Doctoral thesis for the degree of Doctor of Philosophy (PhD) in Medical Science

SKILLED BIRTH ATTENDANT SERVICES IN NEPAL

Overcoming barriers to utilization

Bishnu Prasad Choulagai

Institute of Medicine

Sahlgrenska Academy at University of Gothenburg

UNIVERSITY OF GOTHENBURG

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Bishnu Prasad Choulagai

Institute of Medicine, Sahlgrenska Academy at University of Gothenburg, Gothenburg, Sweden

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Email: bishnu.p.choulagai@gu.se
bishnuc@gmail.com

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“The greatest challenge to any thinker is stating the problem in a way that will allow a solution”

Bertrand Arthur William Russell

ABSTRACT

Background

Skilled birth attendants (SBAs) provide important services that improve maternal and newborn health and reduce maternal and newborn mortality. Utilization and coverage of SBA services reveal wide disparities between the rural and urban areas of Nepal.

Aims

This thesis aimed to identify the barriers to SBA service utilization in Nepal and develop and test a community intervention to address those barriers and increase service utilization.

Methods

Mixed-methods research was applied to identify barriers to SBA service utilization, followed by an intervention to address those barriers. Status of SBA service utilization and associated factors were investigated using cross-sectional surveys in rural settings of mid- and far-western Nepal and in an urban setting in the Jhaukhel-Duwakot Health Demographic Surveillance Site, Bhaktapur, Nepal. The qualitative study explored perceptions of service users and providers regarding barriers to SBA service utilization and suggestions to overcome those barriers. After identifying such barriers, we designed, implemented, and evaluated a five-component community intervention. The intervention was designed as a cluster-randomized controlled trial involving 36 Village Development Committees.

Results

Cross-sectional surveys showed that the utilization of SBA services at delivery was 48% in mid- and far-western Nepal and 93.1% in the JD-HDSS. Distance to a health facility and inadequate transport were major barriers to SBA service utilization. Similarly, inadequate knowledge of women and their families regarding the importance of SBA services and low prioritization of birth care hindered such utilization. Women's knowledge of danger signs of pregnancy and delivery and their educational attainment were determining factors in SBA service utilization. Women who had completed at least four antenatal care (ANC) visits were more likely to use skilled birth care. Our one-year intervention was associated with increased use of skilled birth care services (OR=1.57; CI: 1.19–2.08). However, there was no significant association of the intervention with the use of ANC services.

Conclusions

There is an urgent need to increase the utilization of SBA services in rural areas of Nepal and address the rural–urban gap in such utilization. An effective intervention for increasing SBA utilization includes mobilizing active community groups, improving service quality and physical infrastructure at health facilities, providing adequate SBAs at health facilities, and implementing longer-term and repeated interventions. Community mobilization efforts are effective, but such efforts require supervision and support to ensure quality of the implementation.

Keywords

Maternal health, newborn health, skilled birth attendant, implementation research, health services research, mixed-methods research, cluster-randomized controlled trial, evaluation, Nepal

SAMMANFATTNING PÅ SVENSKA

Bakgrund

Skilled birth attendants (SBAs) innebär kompetent professionell närvaro vid barnafödande av t ex barnmorska, läkare, sjuksköterska eller annan person som utbildats och tränats i hanteringen av okomplicerade graviditeter, födslar och den efterföljande postnatala perioden och även i att identifiera och hänvisa komplicerade fall vidare. Dessa SBA bidrar därmed genom sitt professionella stöd till att både förbättra hälsan och minska mortaliteten hos mödrar och nyfödda. Trots att användningen av SBA-tjänster ökat globalt, sker fortfarande många födslar i framförallt låginkomstländer utan professionell närvaro. I Nepal varierar användningen och tillgängligheten av SBA-tjänster mellan urban och rural miljö.

Syfte

Denna avhandling identifierade hinder för att använda SBA-tjänster i Nepal. Vidare utvecklades och testades en samhällsbaserad intervention som fokuserade på dessa hinder för att därmed försöka bidra till ökat användande av SBA-tjänster.

Metod

I denna avhandling användes mixed-method metodik (blandad kvalitativ och kvantitativ metod) för att identifiera hinder för att använda SBA-tjänster och utveckla en intervention som fokuserade på dessa hinder. Med hjälp av deskriptiva tvärsnittsstudier undersöktes användning av SBA-tjänster och associerade faktorer i rurala miljöer i mellan och västra Nepal samt i en urban miljö i Jhaukhel-Duwakot Health Demographic Surveillance Site (JD-HDSS) i distriktet Bhaktapur. Den kvalitativa studien utforskade hur vårdmottagare

och vårdgivare upplevde hinder för att använda SBA-tjänster samt hur dessa skulle kunna reduceras. Efter att dessa hinder identifierats, utvecklades en intervention med fem komponenter som därefter implementerades och utvärderades. Interventionen designades som en kluster randomiserad kontrollerad studie i 36 village development committees (motsvarande bydistrikt).

Resultat

Tvärsnittsstudierna visade att användandet av SBA-tjänster i samband med förlossning var 48,0% i mellersta och västra Nepal och 93,1% i JD-HDSS. Hinder för att använda dessa tjänster var bl a avståndet till vårdinrättningen samt otillräckliga transportmöjligheter. Ytterligare hinder var begränsad kunskap om betydelsen av SBA-tjänster hos både kvinnor och deras familjer samt att förlossningsvård var lågt prioriterat. Kvinnors kunskap om varningssignaler i samband graviditet och förlossning och deras utbildningsnivå var faktorer som bidrog till användningsgraden av SBA-tjänster. Kvinnor som hade fyra antenatalbesök var mer benägna att söka SBA-tjänster. Den ettåriga interventionen ledde till ett ökat användande av SBA tjänster (OR = 1,57; CI: 1,19 – 2,08), dock fanns ingen statistiskt signifikant koppling mellan interventionen och hur mycket antenatalvård kvinnorna fick.

Konklusion

Det finns ett akut behov att öka användandet av SBA-tjänster i rural miljö i Nepal och att överbrygga det gap som idag finns mellan urban och rural miljö när det gäller sådan användning. En effektiv intervention för att öka både tillgänglighet och användning av SBA-tjänster inkluderar bl a att mobilisera olika grupper i samhället, att öka kvalitén på tjänster som erbjuds samt i den

fysiska infrastrukturen där vård sker, att göra SBA tillgängliga vid vårdinrättningarna och att implementera längre och upprepade interventioner. Att mobilisera befolkningen på samhällsnivå för detta ändamål är ett effektivt sätt att uppnå goda resultat, men sådana insatser kräver stöd och monitorering för att kvalitén i insatserna för att uppnå ökad användning av SBA-tjänster skall kunna bibehållas.

LIST OF PAPERS

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

Paper I

Choulagai B, Onta S, Subedi N, Mehata S, Bhandari GP, Poudyal A, Shrestha B, Mathai M, Petzold M, Krettek A.
Barriers to using skilled birth attendants' services in mid- and far-western Nepal: a cross-sectional study
BMC International Health and Human Rights 2013; 13:49.

Paper II

Onta S*, **Choulagai B***, Shrestha B, Subedi N, Bhandari GP, Krettek A.
Perceptions of users and providers on barriers to utilizing skilled birth care in mid- and far-western Nepal: a qualitative study (*Shared first authorship)
Global Health Action 2014; 7:24580.

Paper III

Choulagai BP, Aryal UR, Shrestha B, Vaidya A, Onta S, Petzold M, Krettek A.
Jhaukhel-Duwakot Health Demographic Surveillance Site, Nepal: 2012 follow-up survey and use of skilled birth attendants
Global Health Action 2015; 8:29396.

