumed that accounting for cluster level effects addresses variations in available health infrastructure thought of as critical to the success of the ASHA. We used whether or not a woman received ASHA services as a proxy for whether the ASHA programme was active in the area. By measuring ASHA exposure based on women's self-reports, we capture functional exposure to the ASHA program. The implication of this for our findings is that there is room for measurement error in estimating the

level of exposure. To account for this, we presented results from sensitivity analyses assuming a range of exposure definitions. Lastly, we are unable to disentangle the impact of the ASHA from the impact of conditional cash transfers in driving the increase in SBA and facility births. Given that in most places, the ASHA bear the responsibility of informing women about the government's conditional cash transfer scheme, we expect the impact of the two programmes to be synergistic.

Our analysis presents an encouraging picture of the ASHA programme 6-7 years into its implementation at scale. The ASHA programme has increased in the utilization of antenatal care services, skilled birth attendance, and facility deliveries across caste, religion and demographic groups. Most importantly, our analysis suggests that the ASHA are more likely to reach groups that are typically left out of the formal healthcare system- poorer populations living in rural areas and women belonging to backward castes. The results of our study are promising given the sustained investments into the ASHA programme by the national and state governments. However, the government needs to invest into supporting and increasing the reach of the ASHA in marginalized regions with scheduled tribes. We emphasize the need to conduct ongoing monitoring and evaluation of the programme to understand approaches to effectively scale the programme and strengthen strategies to recruit, train, incentivize and retain ASHA.

TABLES AND FIGURES

Table 5: Training and responsibilities of ASHA to promote the health of mothers and children

Training

- The ASHA receive training supported by the Government of India for 23 days spread over 12 months. Training models may vary by state, and may involve partnerships with various NGOs and other training centers.
- The ASHA are expected to attend periodic review meetings and ongoing job training.

Primary responsibilities

- Create awareness and provide information to the community on the determinants of health such as nutrition, basic sanitation and hygiene, and existing health services.
- Counsel mothers on birth preparedness, safe delivery, feeding practices, immunization, prevention of common infections and family planning.
- Registering all pregnant women, provide three antenatal visits and two postnatal visits, and facilitate access to health services for the mother and child
- Rollout of other government programs such as the *Janani Suraksha Yojana (JSY)*- a cash entitlement program to incentivize women to give birth in health facilities
- Arrange escort or accompany pregnant women and children requiring treatment to health facilities.
- Additional responsibilities of the ASHA may vary by state

Compensation

- The ASHA are honorary volunteers and receive performance-based compensation based on reported activities.
- The compensation varies by the state and by the type of services provided. It ranges from INR 200 (~\$2.95) for registering a pregnant woman, providing 3 antenatal and 2 postnatal visits to INR 200- 350 (~\$2.95-5) for facilitating institutional birth.
- One study suggested that ASHA earn, on average, about INR 800 (~\$12) per month.(103)

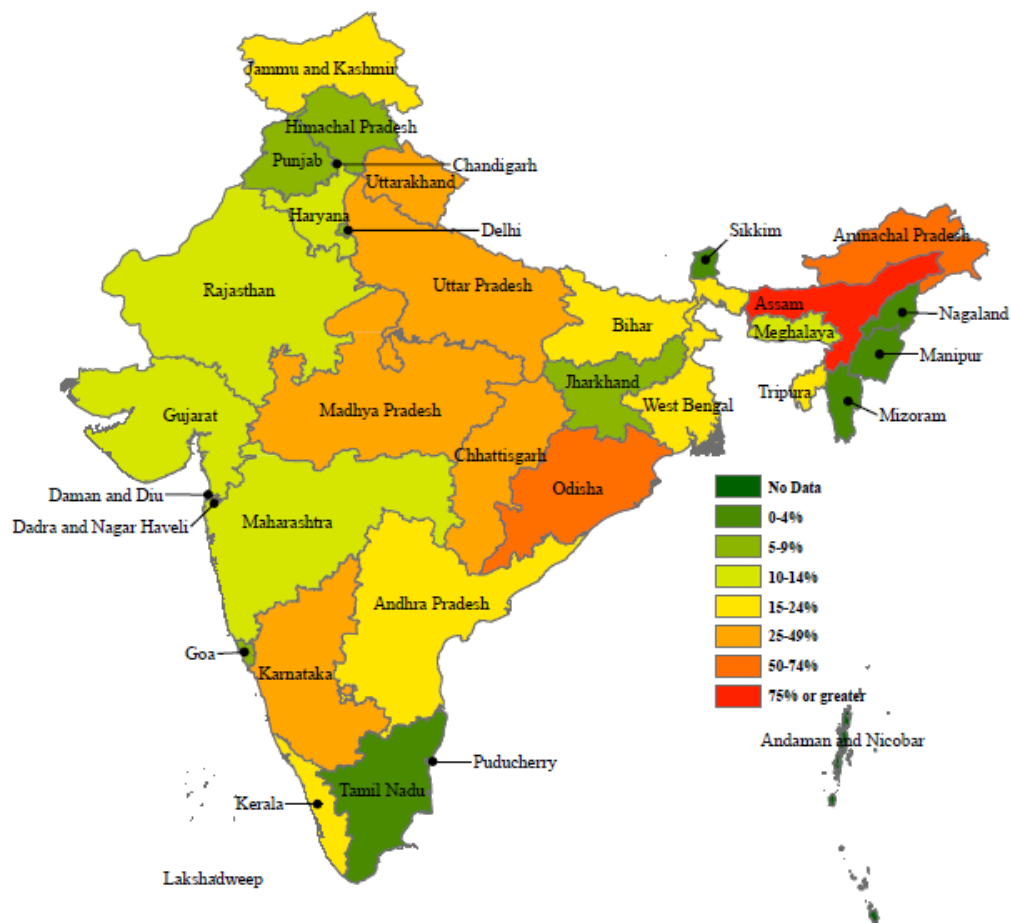


Figure 6: Percentage of women reporting receiving services from an ASHA among all women who had a live birth since 2005

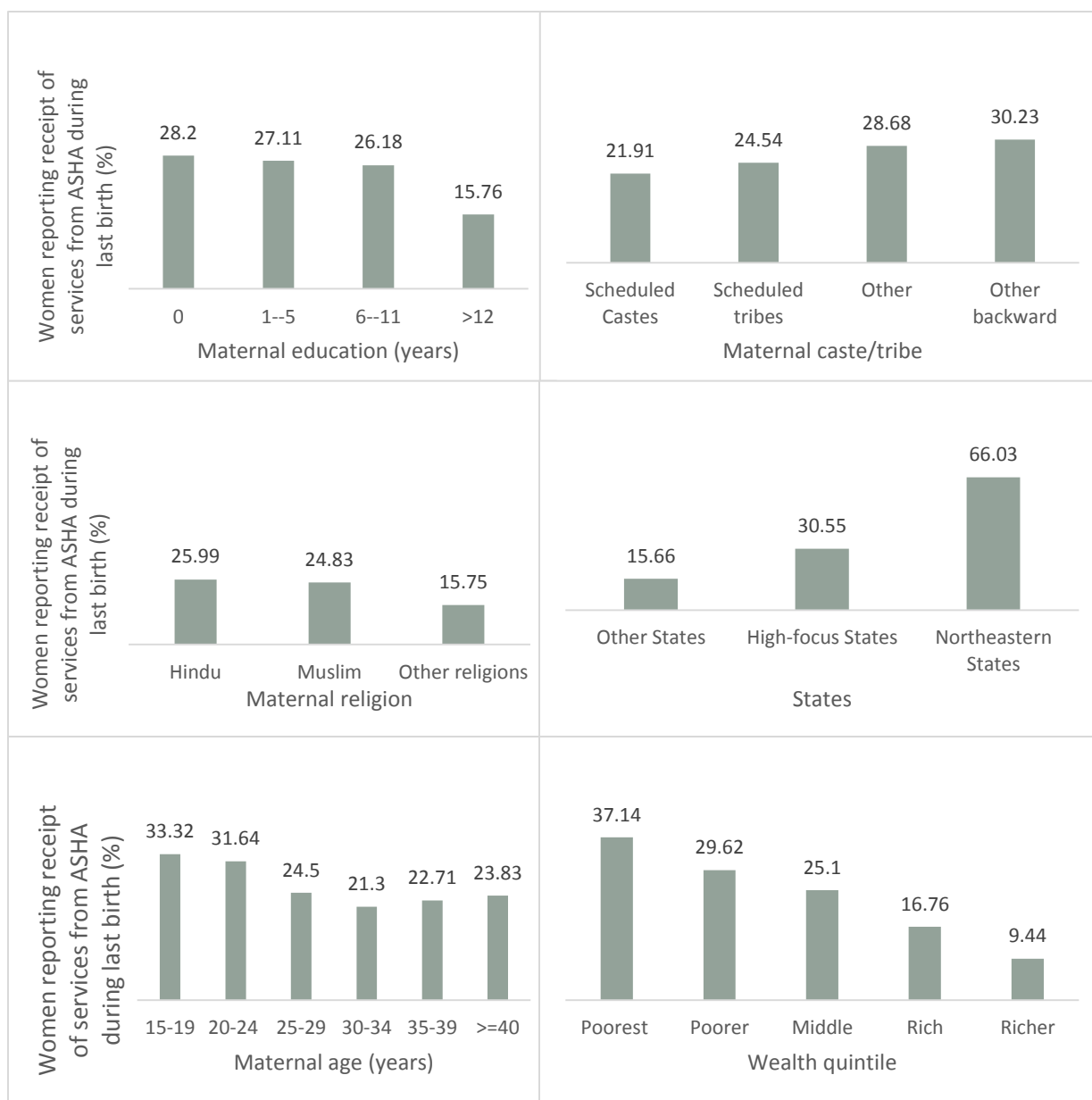


Figure 7: Percentage of women reporting receipt of ASHA services among all women who gave birth from 2005-2011