Paper IV

Choulagai BP, Onta S, Subedi N, Bhatta DN, Shrestha B, Petzold M, Krettek A.
A cluster-randomized evaluation of an intervention to increase skilled birth attendant utilization in mid- and far-western Nepal
Health Policy and Planning 2017; in press.

ABBREVIATIONS

ANC	Antenatal care
ANM	Auxiliary nurse midwife
DiD	Difference-in-differences
FCHV	Female community health volunteer
FGD	Focus group discussion
HFOMC	Health facility operation and management committee
JD-HDSS	Jhaukhel-Duwakot Health Demographic Surveillance Site
MDG	Millennium development goal
PNC	Postnatal care
RCT	Randomized controlled trial
SBA	Skilled birth attendants
SDG	Sustainable development goal
SPSS	Statistical package for social sciences
VDC	Village development committee
WHO	World Health Organization

CONTENTS

BACKGROUND

Safe motherhood

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period [1]. Although motherhood is often a positive and fulfilling experience, for many women it is associated with suffering, ill health, and even death [1]. Safe motherhood begins before conception, with good nutrition and a healthy lifestyle, and continues with proper antenatal care (ANC) and treating any problems that arise [2]. Pregnancy and childbirth can greatly affect the physical, mental, emotional, and socioeconomic health of women and their families [2].

Maternal death describes women who die while pregnant or within 42 days of the termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from incidental or accidental causes. Maternal deaths and disabilities are leading contributors to the burden of disease among women [3]. Globally, major pregnancy-related complications leading to maternal death are hemorrhage (27.1%), hypertension (14%), sepsis (10.7%), abortion (7.9%), and embolism (3.2%) [4].

Unequal burden of maternal and newborn morbidity and mortality

Maternal conditions are the second leading cause of death among women of reproductive age. Worldwide, 303,000 women die every year due to complications of pregnancy and childbirth [5]. Most maternal deaths (99.7%) occur in developing regions, where the risk of dying from a pregnancy-related cause is 20 times higher compared to developed regions [5]. Sub-Saharan Africa accounts for 66.3% of maternal deaths worldwide, followed by

Southern Asia (21.8%) [5]. Maternal mortality exhibits wide gaps between rich and poor, both between and within countries [6]. Gaps in maternal and newborn health care are concentrated in low-income countries and among the most vulnerable (i.e., the poorest and the least educated) [7, 8].

Policies and programs on maternal and newborn health

The 1987 International Safe Motherhood Conference (Nairobi, Kenya) raised awareness about the numbers of women dying each year from complications of pregnancy and childbirth and sensitized the world to do something to promote safe motherhood [9]. The Nairobi Conference also led to the establishment of the Safe Motherhood Inter-Agency Group and to a series of regional and national conferences that made safe motherhood an accepted and understood term in public health [9].

At the United Nations General Assembly in 2000 (New York City, USA), 189 countries adopted the Millennium Development Goals (MDGs), which aimed to reduce poverty and promote human development [10]. MDG Goal 5 called for improving maternal health and reducing maternal mortality by 75% of the 1990 levels by 2015 [10]. The Sustainable Development Goals (SDGs) were adopted by 194 countries at the United Nations General Assembly on 25 September 2015 (New York City, USA) [11]. Goal 3 of the SDGs targeted reducing the maternal mortality ratio to less than 70 deaths per 100,000 live births and the neonatal mortality ratio to less than 12 per 1,000 live births by the year 2030 [11].

The World Health Organization (WHO) model for ANC recommends a minimum of eight ANC contacts for women with no evidence of pregnancy-related complications. The suggested schedule for such contacts is once

during the first 12 weeks of gestation (in the first trimester), twice during the second trimester (weeks 20 and 26), and five times during the third trimester (weeks 30, 34, 36, 38, and 40) [12]. During ANC contacts, skilled birth attendants (SBAs) inform women about the advantages of SBA-assisted childbirth and impart knowledge on the danger signs of pregnancy and delivery so that the women can seek timely medical attention.

Nepal promulgated the Safe Motherhood Policy in 1998 to reduce maternal morbidity and mortality resulting from pregnancy and related causes [13]. This policy facilitated development of safe motherhood programs, protocols, and human resource production plans that focus on improving maternal and newborn care at the various levels of a health facility.

Nepal launched its Maternity Incentive Scheme, now known as the Safe Delivery Incentive Program, in 2005 to encourage women to use SBA services for childbirth [14]. Under this scheme, women who deliver a baby in a health facility receive financial support for transport. It also provides no-cost delivery services at health facilities in districts ranked low on the Human Development Index.

In 2006, the government promulgated a national policy on SBAs to promote maternal health and reduce maternal and newborn morbidity and mortality by ensuring availability, access, and utilization of SBA services [15]. The policy reflects Nepal's commitment to train and deploy physicians, nurses, and auxiliary nurse midwives (ANMs) nationwide. Also in 2006, Nepal launched the National Safe Motherhood and Newborn Health Long Term Plan (2006–2017), which aimed to increase healthy practices and utilization of maternal and newborn health services among women in rural and remote areas [16].

Skilled birth attendants and utilization of their services

An SBA is an accredited health professional such as a midwife, doctor, or nurse who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth, and immediate postnatal care (PNC) and in the identification, management, and referral of complications in women and newborns [17]. SBA services comprise ANC, skilled birth care, and PNC [17]. Therefore, ensuring timely provision of SBA services to every woman and newborn is very important in reducing maternal and newborn mortality and morbidity [18], and utilization of SBAs continues to be main indicator in global strategies [19].

Globally, the utilization of SBAs during childbirth increased from 62% in 2000 to 73% in 2013 [20]. Despite continuous improvement both globally and within regions, millions of births were not assisted by SBAs. In 2015, SBA utilization in WHO's Africa Region was just over 50% [20].

Despite an incremental increase in the use of skilled birth care in Nepal, from 9% in 1996 to 36% in 2011 [21, 22], progress has been unequal across administrative regions. In mid- and far-western Nepal such use in 2011 was 28.7% and 30.7%, respectively, which was lower compared to the eastern, central, and western regions (42.0%, 35.9%, and 37.8%, respectively) [22]. In the peri-urban health and demographic surveillance site (HDSS) covering Jhaukhel and Duwakot village development committees (VDCs), we recently determined that 93.1% of all deliveries are assisted by SBAs, which is higher compared to rural areas of Nepal [23].

Rationale of the thesis

Increasing the utilization of SBA services is a key strategy in reducing maternal and newborn morbidity and mortality [20]. Despite policies and programs that promote such services, utilization is poor in rural and remote areas of Nepal, especially the mid- and far-western regions. Thus, there is a need to identify barriers to accessing SBA services and to design and implement interventions that address those barriers. This thesis provides an evidence base for designing and implementing interventions aimed at increasing SBA service utilization and improving maternal and newborn health through such utilization.

AIMS

This thesis aimed to identify barriers in the utilization of SBA service in Nepal, and to develop and test an intervention to address those barriers. Specifically, this thesis aimed to

- identify the barriers to using SBA services in mid- and far-western Nepal (Paper I);
- explore perceptions and experiences of service users and providers regarding barriers and possible solutions to improve use of skilled birth care (Paper II);
- investigate SBA utilization and associated factors and follow up on health and demographic processes in a peri-urban surveillance site (Paper III); and
- develop an intervention and test its effectiveness in increasing the utilization of SBA services (Paper IV)

THEORETICAL FRAMEWORK

This thesis is based on an investigation of health care utilization status, development of an intervention, and testing its effectiveness in promoting healthcare utilization. Health promotion programs worldwide have long been premised on the idea that providing knowledge about causes of ill health and available choices for health care will change individual behavior toward more beneficial health seeking behavior [24]. However, studies on health seeking behavior in various settings recognize that providing education and knowledge about causes of ill health and available treatment choices is not sufficient in itself to promote a change in behavior. Local dynamics of communities influence the well-being of their inhabitants. Knowledge about health seeking behavior can be incorporated into health service delivery strategies in a way that is sensitive to community dynamics [24]. This thesis identified utilization of SBA services through quantitative surveys, explored local dynamics with a qualitative survey, and applied that knowledge to developing suitable intervention to promote health service utilization.