Table 6: Analysis of association between receipt of ASHA services for the most recent birth and individual characteristics using logistic regression and 2011-2012 IHDS survey

	Restricted clusters* (n=7972)			Rural areas only (n=6841)			High-focus states (n=4650)		
	Odds ratio (95% CI)		p value	Odds ratio (95% CI)		p value	Odds ratio (95% CI)		P value
Maternal Age (yrs)									
15-19	1			1			1		
20-24	0.88	(0.53-1.46)	0.631	0.94	(0.54-1.61)	0.810	0.77	(0.37-1.60)	0.481
25-29	0.65	(0.40-1.06)	0.086	0.69	(0.41-1.16)	0.160	0.60	(0.29-1.21)	0.154
30-34	0.55	(0.33-0.91)	0.020	0.56	(0.33-0.97)	0.039	0.51	(0.25-1.06)	0.071
35-39	0.54	(0.31-0.96)	0.037	0.58	(0.31-1.08)	0.087	0.51	(0.23-1.17)	0.113
>=40	0.51	(0.27-0.94)	0.032	0.54	(0.28-1.06)	0.076	0.48	(0.21-1.11)	0.087
Education									
No education	1			1			1		
1-5 years	1.11	(0.90-1.38)	0.325	1.10	(0.87-1.38)	0.431	1.03	(0.79-1.35)	0.831
6-11 years	1.37	(1.14-1.66)	0.001	1.45	(1.19-1.78)	0.000	1.37	(1.08-1.73)	0.009
12 years or more	1.08	(0.80-1.47)	0.615	1.07	(0.75-1.53)	0.720	0.99	(0.64-1.55)	0.975
Caste									
Forward caste	1			1			1		
Backward castes	1.08	(0.87-1.34)	0.47	1.10	(0.86-1.42)	0.445	1.19	(0.88-1.60)	0.254
Scheduled Castes	1.17	(0.91-1.52)	0.226	1.16	(0.86-1.56)	0.334	1.27	(0.89-1.83)	0.189
Scheduled Tribes	0.96	(0.68-1.37)	0.831	0.97	(0.76-1.53)	0.862	0.96	(0.60-1.55)	0.876
Religion									
Hindu	1			1			1		
Muslim	0.98	(0.77-1.25)	0.89	0.97	(0.73-1.28)	0.815	0.91	(0.67-1.25)	0.572
Others religions	0.84	(0.56-1.23)	0.372	0.88	(0.55-1.40)	0.585	2.34	(0.86-6.37)	0.095
States									
Other states	1			1			1		
High-focus states	1.17	(0.97-1.41)	0.005	1.19	(0.96-1.48)	0.113			
Northeast states	6.73	(4.10-11.06)	0.000	7.29	(4.18-12.71)	0.000			
Urban/Rural									
Urban	0.83	(0.69-1.01)	0.108				0.82	(0.61-1.09)	0.164
Rural	1						1		

Wealth quintile									
Lowest	1			1			1		
Lower	0.74	(0.60-0.91)	0.005	0.73	(0.59-0.90)	0.004	0.73	(0.57-0.94)	0.014
Middle	0.79	(0.63-0.99)	0.042	0.79	(0.62-1.02)	0.068	0.8	(0.59-1.08)	0.150
Richer	0.62	(0.49-0.80)	0.000	0.56	(0.44-0.77)	0.0000	0.63	(0.46-0.88)	0.007
Richest	0.42	(0.32-0.55)	0.000	0.38	(0.27-0.52)	0.0000	0.38	(0.25-0.57)	0.000
Parity	0.94	(0.89-0.99)	0.027	0.94	(0.62-2.05)	0.706	0.94	(0.88-1.00)	0.060

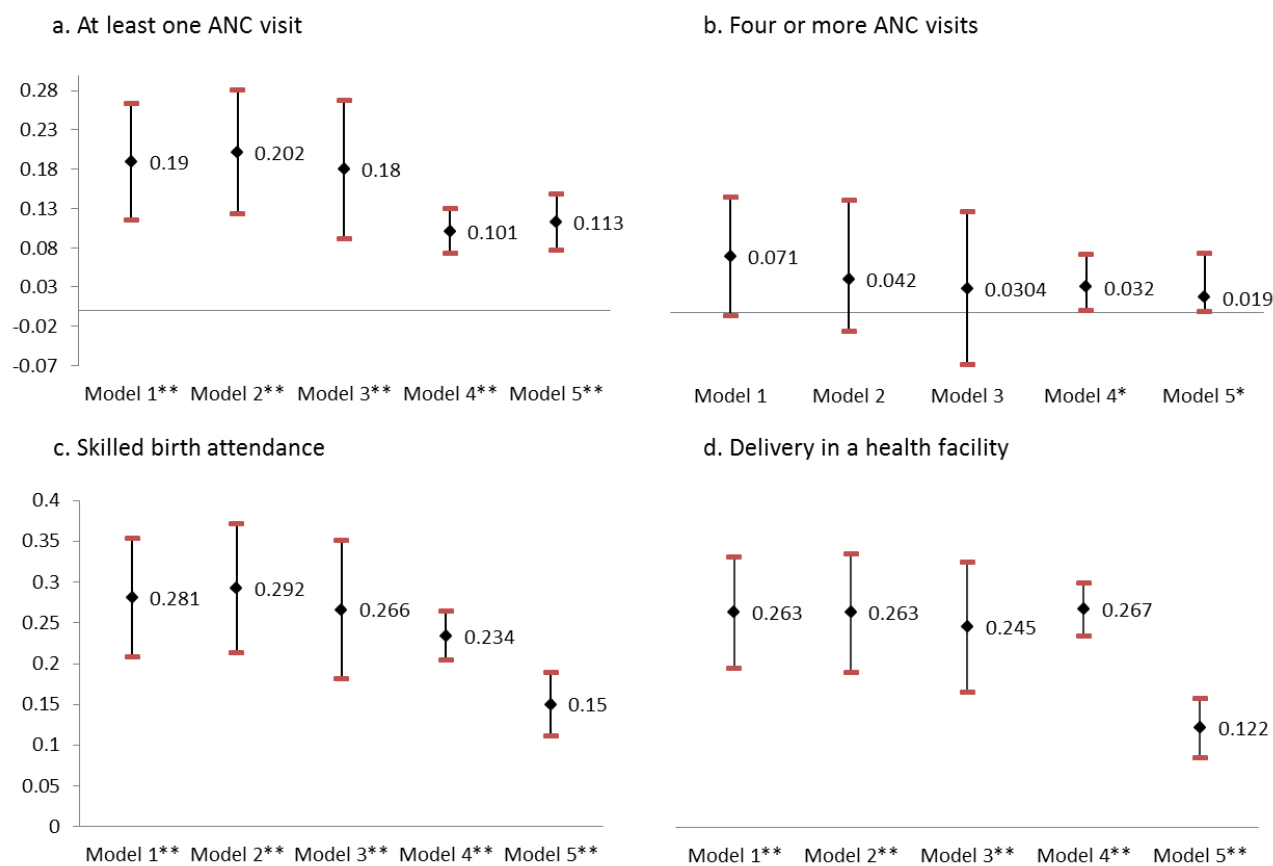
*Analysis is restricted only to clusters where at least one woman reported seeing an ASHA

Table 7: Association between intensity of exposure to the ASHA programme and maternity service utilization outcomes using a linear probability model

	M1 (Crude model)			M2 (M1+other covariates)			M3 (M2 + Cluster fixed effects)		
	N	ME*	(95% CI)	N	M	(95% CI)	N	ME	(95% CI)
Antenatal care, one visit	24,745	-0.087	(-0.142- -0.032)***	24,547	0.081	(0.032-0.129)***	24,547	0.19	(0.115-0.264)***
Antenatal care, four visits	24,759	-0.260	(-0.327- -0.192)***	24,560	0.018	(-0.040-0.076)	24,560	0.071	(-0.004-0.146)*
Skilled birth attendance	24,595	-0.056	(-0.107- -0.004)**	24,402	0.176	(0.121-0.231)***	24,402	0.281	(0.208-0.354)***
Birth at a health facility	24,703	-0.059	(-0.119-0.000)*	24,501	0.212	(0.153-0.271)***	24,501	0.263	(0.195-0.331)***

Estimated marginal effects(ME) are the change in predicted probabilities (95% CI) as a result of receipt of ASHA services , controlling for maternal age, maternal education, caste, religion, parity, socio-economic status, and rurality.