Communities are dynamic systems with inherent strength and capabilities that can be influenced and supported in ways that improve health [25]. Working with local communities has been a central strategy for health promotion workers seeking to improve health or address specific problems. Community organization is a process that helps community groups identify common problems or goals, mobilize resources, and develop implementation strategies for reaching the goals they have collectively set [25].

Diffusion of innovation theory

The diffusion of innovation theory provides guidance on how to introduce new health practices or services into a community [25]. This theory sheds light on the mechanism by which innovations are communicated and adopted [26]. Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system. An innovation is a new idea or practice as perceived by an individual [26]. Five factors influence the success and speed with which communities adopt new ideas: (i) characteristics of potential adopters, (ii) rate of adoption, (iii) nature of the social system, (iv) characteristics of the innovation, and (v) characteristics of the change agents [26]. In a community, some individuals and groups are quicker to adopt new ideas than others [25]. It is essential to know the community with which we are working and what is likely to influence its response to new ideas. Factors in different social systems greatly influence the adoption rate for new ideas. Rural communities with a more homogenous population and traditional practices will take longer to adopt new innovations.

Effective change agents within the community can influence the diffusion of new ideas and practices. The change agent may be an independent person working with a community to introduce an innovation or a resident who is operating to facilitate change. Community members can act as role models for other adopters, and selecting appropriate role models from among the community leaders can help accelerate the rate of adoption [25]. Working at the community level has the advantage of dealing more closely with the social, economic, and environmental determinants of health that originate in local conditions [25].

Behavioral model of health services use

According to Andersen's model, predisposing characteristics, enabling resources, and need determine personal health practices and people's use of health services [27]. Predisposing characteristics include age, education, occupation, ethnicity, and knowledge about health and disease. Enabling resources are those found within the family and community (e.g., distance to the health facility, quality of care, availability of transport, road conditions, and financial status of the family). Need factors are "perceived" and "evaluated." Perceived needs for health services include service users' perception of their own health and functional state and their level of awareness, tradition, culture, and women's roles [27]. Perceived needs also indicate whether service users consider their health problems sufficiently important to seek professional help. Evaluated needs involve professional evaluation of health status and users' needs for health care.

Health literacy

Low literacy associates both directly and indirectly with a range of poor health outcomes. The effects of poor literacy can be mitigated through adaptation to health education content and methods that consider the needs of those with poor literacy. However, even individuals with higher levels of general literacy may not be able to consistently apply their knowledge and skills in relation to health knowledge or a healthcare environment [25]. The World Health Organization has defined health literacy as "the cognitive and social skills which determine motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" [28]. Health literacy comprises a set of skills that enables individuals

to exert a higher degree of control over the personal and social determinants of health. The theoretical framework in this thesis is summarized in Figure 1.

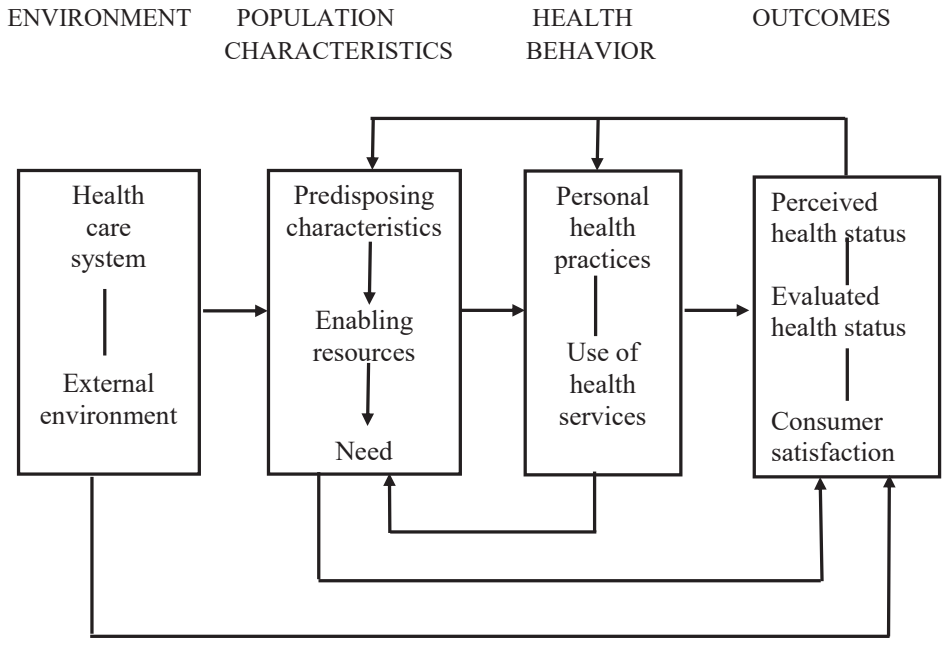

Figure 1 *Theoretical framework used in the thesis [27]*

CONCEPTUAL FRAMEWORK

This thesis identified barriers to the utilization of SBA services in rural and urban settings of Nepal and also developed and tested an intervention to address such barriers in low-utilization areas. Both quantitative and qualitative methods were used to identify barriers categorized in the Three Delays Model (i.e., delay in seeking care, delay in reaching care, and delay in receiving care). Additionally, this thesis identified potential strategies to overcome barriers to service utilization, which formed the basis for designing an intervention. The identification of barriers was followed by an intervention that aimed to address those barriers and thus improve service utilization. Figure 2 summarizes the conceptual framework of this thesis including baseline studies as well as the design, implementation, and evaluation of the intervention.

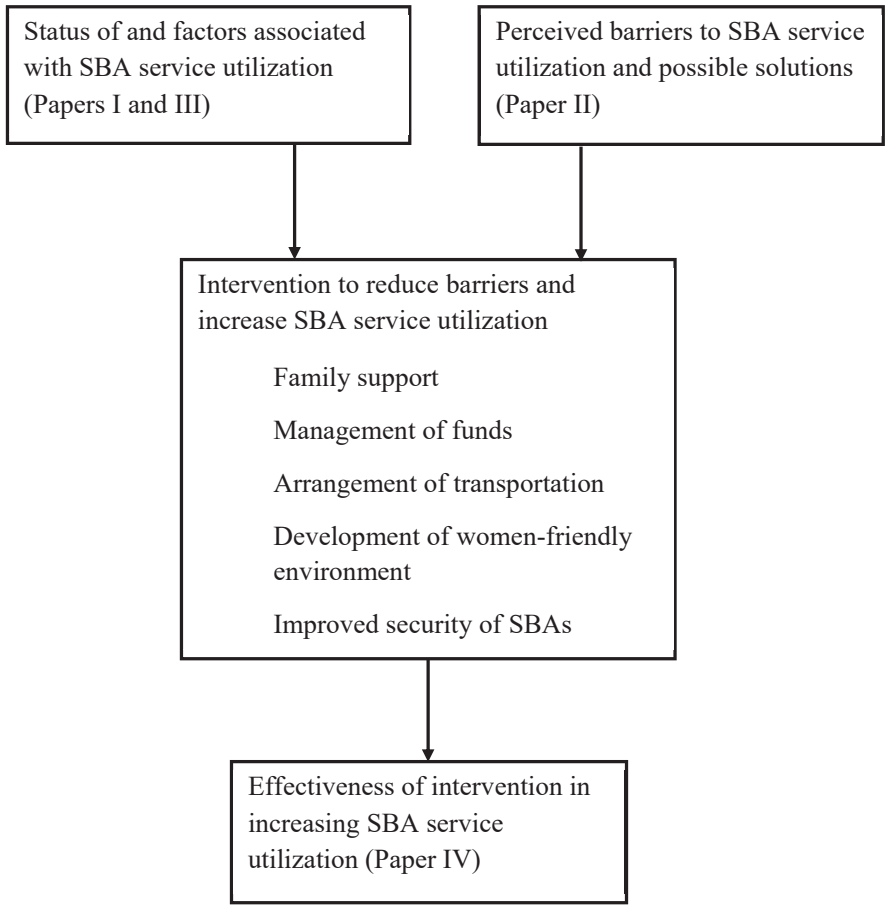

Figure 2 *Conceptual framework of the thesis*

SBA, Skilled birth attendant.

METHODS

Study sites and population

The study sites included three rural and remote districts – Bajhang, Dailekh and Kanchanpur – in mid- and far-western Nepal (Figures 3 and 4) – and the Jhaukhel-Duwakot Health and Demographic Surveillance Site (JD-HDSS), a peri-urban health demographic surveillance site located in the mid-hills of Bhaktapur district of central Nepal (Figure 5). Dailekh is located in the mid-hills of mid-western Nepal, whereas Bajhang is a mountainous district, and Kanchanpur is a Terai (plains) district in far-western Nepal. JD-HDSS includes Jhaukhel and Duwakot VDCs representing prototypical urbanizing villages near Kathmandu, Nepal's capital city. Study populations included women who had delivered a baby during the 12 months immediately preceding data collection in mid- and far-western Nepal and women who delivered a baby within 2 years prior to data collection in JD-HDSS. Our study population for qualitative survey (Paper II) additionally included service providers, i.e., health workers and members of the Health Facility Operation and Management Committee (HFOMC). The HFOMC included health facility managers and local leaders.

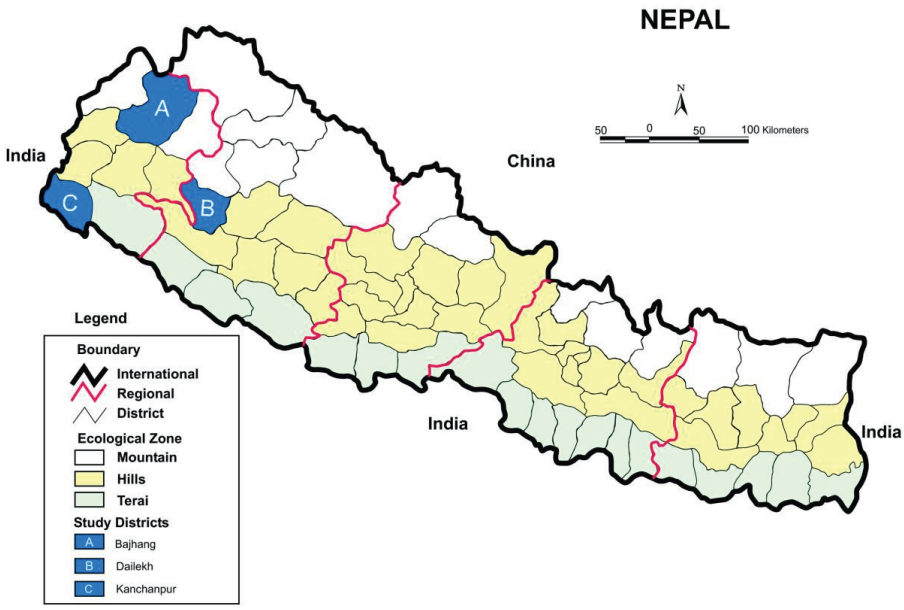

Figure 3 *Map of Nepal showing study districts in mid- and far-western Nepal (Papers I, II and IV)*

Study design and intervention

The studies in my thesis started with surveys that included both quantitative and qualitative methods. The baseline surveys identified barriers to SBA service utilization in rural mid- and far-western Nepal (Papers I and II). The qualitative component also explored perceived strategies to overcome such barriers. The baseline surveys were followed by an intervention and its evaluation, designed as a cluster-randomized controlled trial (cluster RCT). We used VDCs as the units of randomization. Additionally, this thesis incorporated findings on SBA service utilization in JD-HDSS (Paper III).

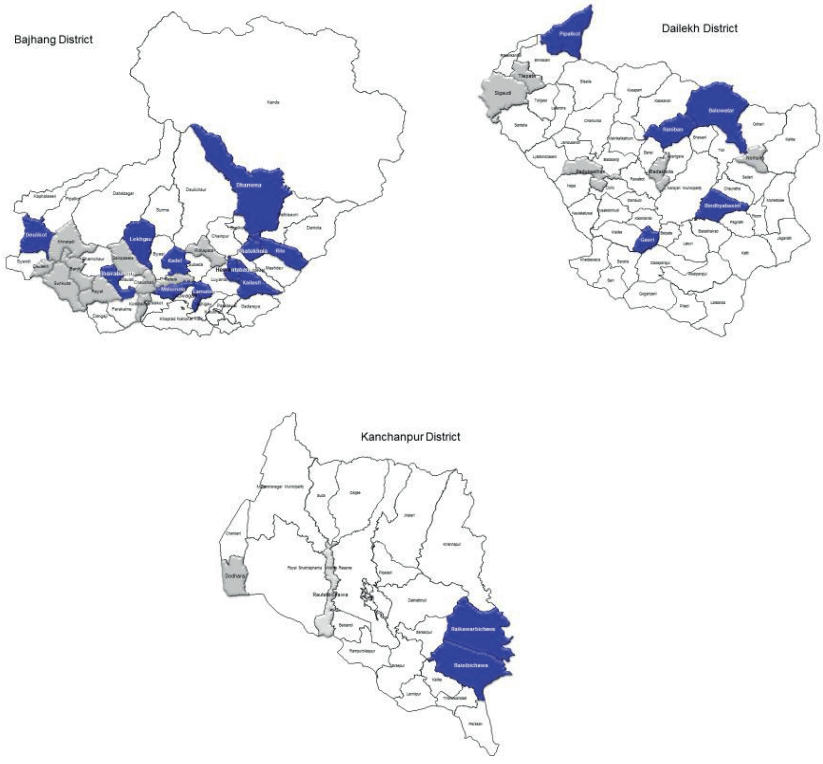

Figure 4 *Maps showing control and intervention VDCs (Paper IV)*

Note: In each of the three districts, blue-colored VDCs are intervention VDCS whereas grey-colored VDCs are control VDCs. VDC, Village Development Committee.

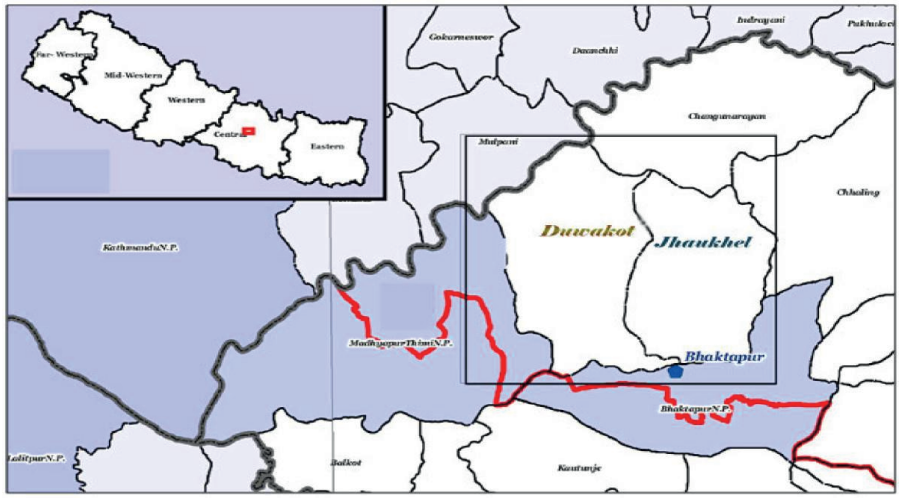

Figure 5 *Jhaukhel and Duwakot VDCs that constitute the JD-HDSS in Bhaktapur district [29]. Map of Nepal (Inset)*

VDC, Village Development Committee; JD-HDSS, Jhaukhel-Duwakot Health Demographic Surveillance Site.