*p<0.10; **p<0.05; ***p<0.01

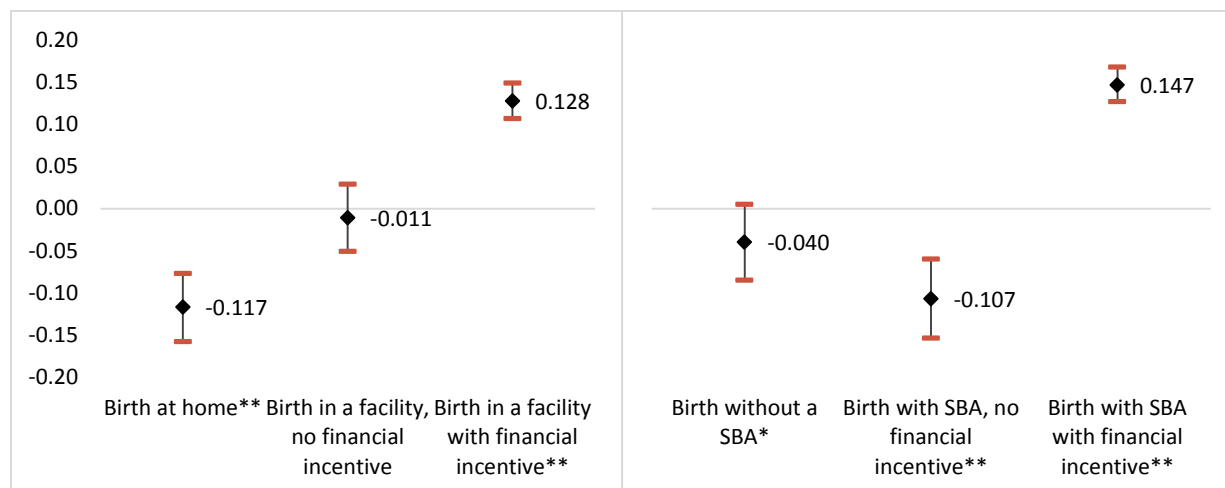


p<0.05; *p<0.01

For each outcome, the point estimates and 95 percent confidence intervals (indicated by the whiskers) correspond to program effect sizes estimated using difference-in-differences models fitted using ordinary least squares regression, controlling for a range of potentially confounding variables.

Model 1: S1 exposure definition (cluster-level intensity of ASHA exposure measured as the number of women who reported exposure to an ASHA in a cluster during the last birth divided by the total number of eligible women who had a birth in 6 years preceding the survey in the cluster); *Model 2:* S1, for clusters >2; *Model 3:* S1, for clusters >3; *Model 4:* S3 exposure definition (Exposure is coded based on individual women's response to whether they received ASHA services- 0 for No, 1 for Yes); *Model 5:* S2 exposure definition (All women in clusters in which at least one woman reports seeing an ASHA received a value of "exposed" (i.e. 1)) ;. All models control for cluster-level fixed effects

Figure 8: Sensitivity analysis for association between exposure to ASHA and utilization of maternity services using a linear probability model



For each outcome, the point estimates and 95 percent confidence intervals (indicated by the whiskers) correspond to program effect sizes estimated using multinomial regression model, adjusted for a range of potentially confounding variables.

Figure 9: Marginal effect of ASHA exposure on the facility deliveries and skilled birth attendance, using a multinomial logistic model

CHAPTER 6: SUMMARY AND CONCLUSIONS

In 2013, an expert consultation on the theme of community health workers (CHWs) in health care, organized by the United Nations Health Agencies (H4+)- (UNAIDS, UNFPA, UNICEF, UN Women, WHO and the World Bank), highlighted the importance of CHW programs in strengthening national health systems and the critical need for identifying evidence-based interventions that CHWs can undertake in the reproductive health space.(113) Identifying what interventions can be effectively delivered by CHWs would further strengthen WHO and partner recommendations on task-sharing/task-shifting. This study addresses this gap by assessing the potential role of CHWs in effectively delivering maternity interventions and identifying the kind of interventions that are most likely to be affected through the engagement of CHWs.

In paper 1, we assess the effect of the ASHA program in India on the number of services utilized by women along the continuum of maternity care. We find that individual women and clusters/communities that had any exposure to ASHA are more likely to initiate care and continue along the maternity continuum, effectively utilizing a greater number of services; however, ASHA exposure did not take them to completion of all the maternity services. When women did not complete the maternity continuum, PNC and ANC-4 were the most frequently missed services. While paper 1 uses cross-sectional data to determine the association between exposure to ASHA and retention in the continuum of maternity care, paper 2 takes this another step forward. In Paper 2, we assess the impact of the ASHA program on individual maternity services using longitudinal data. We find significant increases in the utilization of at least one

antenatal care, skilled birth attendance and facility births attributable to the ASHA program. Furthermore, our analysis suggests that ASHA services are being availed by the most marginalized groups who do not typically use formal health services – younger women, poorer women, and women belonging to the marginalized groups such as OBCs and scheduled castes.

The results of this research have significant programmatic implications for the ASHA program in India, for other countries that are in various stages of deploying similar CHW programs, as well as for donor and advocacy agencies that invest in CHW programs.

PROGRAMMATIC IMPLICATIONS FOR INDIA

In the recent years, several special commissions, including the *Jan Swasthya Abhiyan*, the Independent Commission on Health and Development report, and the Choosing Health report have emphasized the importance of a community-based approach for strengthening comprehensive primary health care as the highest priority of India's health system.(114–116) As part of the National Rural Health Mission, the MoH showed their commitment to strengthening community-based primary health care through the ASHA program – the largest and most ambitious community health worker program with nearly 1 million healthcare workers trained and deployed. However, the ASHA program cannot realize its full potential unless operational processes associated with recruitment, training, incentivizing, retention, and supervision are standardized and streamlined across states.

Our research highlights the importance of the ASHA program for maternal and child health care. Given the demonstrated impact of the ASHA program, it is important to address several shortcomings in the implementation of the ASHA program and strengthen the program further. The ASHA program has been closely monitored and several functional challenges have been identified in the biannual country reports produced by the Ministry of Health and Family Welfare (MoHFW) and the National Health Systems Resource Center.(95,96,104,117–120)

Consistent and timely training of the ASHA, adequate reimbursement for services provided, sustained commitment for financial support towards the program at large, and appropriate quality supervision are some of the key themes that have been highlighted as critical to the optimal functioning of the ASHA program. Successful strategies that address these gaps and that support long-term retention and optimal functioning of the ASHA should be continuously assessed, and success stories shared across state governments.

ASHA are typically seen as a low-cost vehicle to deliver most health and development programs. Given the standing and trust that ASHA typically have in their communities, it is understandable that they are viewed as the quickest means to deploy a variety of community development programs. However, this also places an undue burden on the workload of the ASHA.⁽⁹⁷⁾ While ASHA are effective in supporting and strengthening a number of health services, this may not be the case for all kinds of services. This study provides critical insights on some of the maternity interventions that can be effectively delivered by the ASHA. However, to avoid the risk of overburdening the ASHA, we need to continue to look closely at what kind of programs and specific interventions can be most effectively delivered by ASHA and be strategic in defining their responsibilities. For interventions that do not fall directly within the job description of the ASHA, the possibility of training another cadre of worker should be explored further. This is already being done to some extent with positions such as multi-purpose health worker and *anganwadi* workers; however, their roles are typically not as clearly defined and often overlapping.

POLICY AND PROGRAMMATIC IMPLICATIONS FOR OTHER COUNTRIES

Community health worker programs such as the ASHA program are not a new concept; such programs were implemented by several governments in low and middle income countries following the Alma-Ata Declaration in 1978. However, at scale, these programs did not have the

same success as smaller demonstration trials. Poor quality of care, lack of ongoing training of CHWs, and poor logistical and financial support were identified as some of the key barriers to successful implementation.(49) Over the last decade, CHW programs have experienced a second wave of enthusiasm following the endorsement by the 2008 WHO World Health Report.(57) Apart from India, Afghanistan, Bangladesh, Brazil, Ethiopia, Indonesia, Iran, Pakistan, Rwanda, Zambia are among some of the countries that are currently in the process of planning and implementing national-level CHW programs. Given the demonstrable impact of the ASHA program on the utilization of maternity services in our research, other countries can draw from the unique implementation features of the ASHA program in India.