After identifying barriers and conducting a discussion with the stakeholders, we designed and tested an intervention in mid- and far-western Nepal (Paper IV).

The five components of the intervention included

1. *Increased family support to pregnant women for childbirth at a health facility.* We trained and oriented female community health volunteers (FCHVs) and mothers' groups to hold regular meetings and discussions about promoting family support for pregnant women who wish to seek childbirth in a health facility. FCHVs also discussed the importance of skilled birth care during home visits and mothers' group meetings in their respective VDCs. Further, the FCHVs encouraged mothers' group members to invite their family members to regularly attend meetings

that discussed the importance of SBA assistance and to help pregnant women reach a health facility. Mothers' groups also informed families about emergency funds and transport arrangements (intervention component 3).

2. *Financial assistance to women and families who seek SBA-assisted childbirth.* This component mobilized existing funds to help pregnant women reach health facilities for childbirth. We hosted a discussion with HFOMC, FCHVs, and mothers' groups to arrange financial support covering the cost of transport. The mothers' groups agreed to grant interest-free loans to pregnant woman to enable them to reach a health facility for childbirth. The women repaid their loans to the mothers' group after receiving a transport incentive from the respective health facility. For this purpose, our project donated NRP 2,200 (1 US$ ≈ NRP 103 in April 2017) to each of the 234 mothers' groups in the intervention VDCs.

3. *Transport to a health facility for childbirth.* One youth group in each intervention VDC received a 1-day orientation on the intervention component and their role in it. The youth groups prepared a list of potential contacts who agreed to transport pregnant women. If vehicles were unavailable, youths would arrange for porters or transport the woman to the nearest available vehicle. Our project donated NRP 2,000 for each of the 18 youth groups in the intervention VDCs.

4. *A women-friendly environment at health facilities.* In the intervention VDCs, all health facility staff participated in a 2-day training on

communication skills, focusing on developing friendly behavior and a supportive attitude toward women and their families.

5. *SBA security.* Consultations with HFOMC, mothers' groups, and youth groups helped improve SBA security. A youth group member, FCHV, or family member accompanied SBAs to nighttime births.

The finalization of training manuals, work plans, and human resource mobilization plan took place during November 2012–April 2013. A research coordinator in each of the three study districts and a research assistant in each of the 18 intervention VDCs documented the service utilization and progress of intervention. The intervention was implemented during May 2013 – April 2014.

Table 1 *Thesis' papers: study design, study sites, and participants*

Paper	Study design	Study site	Participants
I	Quantitative	50 VDCs from 3 districts (Bajhang, Dailekh and Kanchanpur) of mid- and far-western Nepal	Women who had delivered a baby during the 12 months preceding data collection
II	Qualitative	12 VDCs from 3 study districts	Married women of reproductive age, and providers of SBA service
III	Quantitative	Two peri-urban VDCs from central Nepal (JD-HDSS)	All residents of the study site, and women who had delivered a baby during the past two years preceding data collection
IV	Cluster-randomized controlled trial	36 VDCs from 3 study districts	Women who had delivered a baby during the 12 months preceding data collection

JD-HDSS, Jhaukhel-Duwakot Health Demographic Surveillance Site; SBA, skilled birth attendant; VDC, village development committee.

Data collection

Table 2 summarizes details of the data collection for this thesis. The quantitative baseline survey (Paper I) employed a 2-stage cluster sampling to select 50 VDCs from 3 districts and 3 wards in each of the selected VDCs. Data collection included all eligible women (n=2,481) from the selected wards

(Figure 6). Trained enumerators and supervisors collected data during May–June 2011.

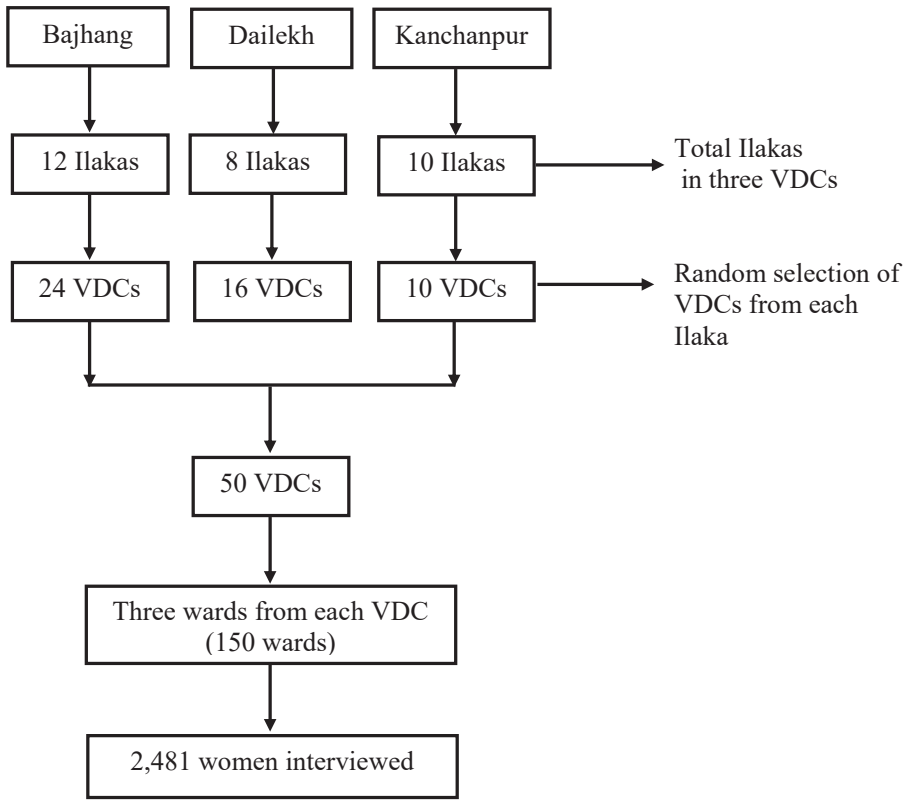

Figure 6 *Sampling procedure (Paper I)*

Administratively, the study districts are divided into "Ilaka" comprising three to five village development committees (VDCs) and municipalities, which are the basic politico-administrative units of Nepal. Each VDC is divided into nine wards.

For the qualitative baseline survey (Paper II), we selected communities for focus group discussion (FGD) based on distance from the district hospital. Out of four communities selected for FGD in each district, two were nearby and two were remote from the district hospital. In each community, we

conducted 12 separate FGDs with service users and service providers. Eight trained field researchers conducted FGDs in the study sites. A local resource person in each district guided the field researchers and informed them about appropriate locations.

During followup of JD-HDSS, we conducted a complete enumeration of the population. The study on SBA utilization in JD-HDSS included all married women of reproductive age who had delivered a baby during the two years prior to data collection. Eighteen enumerators and four field supervisors collected the data from all households in the surveillance site. The follow-up survey covered 3,505 households and 434 eligible women.

Paper IV included 3,844 women from 36 VDCs selected from the 50 VDCs that participated in the baseline survey. We randomly allocated the 36 VDCs to 18 VDCs each in the intervention and control groups (Figure 7). During May–June 2014, we interviewed all women in the study VDCs who had delivered a baby within the 12 months immediately preceding the post-intervention survey. Post-intervention data collection employed the same procedures as the baseline survey [30].

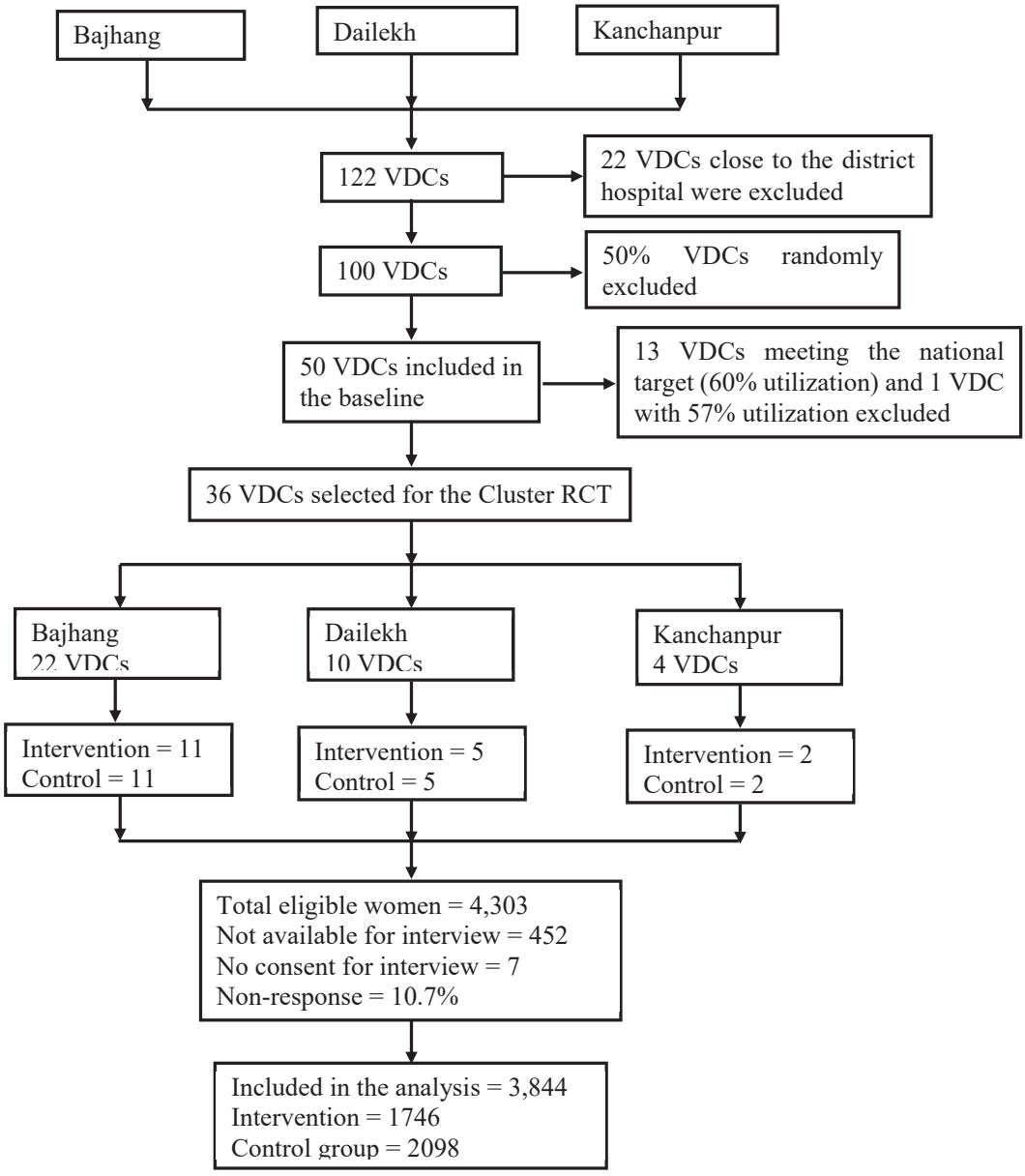

Figure 7 *Trial profile for measuring the utilization of SBA services*

VDC, Village Development Committee; RCT, Randomized Controlled Trial.

Table 2 *Sampling method, sampling unit and sample size*

Paper	Sampling method	Sampling unit	Sample size
I	2-stage cluster sampling	VDC	50 VDCs 2,481 women
II	Purposive	Community (VDC)	113 women, FCHVs 92 health workers, facility managers, local leaders
III	Census	Household Women	3,505 households 434 women
IV	Cluster-randomization into intervention and control	VDC	36 VDCs 3,844 women

VDC, village development committee; FCHV, female community health volunteer

Study tools

Paper I

Paper I included a structured questionnaire to collect data from women who had delivered a baby during the 12 months immediately preceding data collection. The questionnaire was pre-tested in Pharping and Setidevi VDCs in the central Nepal, which had a rural scenario similar to the study sites. Modifications that were incorporated based on pre-test findings increased the clarity of the questionnaire. The questionnaire covered socioeconomic information, availability of SBA services, and women's knowledge of the danger signs that may occur during pregnancy and delivery.

Paper II

We developed separate FGD guidelines for service users and providers to explore the social context, cultural issues, and concerns related to SBA service utilization. We also used the guidelines to explore information about users' and providers' perspectives on barriers to SBA services and their perceived strategies to overcome those barriers.

Paper III

We used follow-up questionnaire based on the baseline JD-HDSS survey [29] to measure health and demographic indicators. Additionally, we used a separate structured questionnaire to measure the utilization of SBAs and associated factors.

Paper IV

We conducted a post-intervention survey to compare our results with the baseline findings and determine the effectiveness of the intervention. Data were collected using a structured questionnaire from the baseline survey (Paper I).

Study variables

The dependent variables in my thesis were the three components of SBA services: ANC, skilled birth care, and PNC. The baseline (Paper I) and post-intervention (Paper IV) studies used ANC and skilled birth care as dependent variables. The SBA study in JD-HDSS included all three components (i.e., ANC care, skilled birth care, and PNC). The qualitative study (Paper II) explored perceived barriers to using skilled birth care services.

Data management and analysis

We coded all responses before entering data into a computer. We used EpiData software to enter quantitative data and conducted analyses using MS Excel, SPSS [31], and R software [32]. Qualitative data were manually analyzed by the content analysis method using deductive approach.

Paper I

We used simple and multiple logistic regression analyses to determine the association of ANC and skilled birth care with background variables (i.e., education, occupation, wealth quintile, distance to health facility, and knowledge of danger signs). After checking for collinearity among the independent variables, we used multiple regression analyses including all variables significant at the 10% level in the simple regression analyses.

Paper II

We labeled the 24 FGD notes according to participant type and entered all data into a computer in the original Nepali language. Next, we conducted a thorough review of Nepali transcription and translation into English language. Using content analysis [33], we analyzed the English-translated text to identify barriers for accessing care according to the Three Delays Model, including delay in seeking, reaching, and receiving care. Additionally, we added a fourth theme based on the model of supply and demand [34] to describe perceived strategies for overcoming those barriers. The coding of FGD notes followed the four themes of the analysis. Finally, all data were organized and summarized according to themes and categories for all FGDs [35].