The ASHA program can be differentiated from prior large-scale CHW programs in the way it has been implemented. First and foremost, the ASHA are seen as a link between the community and the health care system, and are not envisaged in isolation from the broader health system; in fact, a major emphasis of the ASHA program is to develop appropriate management and support structures at the block, district, state and national levels. These support structures have been critical to the training and retention of the ASHA in the program. Second, unlike most prior CHW programs, ASHA are compensated for their time based on their performance. While the performance based financing is still being refined, it has been a key focus of the MoHFW. Lastly, there has been consistent ongoing political commitment to the ASHA program, reflected in the way the program has been responsively financed. Based on regular monitoring reports, additional funding has been allocated, as needed, to strengthen the ASHA support structures at the state, district and block-levels.(97) Each of these strategies have been documented in significant detail, and continuously monitored over the course of the ASHA program.(95,96,117,119) Countries that are in the process of scaling up their CHW

programs would benefit from drawing upon, and adapting these strategies to their specific health context.

Relevance for donor agencies

Historically, the enthusiasm of donor agencies for CHW programs has wavered – these programs take time to develop and the results are often not visible within the short-term of an individual project. The critical importance of CHWs emerged during the recent Ebola crisis in Liberia and Sierra Leone, where in the absence of a well-structured health information system, CHWs played several key roles in educating communities, reporting new suspected Ebola cases and facilitating timely treatment.⁽¹²¹⁾ As a result, a recent report endorsed by the Office of UN Special Envoy for Health, the World Bank, Partners in Health, Last Mile Health, the Clinton Foundation, governments of Ethiopia and Liberia and Johns Hopkins University, made a compelling case for investments in CHWs as a component of primary health care. ⁽¹²²⁾ The results of our study further substantiate the recommendations presented in this report regarding continued and consistent investments by bilateral and multilateral donors in CHW programs. For countries to have strong national CHW programs, coordination of different financing sources, and long-term financial commitments from domestic and international donors is important. Resources should be mobilized to support CHW programs independent of other programs, as well as a key component integrated with other vertical health programs.

Furthermore, CHWs may play a critical role in addressing several objectives under the Sustainable Development Goals (SDGs). The first International Symposium on CHWs emphasized the importance of CHWs in the realization of universal health care and the SDGs. The Symposium resulted in the Kampala Statement which noted the role of CHW in addressing seven SDGs – “SDG 1 (ending poverty), 2 (ending hunger and ensuring food security), 3 (health and wellbeing), 5 (gender equality), 6 (clean water and sanitation), 10 (reduce inequalities), and

17 (partnerships for global health)".(123) In order to tap into the potential contributions of CHWs towards the SDGs, it is vital for donor agencies to support evidence-based decisions on the type of interventions that can be effectively delivered by CHWs. This is already being done to some extent with the recently published WHO OptimizeMNH guidelines for optimizing health worker roles for maternal and newborn health through task shifting. The guideline recommends the interventions that can be safely administered by CHWs, and also identifies a number of interventions where the evidence is inadequate.(124) As we work towards the SDGs, it is important that research to address these gaps in evidence is supported by donor agencies.

FUTURE RESEARCH DIRECTIONS

The above discussion has highlighted three primary areas where future research can aid in strengthening community health worker programs and improving community health outcomes. First, CHWs are often overburdened with a wide array of responsibilities.(125) While they are effective in addressing certain barriers to healthcare utilization, they should not be viewed as a panacea for all health problems at the community-level. Their roles and responsibilities should be thoughtfully guided by evidence on what interventions can be safely and effectively delivered by them. Our study looks at the impact of the ASHA only on the coverage of interventions; future research should be extended to assess and take into account the quality of services delivered by the ASHA as well. Given the acute shortage of health care workers in many low-income settings, the questions around CHW programs need to shift from whether such programs work to what are some specific services that can be safely and effectively provided by well-trained CHWs. The WHO OptimizeMNH guidelines highlight several specific areas where the lack of evidence limits our ability to provide recommendations on services that can be safely delivered by CHWs.(124)

Second, time and again, CHW programs have been implemented at scale without adequate attention to the compensation provided to the CHWs. Lack of appropriate incentives result in poor retention of the CHW and high rates of turnover; this in turn, not only hampers the success of such programs, but is also costlier in terms of the cost to recruit, train and replace the CHW. (68) The ASHA program has experimented with performance based financing to incentivize the ASHA, but the impact of the financing mechanism on the activity and effectiveness of the ASHA needs to be assessed. Financial compensation is only one of the many influences that motivates CHWs to work in their communities.(68) Research studies should be developed to assess the impact of indirect non-material incentives, such as supportive health systems/environments, and other non-material incentives such as social recognition, in addition to financial incentives on the performance of the CHW.

Lastly, our study has highlighted the need to understand the factors that are associated with optimal scaling of CHW programs. As discussed previously, implementation strategies that work on a small scale cannot typically be replicated, as such, at the national level. The decentralized nature of the ASHA program, such that the implementation of the program varies across states, provides an opportunity to conduct more process evaluations to understand the role of other factors that are critical to retention and effectiveness of the ASHA. These may include factors such as opportunities for ongoing training, and mechanisms for providing supportive supervision and management support. Understanding the role of each of these factors in the successful implementation of the ASHA program can be valuable to the ASHA as well as to other CHW programs in determining the best areas for continued investments to support scaling of the program.

**APPENDIX A: DEMOGRAPHIC CHARACTERISTICS OF THE STUDY SAMPLE
IN IHDS-1 (2005) AND IHDS-II (2012) SURVEYS**

	2005		2012	
	Total population		Total population	
	N=11670	%	N= 13,881	%
Maternal Age (yrs)				
15-19	438	3.75%	294	2.12%
20-24	3361	28.80%	3,180	22.91%
25-29	3979	34.10%	5,051	36.39%
30-34	2241	19.20%	3,197	23.03%
35-39	1180	10.11%	1,455	10.48%
>=40	471	4.04%	704	5.07%
Education				
No education	5312	45.52%	4,592	33.08%
1-5 years	1774	15.20%	2,042	14.71%
6-11 years	3287	28.17%	5,101	36.75%
12 years or more	1091	9.35%	2,139	15.41%
Missing	204	1.75%	8	0.06%
Caste				
Forward caste	3012	25.81%	3,512	25.30%
Other backward castes	4953	42.44%	5,919	42.64%
Scheduled Castes	2706	23.19%	3,230	23.27%
Scheduled Tribes	999	8.56%	1,191	8.58%
Missing			29	0.21%
Religion				
Hindu	9413	80.66%	11,152	80.34%
Muslim	1627	13.94%	2,121	15.28%
Others religions	630	5.40%	608	4.38%
States				
Other States	5212	44.66%	6,081	43.81%
High-focus states	6148	52.68%	7,278	52.43%
Northeast states	310	2.66%	522	3.76%
Urban/Rural residence				
Rural	8625	73.91%	9,886	71.22%
Urban	3045	26.09%	3,995	28.78%
Wealth quintile				
Lowest	3475	29.78%	3,766	27.13%
Lower	2688	23.03%	2,918	21.02%
Middle	2248	19.26%	2,553	18.39%
Richer	1791	15.35%	2,440	17.58%
Richest	1467	12.57%	2,204	15.88%

**APPENDIX B: ASSOCIATION BETWEEN CLUSTER-LEVEL EXPOSURE TO ASHA MEASURED AS
“INTENSITY OF EXPOSURE” AND MATERNITY SERVICE UTILIZATION OUTCOMES USING A LINEAR
PROBABILITY MODEL WITH FIXED EFFECTS AT THE CLUSTER LEVEL**

	ANC-1 (N=24,920)			ANC-4 (N=24,560)			SBA (N=24,402)			Facility birth (N=24,501)		
	β (95% CI)		p value	β (95% CI)		p value	β (95% CI)		p value	β (95% CI)		p value
Outcome	0.18	(0.106-0.254)	0.000	0.071	(-0.004-0.046)	0.065	0.281	(0.208-0.354)	0.000	0.263	0.195-0.332)	0.000
Maternal Age (yrs)												
15-19	1			1			1			1		
20-24	-0.014	(-0.061-0.034)	0.571	0.007	(-0.056-0.041)	0.768	0.001	(-0.041-0.043)	0.969	0.015	(-0.032-0.062)	0.528
25-29	-0.000	(-0.048-0.048)	0.993	0.013	(-0.062-0.036)	0.603	-0.020	(-0.060-0.021)	0.340	-0.017	(-0.064-0.031)	0.495
30-34	-0.010	(-0.063-0.044)	0.719	0.008	(-0.060-0.044)	0.767	-0.039	(-0.083-0.004)	0.078	-0.035	(-0.085- 0.015)	0.170
35-39	-0.008	(-0.065-0.048)	0.770	0.005	(-0.050-0.060)	0.857	-0.007	(-0.059-0.044)	0.780	-0.028	(-0.086-0.029)	0.335
>=40	0.000	(-0.071-0.072)	0.994	0.025	(-0.036-0.086)	0.426	-0.044	(-0.106-0.018)	0.163	-0.031	(-0.097-0.036)	0.362
Education	-						-					
No education	1			1			1			1		
1-5 years	0.051	(0.031-0.071)	0.000	0.042	(0.019-0.065)	0.000	0.047	(0.020-0.074)	0.001	0.029	(0.002-0.056)	0.033
6-11 years	0.062	(0.041-0.082)	0.000	0.096	(0.074-0.118)	0.000	0.092	(0.070-0.115)	0.000	0.091	(0.066-0.117)	0.000
12 years or more	0.072	(0.048-0.096)	0.000	0.175	(0.144-0.206)	0.000	0.131	(0.103-0.158)	0.000	0.140	(0.107-0.174)	0.000
Caste	-											
Forward caste	1			1			1			1		
Other backward castes	-0.028	(-0.049--0.008)	0.007	-0.013	(-0.036-0.011)	0.289	-0.013	(-0.035--0.010)	0.267	-0.019	(-0.044-0.005)	0.120
Scheduled Castes	-0.013	(-0.038--0.011)	0.291	-0.036	(-0.063-- 0.009)	0.010	-0.022	(-0.048-0.003)	0.083	-0.031	(-0.061--0.001)	0.046
Scheduled Tribes	-0.041	(-0.080-0.001)	0.042	-0.032	(-0.076-0.011)	0.143	-0.078	(-0.129--0.027)	0.003	-0.075	(-0.123--0.026)	0.003
Religion	-											
Hindu	1			1			1			1		