Table 3 *Framework for qualitative data analysis (Paper II)*

SN	Themes	Categories
1.	Delay in seeking care: demand-side barriers (community awareness, and cultural and financial issues)	(a) Level of awareness
		(b) Tradition, culture, and women's role
		(c) Financial issues
2.	Delay in reaching health facility (non-health infrastructure issues related to road, transport, and community organization)	(a) Geography, road conditions, and transport
		(b) Family and community support
3.	Delay in receiving care: human resources, health infrastructure, and logistic supply	(a) Human resource availability, capacity and motivation
		(b) Health infrastructure and logistic supply
4.	Perceived strategy to overcome barriers	(a) Demand-side intervention: health promotion and education programs to improve awareness and reduce cultural barriers
		(b) Improving physical access: road access and means of transportation to increase accessibility to health facility
		(c) Improving availability of service providers
		(d) Improving health infrastructure and supply logistics
		(e) Policy and program interventions for motivation of SBAs

SBA, skilled birth attendant

Paper III

The data were entered using EpiData software and transferred to SPSS for analysis. Measurement of fertility and mortality covered such events within the 12 months immediately preceding the survey. Residents who moved into the surveillance site at least 3 months prior to data collection were considered in-migrants, and residents who left the surveillance site for 3 months or longer were considered out-migrants. Data analysis included both descriptive (percentage, mean, standard deviation) and inferential (logistic regression) statistics. We compared health and demographic parameters with those from the baseline survey. Multivariate logistic regression analysis assessed the association of antenatal care, skilled birth care, and PNC with independent variables.

Paper IV

Data analysis focused on post-intervention changes in the utilization of ANC and skilled birth care. Difference-indifferences (DiD) estimates were derived from a linear model containing a repeated data set on the use of ANC and skilled birth care between control and intervention groups at baseline and post-intervention. We used a binary variable in an additive linear regression model.

DiD methods are relevant when using research designs based on controlling for confounding variables and when pre-treatment information is available [36]. This approach involves recognizing the intervention and evaluates the differences in results before and after the intervention for treated and untreated groups. We analyzed the DiD to evaluate results between control and intervention groups at baseline and post-intervention [37].

Mixed-effects logistic regression model with ANC skilled birth care utilization as primary and secondary outcome variables, respectively, analyzed the effect of intervention on participants' utilization of those services. VDCs functioned as random intercept.

Ethical considerations

Ethical approval was issued by the Nepal Health Research Council (Papers I – IV) and the World Health Organization in Geneva, Switzerland (Papers I, II, and IV).

Before collecting data for the baseline and post-intervention surveys on SBAs (Papers I, II, and IV), the enumerators explained the nature of the study, its rationale, and the extent of participant involvement. Next, we sought written informed consent from every participant. A witness read the informed consent form to illiterate participants, who added their thumbprint to the questionnaire to indicate consent. The witness signed the consent form as well. Informed consent and interviews were conducted with due respect to providing privacy and helping respondents feel secure in expressing their responses.

In the JD-HDSS survey (Paper III), we obtained informed verbal consent from all respondents. We also informed local administrative authorities, health personnel, and political leaders about the study's objectives and secured their cooperation in the survey.

For the intervention (Paper IV), we received additional approval from the district health teams, and a sensitization process was put in place for local communities. We informed health volunteers, health providers, women, and youth groups about the objectives of the study, the implementation package,

and the evaluation process. Because our intervention was non-invasive, we anticipated no health risks for the participants. The intervention aimed to benefit the most vulnerable (women and newborns) and, within that group, those with the most difficult access to health facilities. For the evaluation of intervention, we sought individual written consent from the study participants.

RESULTS

This section summarizes the key results of the thesis, based on the aims of the individual papers.

Paper I: Barriers to using skilled birth attendants' services in mid- and far-western Nepal: a cross sectional study

Sociodemographic characteristics

Among 2,481 study participants, 98% followed the Hindu religion. The major ethnicities were Brahmin and Chhetri (61%), followed by Dalit (lower caste; 20%) and Janajati (indigenous groups, 13%). Three-quarters of the respondents were 20–35 years of age and 22.1% were younger than 20 years. Nearly one-quarter (23.8%) of the respondents could not read or write compared to those who had attended higher secondary school or above (8%). Median age at marriage was 17 years and 70% of participants gave birth to their first child before reaching 20 years of age. At the time of data collection, 41% of the women had three or more children.

Utilization of SBA services

Most participants (88.3%) had attended at least one ANC visit. Fewer than half (48%) had used skilled birth care, mainly due to distance from a health facility (45%) and inadequate transport (21%). Women who sought skilled birth care wanted to ensure a safe delivery (70%) and better management of complications (26%).

More than half of the participants (51%) knew at least one danger sign of pregnancy and delivery. Women's knowledge of danger signs was associated with completion of at least four ANC visits (OR=1.71, CI: 1.41–2.07) and

utilization of skilled birth care (OR=1.31, CI: 1.08–1.58). Women who lived less than 30 min from a health facility used both ANC (OR=1.44; CI: 1.18–1.77) and skilled birth care (OR=1.25; CI: 1.03–1.52) more frequently than women who lived further away. Completion of at least four ANC visits was a determining factor for utilization of skilled birth care (OR=2.39, CI: 1.97–2.89). The odds that women would utilize ANC and skilled birth care were higher among those with a higher level of education. Compared to illiterate women, participants who completed the 12th grade and above were 2.41 and 4.41 times more likely to seek ANC and skilled birth care, respectively (CI: 1.55–3.75 and CI: 2.89–6.72, respectively). Age did not associate with either ANC or delivery service utilization.

Paper II: Perceptions of users and providers on barriers to utilizing skilled birth care in mid- and far-western Nepal: a qualitative study

Barriers in seeking care

Reasons for delay in seeking care included inadequate awareness of the importance of skilled birth care, women's lack of autonomy in decision making, and financial constraints. The women and their families thought that skilled birth care was unnecessary unless there was a complication during pregnancy. Further, inability to predict the expected date of delivery adversely affected women's preparations for seeking care.

The mountainous and hilly districts in our study area have a cultural practice of untouchability, which isolates women in their own homes during delivery and the post-partum period. Some families refuse to take pregnant women to a health facility for delivery because they fear an evil spirit might haunt the mother and the baby.

Women were mostly busy with household chores and childcare and thus did not have time to travel to a health facility for delivery. Because most males in the study area migrate to India in search of work, many women lacked adequate family support to go to a health facility.

Although the government provided transport incentives for accessing skilled birth care at a health facility, poor families could not afford the additional cost of food and living arrangements for an accompanying family member or neighbor.

Barriers in reaching the health facility

Distance, poor road conditions, and inadequate availability of transport were major barriers to reaching the health facility. During planting and harvesting seasons, it was difficult to arrange for enough people to bring the pregnant woman to the health facility. Reaching the health facility at night or during the rainy season was even more difficult. Moreover, arranging transport or finding enough people was challenging when youths in the study area migrated temporarily to seek work.

Barriers in receiving care

Poor availability of SBAs and inadequate infrastructure and logistic supply were major barriers to receiving timely care after the women reached the health facility. Unfilled posts caused a scarcity of health workers in the health facilities. SBAs in peripheral areas were mostly ANMs with limited training and were unable to handle complicated deliveries.

Health facility buildings were generally small, and the rooms and waiting area were inadequate for the number of deliveries. Water supply, toilets, and

privacy in the labor room were frequently insufficient. Limited availability of necessary furniture, medicines, equipment, and laboratory services hindered SBA services. Likewise, poorly managed staff quarters negatively affected the regular availability of health workers.

Strategies to overcome the barriers

Perceived strategies to overcome barriers included training and recruiting locally available health workers, helping community groups establish transport mechanisms, upgrading physical facilities and services at health institutions, and increasing community awareness of the importance of skilled birth care.