Muslim	0.009	(-0.023-0.042)	0.582	-0.009	(-0.052-0.033)	0.659	-0.024	(-0.060-0.012)	0.196	-0.065	(-0.010- -0.021)	0.004
Others religions	-0.002	(-0.026-0.023)	0.900	0.026	(-0.026-0.078)	0.326	-0.007	(-0.039-0.024)	0.642	-0.006	(-0.040- 0.029)	0.748
Urban/ Rural residence	-											
Urban	-0.074	(-0.134-0.014)	0.016	-0.055	(-0.191-0.081)	0.426	-0.078	(-0.173-0.016)	0.104	-0.052	(-0.139-0.035)	0.244
Rural	1			1						1		
Wealth quintile												
Lowest	1			1			1			1		
Lower	0.056	(0.030-0.081)	0.000	0.053	(0.028-0.078)	0.000	0.054	(0.028-0.080)	0.000	0.022	(-0.006-0.050)	0.127
Middle	0.088	(0.059-0.116)	0.000	0.090	(0.061-0.119)	0.000	0.099	(0.070-0.128)	0.000	0.075	(0.043-0.108)	0.000
Richer	0.090	(0.061-0.119)	0.000	0.105	(0.072-0.138)	0.000	0.117	(0.087-0.147)	0.000	0.098	(0.064-0.133)	0.000
Richest	0.109	(0.079-0.140)	0.000	0.154	(0.116-0.192)	0.000	0.147	(0.112-0.182)	0.000	0.136	(0.094-0.178)	0.000
Parity	-0.028	(-0.034--0.021)	0.000	-0.019	(-0.025--0.013)	0.000	-0.035	(-0.043--0.027)	0.000	-0.031	(-0.036- -0.026)	0.000

APPENDIX C: ANALYSIS OF HOUSEHOLDS THAT WERE LOST TO FOLLOW UP IN IHDS-II

Table 8: Characteristics of households that were lost to follow up in IHDS-II compared to households that were interviewed in both rounds

	Households lost to follow-up	Households interviewed in both rounds	p-value
	(N=6911)	(N=34,643)	
Avg. Number of individuals in the household	4.24	5.38	0.000
Avg. number of children in the household	1.22	1.73	0.000
Avg. number of married women in the household	1.01	1.26	0.000
Avg. number of married men in the household	1.00	1.21	0.000
Avg. household asset score (0-30)	14.34	11.84	0.000
Caste/religion categories N(%)			0.000
Brahmin	564 (8.16)	1857(5.36)	
Upper Caste	1,459 (21.11)	5,692(16.43)	
Other backward Caste	2,069 (29.94)	11,999(34.64)	
Scheduled Castes	1,081 (15.64)	7,252 (20.93)	
Schedules Tribes	530 (7.67)	2909(8.40)	
Muslims	904 (13.08)	3804(10.98)	
Other religions (Sikhs, Jains, Christians)	304(4.4)	1130 (3.26)	
Rural/Urban N(%)			0.000
Rural	2764 (39.99)	23,970 (69.19)	
Urban	4,147(60.01)	10,673 (30.81)	

Table 9: Study outcomes among eligible women (with a live birth in the five years preceding the interviews) from households that were lost to follow up in IHDS-II compared to women from households that were interviewed in both rounds

	Households lost to follow-up	Households interviewed in both rounds	p-value
Any antenatal care			0.000
Total number	1646	9924	
No ANC	215 (13.06)	2247 (22.64)	
At least one ANC visit	1431 (86.94)	7,677 (77.36)	
Skilled birth attendance			0.000
Total number	1,643	9,994	
Birth by non-medically trained provider	490 (29.82)	4,457 (45.09)	
Birth by medically trained provider	1,153 (70.18)	5,427 (54.91)	
Birth in a health facility			0.000
Total number	1,646	9,965	
Birth at home	580 (35.24)	5,467 (54.86)	
Birth in a health facility	1,061 (64.46)	4,432 (44.48)	

REFERENCES

1. WHO: Department of Health Statistics and Information Systems. State of Inequality Reproductive, maternal, newborn and child health. 2015;1-100.
2. Say L, Raine R. A systematic review of inequalities in the use of maternal health care in developing countries. *Bull World Heal Organ* [Internet]. 2007;85(August 2006):812-9. Available from: http://www-wds.worldbank.org/external/default/WDSPContentServer/WDSP/IB/2006/02/02/000160016_20060202161329/Rendered/PDF/351170Benefit0incidence0practitioner.pdf
3. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller A-B, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. *Lancet Glob Heal* [Internet]. 2014;2(6):e323-33. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S2214109X1470227X>
4. Koblinsky M, Matthews Z, Hussein J, Mavalankar D, Mridha MK, Anwar I, et al. Going to scale with professional skilled care. *Lancet* [Internet]. 2006;368(9544):1377-86. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0140673606693823>
5. Haines A, Sanders D, Lehmann U, Rowe AK, Lawn JE, Jan S, et al. Achieving child survival goals: potential contribution of community health workers. *Lancet*. 2007;369(9579):2121-31.
6. Kumar V, Mohanty S, Kumar A, Misra RP, Santosham M, Awasthi S, et al. Effect of community-based behaviour change management on neonatal mortality in Shivgarh, Uttar Pradesh, India: a cluster-randomised controlled trial. *Lancet (London, England)* [Internet]. 2008 Sep 27 [cited 2016 Mar 10];372(9644):1151-62. Available from: <http://www.sciencedirect.com/science/article/pii/S014067360861483X>
7. Baqui AH, Arifeen SE, Williams EK, Ahmed S, Mannan I, Rahman SM, et al. Effectiveness of home-based management of newborn infections by community health workers in rural Bangladesh. *Pediatr Infect Dis J*. 2009;28(4):304-10.
8. Jokhio AH, Winter HR, Cheng KK. An intervention involving traditional birth attendants and perinatal and maternal mortality in Pakistan. *N Engl J Med* [Internet]. Massachusetts Medical Society; 2005 May 19 [cited 2016 Apr 8];352(20):2091-9. Available from: <http://www.nejm.org/doi/full/10.1056/NEJMsa042830>
9. Bhutta Z, Memon Z. Implementing community-based perinatal care: results from a pilot study in rural Pakistan. *Bull World ...* [Internet]. 2008 [cited 2016 Apr 8]; Available from: <http://www.scielosp.org/pdf/bwho/v86n6/a13v86n6.pdf>
10. WHO. Increasing access to health workers in remote and rural areas through improved retention [Internet]. 2009. Available from: http://www.who.int/hrh/migration/background_paper.pdf
11. Andersen RM. Revisiting the Behavioral Model and Access to Medical Care: Does it Matter? *J Health Soc Behav* [Internet]. 1995 Mar [cited 2016 Jul 27];36(1):1. Available

from: <http://www.jstor.org/stable/2137284?origin=crossref>

12. WHO, UNICEF, UNFPA, World Bank Group, United Nations Population Division. Trends in Maternal Mortality : 1990 to 2015. Organization [Internet]. 2015;32(5):1–55. Available from: http://whqlibdoc.who.int/publications/2010/9789241500265_eng.pdf
13. Ronsmans C, Graham W, The Lancet Maternal Survival Series. Maternal mortality: who, when, where, and why. Lancet [Internet]. Elsevier; 2006 Sep 30;368(9542):1189–200. Available from: <http://www.thelancet.com/article/S014067360669380X/fulltext>
14. Thaddeus S, Maine D. Too far to walk: Maternal mortality in context. Soc Sci Med. 1994;38(8):1091–110.
15. Gabrysch S, Campbell O. Still too far to walk: Literature review of the determinants of delivery service use. BMC Pregnancy Childbirth [Internet]. 2009;9(1):34. Available from: <http://www.biomedcentral.com/1471-2393/9/34>
16. Simkhada B, Teijlingen ER van, Porter M, Simkhada P. Factors affecting the utilization of antenatal care in developing countries: systematic review of the literature. J Adv Nurs. 2008;61(3):244–60.
17. Navaneetham K, Dharmalingam A. Utilization of maternal health care services in Southern India. Soc Sci Med [Internet]. 2002 Nov [cited 2016 Jan 26];55(10):1849–69. Available from: <http://www.sciencedirect.com/science/article/pii/S0277953601003136>
18. Filippi V, Ronsmans C, Campbell OM, Graham WJ, Mills A, Borghi J, et al. Maternal health in poor countries: the broader context and a call for action. Lancet [Internet]. 2006;368(9546):1535–41. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0140673606693847>
19. Borghi J, Ensor T, Somanathan A, Lissner C, Mills A. Mobilising financial resources for maternal health. Lancet [Internet]. 2006;368(9545):1457–65. Available from: <http://www.sciencedirect.com/science/article/pii/S0140673606693835>
20. WHO. Strategies toward ending preventable maternal mortality (EPMM). 2015;6736(2013):1–4.
21. Villar J, Ba'aqeel H, Piaggio G, Lumbiganon P, Belizán JM, Farnot U, et al. WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. Lancet. 2001;357(9268):1551–64.
22. Carroli G, Villar J, Piaggio G, Khan-Neelofur D, Gülmezoglu M, Mugford M, et al. WHO systematic review of randomised controlled trials of routine antenatal care. Lancet [Internet]. 2001;357(9268):1565–70. Available from: <http://www.thelancet.com/article/S0140673600047231/fulltext>
23. Abou-Zahr I, Lidia C, Wardlaw Tessa M. Antenatal Care in Developing Countries Promises, achievements and missed opportunities. 2003;1–36. Available from:

- http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/9241590947/en/
24. Lincetto O, Mothebesoane-anoh S, Gomez P, Munjanja S. Opportunities for Africa's Newborns: Antenatal Care. WHO. 2013.
 25. World Health Organization. Provision of effective antenatal care. 2006; Available from: http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/effective_antenatal_care.pdf
 26. Beeckman K, Louckx F, Masuy-Stroobant G, Downe S, Putman K. The development and application of a new tool to assess the adequacy of the content and timing of antenatal care. BMC Health Serv Res [Internet]. BioMed Central Ltd; 2011;11(1):213. Available from: <http://www.biomedcentral.com/1472-6963/11/213>
 27. Barros H, Tavares M, Rodrigues T. Role of prenatal care in preterm birth and low birthweight in Portugal. J Public Health Med [Internet]. 1996;18(3):321-8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/8887844>
 28. Campbell OM, Graham WJ. Strategies for reducing maternal mortality: getting on with what works. Lancet [Internet]. 2006;368(9543):1284-99. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0140673606693811>
 29. Kyei NNA, Chansa C, Gabrysch S. Quality of antenatal care in Zambia : a national assessment. BMC Pregnancy Childbirth [Internet]. BMC Pregnancy and Childbirth; 2012;12(1):1. Available from: BMC Pregnancy and Childbirth
 30. Acharya LB, Cleland J. Maternal and child health services in rural Nepal: does access or quality matter more? Health Policy Plan. 2000;15(2):223-9.
 31. Oladapo OT, Iyaniwura C a, Sule-Odu AO. Quality of antenatal services at the primary care level in southwest Nigeria. Afr J Reprod Health. 2008;12(3):71-92.
 32. Sarker M, Schmid G, Larsson E, Kirenga S, De Allegri M, Neuhaan F, et al. Quality of antenatal care in rural southern Tanzania: a reality check. BMC Res Notes. 2010;3:209.
 33. International Institute for Population Sciences (IIPS), Macro International. National Family Health Survey (NFHS-3), 2005-2006- India: Key Findings. Mumbai, India;
 34. National Institute of Population Research and Training, Mitra and Associates, ICF International. Bangladesh Demographic and Health Survey 2014: Key Indicators. Dhaka, Bangladesh; Rockville, Maryland; 2014.
 35. Graham WJ, Jacqueline SB, Bullough CH. "Can skilled attendance at delivery reduce maternal mortality in developing countries." Safe motherhood strategies: a review of the evidence. 2001.
 36. Lawn JE, Cousens S, Zupan J. 4 million neonatal deaths: when? Where? Why? Lancet.

2005;365(9462):891–900.

37. Stanton C, Blanc AK, Croft T, Choi Y. Skilled Care At Birth in the Developing World: Progress To Date and Strategies for Expanding Coverage. *J Biosoc Sci* [Internet]. 2007;39(01):109. Available from: http://www.journals.cambridge.org/abstract_S0021932006001271
38. World Health Organization department of reproductive health and research. Making pregnancy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO. Geneva, Switz WHO [Internet]. 2004;1–18. Available from: <http://whqlibdoc.who.int/publications/2004/9241591692.pdf>
39. Koblinsky M a., Campbell O, Heichelheim J. Organizing delivery care: What works for safe motherhood? *Bull World Health Organ*. 1999;77(5):399–406.
40. Harvey SA, Blandón YCW, McCaw-Binns A, Sandino I, Urbina L, Rodríguez C, et al. Are skilled birth attendants really skilled? A measurement method, some disturbing results and a potential way forward. *Bull World Health Organ* [Internet]. World Health Organization; [cited 2016 Jan 26];85(10):783–90. Available from: http://www.scielo.org/scielo.php?script=sci_arttext&pid=S0042-96862007001000015&lng=en&nrm=iso&tlng=en
41. Pathak PK, Singh A, Subramanian S V. Economic inequalities in maternal health care: prenatal care and skilled birth attendance in India, 1992-2006. *PLoS One* [Internet]. Public Library of Science; 2010 Jan 27 [cited 2016 Jan 9];5(10):e13593. Available from: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0013593>
42. Anwar I, Sami M, Akhtar N, Chowdhury ME, Salma U, Rahman M, et al. Inequity in maternal health-care services: Evidence from home-based skilled-birth-attendant programmes in Bangladesh. *Bull World Health Organ*. 2008;86(4):252–9.
43. WHO. Postnatal care of the mother and newborn 2013 [Internet]. World Health Organization. 2013. Available from: http://apps.who.int/iris/bitstream/10665/97603/1/9789241506649_eng.pdf
44. USAID. Postnatal Care for Mothers and Newborns Highlights from the World Health Organization 2013 Guidelines. 2015.
45. Warren C, Daly P, Toure L, Mongi P. Postnatal care. *Oppor Africa's Newborns* [Internet]. (Imci):1–12. Available from: http://www.who.int/pmnch/media/publications/aonsectionIII_4.pdf
46. Wang W, Alva S, Wang S, Fort A. Levels and Trends in the Use of Maternal Health Services in Developing Countries. DHS Comparative Reports No. 26. Calverton, Maryland, USA: ICF Macro. DHS Comp Reports No 26 Calverton, Maryland, USA ICF Macro. 2011;(June).
47. Syed U, Khadka N, Khan A, Wall S. Care-seeking practices in South Asia: using

- formative research to design program interventions to save newborn lives. *J Perinatol* [Internet]. Nature Publishing Group; 2008 Dec [cited 2016 Jan 26];28 Suppl 2(S2):S9–13. Available from: <http://dx.doi.org/10.1038/jp.2008.165>
48. WHO. A Summary of the 2008 World Health Report “ Primary Health Care : Now More Than Ever .” World Heal Rep 2008. 2008;2008.
 49. Christopher JB, Le May A, Lewin S, Ross D a. Thirty years after Alma-Ata: a systematic review of the impact of community health workers delivering curative interventions against malaria, pneumonia and diarrhoea on child mortality and morbidity in sub-Saharan Africa. *Hum Resour Health* [Internet]. BioMed Central Ltd; 2011;9(1):27. Available from: <http://www.human-resources-health.com/content/9/1/27>
 50. UNAIDS, UNFPA, UNICEF, UN Women, WHO, World Bank. Technical brief by the H4+ (UNAIDS, UNFPA, UNICEF, UN Women, WHO and the World Bank). 2015.
 51. Lawn JE, Lawn JE, Rohde J, Rohde J, Rifk S, Rifk S, et al. Series Alma-Ata: Rebirth and Revision 1 Alma-Ata 30 years on: revolutionary, relevant, and time to revitalise. *Lancet, The*. 1978;917–27.
 52. Bang AT, Bang RA, Baitule SB, Reddy MH, Deshmukh MD. Effect of home-based neonatal care and management of sepsis on neonatal mortality: field trial in rural India. *Lancet (London, England)* [Internet]. 1999 Dec 4 [cited 2016 Apr 6];354(9194):1955–61. Available from: <http://www.sciencedirect.com/science/article/pii/S0140673699030469>
 53. Chowdhury AM, Chowdhury S, Islam MN, Islam A, Vaughan JP. Control of tuberculosis by community health workers in Bangladesh. *Lancet (London, England)* [Internet]. 1997 Jul 19 [cited 2016 Apr 6];350(9072):169–72. Available from: <http://www.sciencedirect.com/science/article/pii/S0140673696113118>
 54. Gilson L, Walt G, Heggenhougen K, Owuor-Omondi L, Perera M, Ross D, et al. National community health worker programs: How can they be strengthened? *J Public Health Policy*. 1989;10(4):518–32.
 55. Frankel S. The community health worker: effective programmes for developing countries. Oxford University Press; 1992.
 56. Rosato M, Laverack G, Grabman LH, Tripathy P, Nair N, Mwansambo C, et al. Community participation: lessons for maternal, newborn, and child health. *Lancet* [Internet]. 2008;372(9642):962–71. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18790319> \n http://journals.ohiolink.edu/ejc/pdf.cgi/Rosato_Mikey.pdf?issn=01406736&issue=v372i9642&article=962_cplfmnach
 57. World Health Organization. Primary health Care - Now more than ever. [Internet]. The World Health Report. 2008. Available from: http://www.who.int/whr/2008/whr08_en.pdf
 58. World Health Organization. World Health Report [Internet]. WHO. 2006. Available from:

http://www.who.int/whr/2006/whr06_en.pdf

59. Walley J, Lawn JE, Tinker A, de Francisco A, Chopra M, Rudan I, et al. Primary health care: making Alma-Ata a reality. *Lancet* (London, England). 2008;372(9642):1001–7.
60. Kerber KJ, de Graft-Johnson JE, Bhutta ZA, Okong P, Starrs A, Lawn JE. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. *Lancet*. 2007;370(9595):1358–69.
61. Bhutta ZA, Ali S, Cousens S, Ali TM, Haider BA, Rizvi A, et al. Interventions to address maternal, newborn, and child survival: what difference can integrated primary health care strategies make? *Lancet*. 2008;372(9642):972–89.
62. Jokhio AH, Winter HR, Cheng KK. An Intervention Involving Traditional Birth Attendants and Perinatal and Maternal Mortality in Pakistan. *N Engl J Med* [Internet]. 2005;352(20):2091–9. Available from: <http://www.nejm.org/doi/abs/10.1056/NEJMsa042830>
63. Manandhar DS, Osrin D, Shrestha BP, Mesko N, Morrison J, Tumbahangphe KM, et al. Effect of a participatory intervention with women's groups on birth outcomes in Nepal: cluster-randomised controlled trial. *Lancet* (London, England) [Internet]. 2004 Jan [cited 2016 Apr 8];364(9438):970–9. Available from: <http://www.sciencedirect.com/science/article/pii/S0140673604170219>
64. Lewin S, Munabi-Babigumira S, Glenton C, Daniels K, Bosch-Capblanch X, van Wyk BE, et al. Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases. *Cochrane Database Syst Rev* [Internet]. 2010;3(3):CD004015. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=20238326
65. Lewin SA, Dick J, Pond P, Zwarenstein M, Aja G, van Wyk B, et al. Lay health workers in primary and community health care. *Cochrane database Syst Rev* [Internet]. 2005 [cited 2016 Jul 19];(1):CD004015. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15674924>
66. Rowe AK, De Savigny D, Lanata CF, Victora CG. How can we achieve and maintain high-quality performance of health workers in low-resource settings? *Lancet*. 2005;366(9490):1026–35.
67. Arifeen SE, Bryce J, Gouws E, Baqui a. H, Black RE, Hoque DME, et al. Quality of care for under-fives in first-level health facilities in one district of Bangladesh. *Bull World Health Organ*. 2005;83(4):260–7.
68. Perry H, Crigler L, Hodgins S, Advisor T. Developing and Strengthening Community Health Worker Programs at Scale A Reference Guide and Case Studies for Program Managers and.

69. Unicef. What Works for Children in South Asia: Community Health Workers. 2004.
70. de Bernis L, Kinney M V, Stones W, ten Hoope-Bender P, Vivio D, Leisher SH, et al. Stillbirths: ending preventable deaths by 2030. *Lancet*. 2016;387(10019):703–16.
71. Lawn JE, Blencowe H, Waiswa P, Amouzou A, Mathers C, Hogan D, et al. Stillbirths: rates, risk factors, and acceleration towards 2030. *Lancet*. 2016;387(10018):587–603.
72. Koblinsky M, Moyer CA, Calvert C, Campbell J, Campbell OMR, Feigl AB, et al. Maternal Health 6 Quality maternity care for every woman , everywhere : a call to action. *Lancet* [Internet]. Elsevier Ltd; 2016;388(10057):2307–20. Available from: [http://dx.doi.org/10.1016/S0140-6736\(16\)31333-2](http://dx.doi.org/10.1016/S0140-6736(16)31333-2)
73. Frøen JF, Friberg IK, Lawn JE, Bhutta ZA, Pattinson RC, Allanson ER, et al. Stillbirths: progress and unfinished business. *Lancet*. 2016;387(10018):574–86.
74. Wang W, Hong R. Levels and determinants of continuum of care for maternal and newborn health in Cambodia-evidence from a population-based survey. *BMC Pregnancy Childbirth*. 2015;15:62.
75. Singh K, Story WT, Moran AC. Assessing the Continuum of Care Pathway for Maternal Health in South Asia and Sub-Saharan Africa. *Matern Child Health J* [Internet]. Springer US; 2015; Available from: "<http://dx.doi.org/10.1007/s10995-015-1827-6>
76. Stanton C, Blanc AK, Croft T, Choi Y. Skilled care at birth in the developing world: progress to date and strategies for expanding coverage. *J Biosoc Sci* [Internet]. Cambridge University Press; 2007 Jan [cited 2016 Jan 12];39(1):109–20. Available from: http://journals.cambridge.org/abstract_S0021932006001271
77. Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L. Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet*. 2005;365(9463):977–88.
78. Yeji F, Shibanuma A, Oduro A, Debpuur C, Kikuchi K, Owusu-Agei S, et al. Continuum of Care in a Maternal, Newborn and Child Health Program in Ghana: Low Completion Rate and Multiple Obstacle Factors. *PLoS One* [Internet]. Public Library of Science; 2015 Jan 9 [cited 2015 Dec 15];10(12):e0142849. Available from: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0142849>
79. Bhutta Z a, Darmstadt GL, Hasan BS, Haws R a. Community-based interventions for improving perinatal and neonatal health outcomes in developing countries: a review of the evidence. *Pediatrics*. 2005;115(2 Suppl):519–617.
80. Perry HB, Zulliger R, Rogers MM. Community Health Workers in Low-, Middle-, and High-Income Countries: An Overview of Their History, Recent Evolution, and Current Effectiveness. *Annu Rev Public Heal*. 2014;35:399–421.
81. Perry H ZR. How effective are community health workers? [Internet]. 2013. Available

- from:
http://www.coregroup.org/storage/Program_Learning/Community_Health_Workers/review_of_chw_effectiveness_for_mdgs-sept2012.pdf
82. Bajpai N, Dholakia R. Improving the Performance of Accredited Social Health Activist in India. 2011.
 83. Desai S, Vanneman R. India Human Development Survey-II (IHDS-II) 2011-12 User Guide. New Delhi, India; Ann Arbor, MI, USA; 2015.
 84. Department of Reproductive Health and Research. Proportion of births attended by a skilled health worker 2008 updates [Internet]. 2008 [cited 2016 Dec 15]. Available from: http://apps.who.int/iris/bitstream/10665/69950/1/WHO_RHR_08.22_eng.pdf
 85. Williams R. Using the margins command to estimate and interpret adjusted predictions and marginal effects. *Stata J*. 2012;12(2):308–31.
 86. Kolenikov S, Angeles G. Socioeconomic status measurement with discrete proxy variables: Is principal component analysis a reliable answer? *Rev Income Wealth* [Internet]. 2009;55(1):128–65. Available from: <https://uncch.pure.elsevier.com/en/publications/socioeconomic-status-measurement-with-discrete-proxy-variables-is>
 87. Lincetto O, Mothebesoane-Anoh S, Gomez P, Munjanja S. Antenatal care. In: Lawn J, Save the Children, Kerber K, editors. Opportunities for Africa’s Newborns [Internet]. World Health Organization; 2006. p. 51–62. Available from: <http://www.who.int/pmnch/media/publications/africannewborns/en/>
 88. Martin LR, Williams SL, Haskard KB, Dimatteo MR. The challenge of patient adherence. *Ther Clin Risk Manag* [Internet]. Dove Press; 2005 Sep [cited 2017 Feb 24];1(3):189–99. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18360559>
 89. World Health Organization, UNICEF. Home visits for the newborn child: a strategy to improve survival [Internet]. Geneva, Switzerland; 2009. Available from: http://apps.who.int/iris/bitstream/10665/70002/1/WHO_FCH_CAH_09.02_eng.pdf
 90. Miller S, Abalos E, Chamillard M, Ciapponi A, Colaci D, Comandé D, et al. Maternal Health 2 Beyond too little , too late and too much , too soon : a pathway towards evidence-based , respectful maternity care worldwide. *Lancet*. 2016;388:2176–92.
 91. Campbell OMR, Calvert C, Testa A, Strehlow M, Benova L, Keyes E, et al. Maternal Health 3 The scale , scope , coverage , and capability of childbirth care. *Lancet* [Internet]. Elsevier Ltd; 2016;388(10056):2193–208. Available from: [http://dx.doi.org/10.1016/S0140-6736\(16\)31528-8](http://dx.doi.org/10.1016/S0140-6736(16)31528-8)
 92. UNDP. Eight Goals for 2015 [Internet]. 2015 [cited 2016 Nov 20]. Available from: <http://www.in.undp.org/content/india/en/home/post-2015/mdgoverview.html>

93. National Rural Health Mission. Achievement of Key Maternal Health Performance Indicators [Internet]. India; 2016 [cited 2016 Nov 20]. Available from: <http://nrhm.gov.in/nrhm-components/rmnch-a/maternal-health/background.html>
94. Bajpai N, Dholakia RH. Improving the Performance of Accredited Social Health Activist in India [Internet]. Mumbai, India; 2011. Available from: http://globalcenters.columbia.edu/files/cgc/pictures/Improving_the_Performance_of_ASHAs_in_India_CGCSA_Working_Paper_1.pdf
95. Ministry of Health and Family Welfare. Update on ASHA Programme- July 2013 [Internet]. New Delhi; 2013. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
96. Ministry of Health and Family Welfare. Update on the ASHA Programme- January 2015 [Internet]. New Delhi; 2015. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
97. National Rural Health Mission. ASHA- Which way forward? Evaluation of the ASHA programme [Internet]. New Delhi; 2011. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
98. Government of India Planning Commission. Report of the Working Group on National Rural Health Mission for the Twelfth Five Year Plan (2012-2017) [Internet]. 2011. Available from: http://planningcommission.nic.in/aboutus/committee/wrkgrp12/health/WG_1NRHM.pdf
99. National Rural Health Mission. All India Health Status-Executive Summary [Internet]. [cited 2016 Dec 20]. Available from: <http://nrhm.gov.in/images/pdf/mis-report/Dec-2015/1-NRHM.pdf>
100. National Rural Health Mission (2005-2012) [Internet]. 2005. Available from: http://www.nird.org.in/brgf/doc/RuralHealthMission_Document.pdf
101. National Rural Health Mission. Guidelines on Accredited Social Health Activists (ASHA) [Internet]. New Delhi, India; Available from: <http://nrhm.gov.in/images/pdf/communitisation/task-group-reports/guidelines-on-asha.pdf>
102. Wang H, Juyal R, Miner S, Fischer E. Performance-based payment system for the ASHAs in India: What does International experience tell us? [Internet]. 2012. Available from: <http://www.intrahealth.org/files/media/performance-based-payment-system-for-ashas-in-india-what-does-international-experience-tell-us-technical-report/PerformanceBasedPaymentSystemASHAsIndiaReport.pdf>

103. Sundararaman T, Gupta G. Indian approaches to retaining skilled health workers in rural areas. Bull World Heal [Internet]. 2011 [cited 2016 Jul 6]; Available from: <http://www.scielosp.org/pdf/bwho/v89n1/v89n1a16.pdf>
104. Ministry of Health and Family Welfare. Update on the ASHA Programme- July 2015 [Internet]. New Delhi; 2015. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSR_C_Contribution/index.php?option=com_content&view=article&id=286
105. Fathima FN, Raju M, Varadharajan KS, Krishnamurthy A, Ananthkumar SR, Mony PK. Assessment of “accredited social health activists”-a national community health volunteer scheme in Karnataka State, India. J Health Popul Nutr [Internet]. BioMed Central; 2015 Mar [cited 2016 Dec 24];33(1):137–45. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25995730>
106. Gopalan SS, Mohanty S, Das A. Assessing community health workers’ performance motivation: a mixed-methods approach on India’s Accredited Social Health Activists (ASHA) programme. BMJ Open [Internet]. 2012 Jan 1 [cited 2016 Apr 15];2(5). Available from: <http://bmjopen.bmj.com/content/2/5/e001557.abstract>
107. Desai S, Vanneman R. Indian Human DEvelopment Survey (IHDS) 2005. Maryland, USA; New Delhi, India; 2008.
108. Agresti A. An introduction to categorical data analysis [Internet]. 1996 [cited 2016 Jul 6]. Available from: http://vgloop.net/_files/1424628104-46266.pdf
109. Gertler P, Martinez S, Premand P. Impact evaluation in practice [Internet]. 2011 [cited 2016 May 29]. Available from: <https://books.google.com/books?hl=en&lr=&id=XaN7kobaJtcC&oi=fnd&pg=PR5&dq=gertler+impact+evaluation+in+practice&ots=dB4EdZAYm-&sig=-JgdCbT-N391yTtDdKHVAYO8kag>
110. Paul VK, Sachdev HS, Mavalankar D, Ramachandran P, Sankar MJ, Bhandari N, et al. Reproductive health, and child health and nutrition in India: meeting the challenge. Lancet (London, England) [Internet]. Europe PMC Funders; 2011 Jan 22 [cited 2016 May 20];377(9762):332–49. Available from: [/pmc/articles/PMC3341742/?report=abstract](http://pmc/articles/PMC3341742/?report=abstract)
111. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva; 2016.
112. National Health Mission. Common Review Mission Report. New Delhi, India; 2015.
113. World Health Organization, United Nations Population Fund (UNFPA). Strengthening the capacity of community health workers to deliver care for sexual, reproductive, maternal, newbornm child and adoelscent health [Internet]. Geneva, Switzerland; 2015. Available from: http://apps.who.int/iris/bitstream/10665/174112/1/WHO_FWC_MCA_15.04_eng.pdf

114. Reddy KS, Patel V, Jha P, Paul VK, Kumar AS, Dandona L. Towards achievement of universal health care in India by 2020: a call to action. *Lancet* [Internet]. 2011 Feb [cited 2017 Mar 7];377(9767):760–8. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0140673610619605>
115. Bajpai N, Sachs JD, Dholakia RH. Improving access, service delivery, and efficiency of the public health system in rural India [Internet]. New York, USA; 2009. Available from: <http://csd.columbia.edu/files/2016/10/Improving-the-Public-Health-System-in-rural-India.pdf>
116. Jha P, Laxminarayan R. Choosing Health: An entitlement for all Indians [Internet]. Toronto, Canada; 2009. Available from: <http://www.cghr.org/wordpress/wp-content/uploads/2011/06/Choosing-Health-report-FINAL.pdf>
117. Ministry of Health and Family Welfare. Update on ASHA Program June 2010 [Internet]. New Delhi; 2010. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
118. Ministry of Health and Family Welfare. Update on the ASHA Programme- July 2014 [Internet]. New Delhi; 2014. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
119. Ministry of Health and Family Welfare. Update on the ASHA Programme- January 2013 [Internet]. New Delhi; 2013. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
120. Ministry of Health and Family Welfare. Update on the ASHA Programme- January 2014 [Internet]. New Delhi; 2014. Available from: http://nhsrcindia.org/pdf_files/resources_thematic/Community_Participation/NHSRC_Contribution/index.php?option=com_content&view=article&id=286
121. Perry HB, Dhillon RS, Liu A, Chitnis K, Panjabi R, Palazuelos D, et al. Community health worker programmes after the 2013–2016 Ebola outbreak. *Bull World Health Organ* [Internet]. 2016 Jul 1 [cited 2017 Mar 16];94(7):551–3. Available from: <http://www.who.int/entity/bulletin/volumes/94/7/15-164020.pdf>
122. World Health Organization. Strengthening Primary health Care through Community Health Workers: Investment Case and Financing Recommendations [Internet]. Available from: <http://www.who.int/hrh/news/2015/CHW-Financing-FINAL-July-15-2015.pdf>
123. Kampala Statement from the 1st International Symposium on Community Health Workers. 2017.
124. World Health Organization. WHO recommendations: Optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting.

Geneva, Switzerland; 2012.

125. The Earth Institute. One Million Community Health Workers - Technical Task Force Report [Internet]. The Earth Institute Columbia University; 2014. Available from: http://1millionhealthworkers.org/files/2013/01/1mCHW_TechnicalTaskForceReport.pdf
126. Agresti A, Kateri M. Categorical Data Analysis. International Encyclopedia of Statistical Science [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2011 [cited 2017 Jan 31]. p. 206–8. Available from: http://link.springer.com/10.1007/978-3-642-04898-2_161
127. Williams R. GOLOGIT2: Stata module to estimate generalized logistic regression models for ordinal dependent variables. Stat Softw Components. Boston College Department of Economics; 2016;