Paper III: Jhaukhel-Duwakot Health Demographic Surveillance Site, Nepal: 2012 follow-up survey and use of skilled birth attendants

Sociodemographic characteristics

At the time of the follow-up survey, JD-HDSS accounted for 5.55% of the total population of Bhaktapur district. In the peri-urban JD-HDSS, most health indicators exceeded the national average. The crude death rate was 3.8 per 1,000 population compared to the national average (7.3 per 1,000) [38]. Likewise, the proportion of women in JD-HDSS who attended at least four ANC visits and delivered with the assistance of an SBA was higher compared to urban areas of Nepal (93.1% vs. 72.7% and 90.8% vs. 71.8%, respectively) [22]. In-migration to JD-HDSS increased significantly during our study, from 2.3% at baseline to 10.5% at followup. Due to rising in-migration, the total population and number of households in JD-HDSS increased from 13,669 and 2,712 in 2010 to 16,918 and 3,505 in 2012, respectively. The proportion of illiteracy among people aged 6 years and above decreased from 18.2% at

baseline to 16.4% at followup. At followup, 35.4% of the population had completed secondary-level education and 1.8% had completed Master level education. The proportion of unemployed people decreased from 2% at baseline to 1% at followup.

Mortality, morbidity, and health behaviors

At followup, the crude death rate had decreased to 3.8 per 1,000 population from baseline (3.9 per 1,000 population). Major morbidity conditions – respiratory diseases, fever, gastrointestinal problems, and bone and joint problems – remained unchanged. Self-reported morbidity decreased from 11.1% at baseline to 7.1% at followup, whereas accidents and injuries increased from 2.9% to 6.5% of overall morbidity, respectively. Regarding treatment seeking behavior, 22.7% of participants visited a private clinic, 16.9% went to the district hospital in Bhaktapur, 14.2% visited the teaching hospital run by Nepal Medical College, and 5.4% visited local pharmacy shops. Although overall smoking prevalence was similar at baseline and followup (15% vs. 15.5%, respectively), prevalence of smoking among males increased from 20% to 23%, respectively. At followup, 15.5% males and 8.5% females consumed alcohol.

Skilled birth attendant services

Altogether, 434 women participated in the study of SBA services in JD-HDSS; most (90.1%) were 20–34 years of age (median age=26 years). It took most women (73.8%) more than 30 minutes to reach a health facility and avail themselves of SBA services.

The proportion of institutional delivery in JD-HDSS exceeded the national average (93.1% vs. 36%, respectively) [22]. Almost all (97.2%) of our

participants women attended at least one ANC visit and 90.8% attended four or more visits. Women who accessed ANC and used transport to reach a health facility were more likely to access institutional delivery. Ethnically, Newar and Brahmin/Chhetri women were 5.0 and 5.7 times more likely, respectively, to access adequate ANC services compared to "disadvantaged Janajati" and Dalit women. Brahmin/Chhetri women were 0.34 times less likely to attend an adequate number of PNC visits compared to "disadvantaged Janajati" and Dalit women.

Paper IV: A cluster-randomized evaluation of an intervention to increase skilled birth attendant utilization in mid- and far-western Nepal

The post-intervention survey was carried out in 36 VDCs that had been randomized into 18 intervention and 18 control VDCs. A total of 3,844 women participated in the survey, including 2,098 in the intervention area and 1,746 in the control area. The evaluation compared post-intervention and baseline data.

Sociodemographic characteristics

Nearly three-quarters (73.8%) of the women were 20–35 years of age (median age=24 years) at the time of data collection. The major ethnic group comprised Brahmin and Cheetri (63.5%), followed by Dalit (lower caste, 25.2%) and Janajati (indigenous group, 10.9%). Median age at marriage and first childbirth was 17 and 19 years, respectively. Participants who could not read or write totaled 20.2%, whereas those who had completed higher secondary education or above totaled 8.4%. Agriculture was the major primary occupation for 60.4% of the participants.

Utilization of SBA services and the effect of the intervention

Most participants (90.8%) completed at least one ANC visit, 65% completed four or more visits, and 56.7% used skilled birth care. More than three fourths (76.5%) had to walk more than 30 minutes to reach the nearest health facility.

Post-intervention, the proportion of one or more ANC visits increased by 4%, which was significant in DiD analysis. The proportion of SBA-assisted births increased by 5% in the intervention group, whereas four or more ANC visits decreased by 2.6%. However, these changes were statistically insignificant in DiD analysis. In the mixed-effects logistic regression model, post-intervention women were more likely to use skilled birth care (OR=1.57; 95% CI: 1.19–2.08). The intervention was not associated with change in ANC utilization. Women aged 20–35 years were less likely to use skilled birth care compared to women aged younger than 20 years (OR=0.81; p <0.001). Educational level associated positively with both ANC and skilled birth care services.

DISCUSSION

This thesis contributes to current understanding of the barriers to SBA service utilization and how those barriers could be overcome in rural and remote areas of Nepal. Our studies on utilization and barriers to SBA services were conducted in both rural and peri-urban areas of Nepal (Papers I, II, and III). The design of the intervention considered the barriers identified through the baseline surveys, which used both quantitative and qualitative methods. To identify possible interventions to increase the SBA service utilization, we designed and implemented an evaluation in mid- and far-western Nepal (Paper IV), where SBA utilization is lower than the national average. By implementing a cluster RCT, this thesis aimed to assess the effectiveness of an intervention for increasing the utilization of SBA services in rural and remote areas of Nepal.

The cluster RCT in this thesis is an appropriate design for community-based interventions [39-42]. Cluster RCTs are considered strong designs in health research that requires allocation of an identifiable group [43]. Our study allocated VDCs rather than individuals in the intervention and control groups to prevent unintentional spillover of intervention effects from the intervention group to control group [44, 45].

Status of SBA service utilization

The utilization of SBA services is increasing in Nepal in a secular trend (i.e., 9% in 1996, 18.7% in 2006, 36% in 2011, and 55.6% in 2014) [21, 22, 46, 47]. Despite increased utilization at the national level, a wide gap persists in rural and urban areas and in different administrative regions. SBA utilization in rural areas increased from 28.2% in 2011 to 50.5% in 2014 vs. 71.8% to

90.4% in urban areas during the same period [22, 47]. Nepal's Demographic and Health Survey 2011 reports that SBA-provided delivery care in Nepal's mid- and far-western regions is 28.7% and 30.6%, respectively, which is lower than the national average (36%) [22]. In rural mid- and far-western Nepal and the peri-urban JD-HDSS, we found that 48% and 93.1% women, respectively, utilized delivery care from SBAs (Papers I and III). SBA services are critically important for reducing maternal and newborn mortality and morbidity because they provide timely delivery of obstetric and newborn care [20]. Thus, there is a need to identify barriers to service utilization and devise interventions that increase services in areas with poor SBA utilization.

Identifying barriers to SBA service utilization

This thesis identified the barriers pertaining to both the demand side and supply side, which formed a basis for designing, implementing, and evaluating an intervention aimed at overcoming those barriers. At various stages, these barriers affected utilization due to delays in (i) seeking, (ii) reaching, and (iii) receiving care from SBAs [48], as discussed below.

Barriers to seeking care: cultural practices, health literacy, education level, and financial issues

Our survey in mid- and far-western Nepal found that many women did not seek SBA services due to the cultural practice of isolating women during delivery and the post-partum period (Paper II). Because of the prevailing culture that considered women who recently delivered a child impure, they were ashamed to seek health services for delivery and PNC. Further, women were mostly engaged in household chores and were not allowed to decide whether they should access health care (Paper II). Women lacked family

support because most husbands seasonally migrated to India in search of work. In Nepal, women live with their husband's family after marriage and must depend on their mothers-in-law's perception of pregnancy and delivery-care needs [49]. As confirmed by other studies in Southeast Asia, women's autonomy is important in their decision to seek SBA services [50-52].

Importantly, women's level of health literacy and educational attainment help determine whether they would seek SBA services. Our study showed that women with knowledge of at least one danger sign of pregnancy and delivery were 1.7 and 1.3 times more likely to use ANC and delivery services, respectively (Paper I). Likewise, women who had completed 12 or more years of schooling were 2.4 and 4.4 times more likely to use ANC and delivery services, respectively (Paper I). Women's level of education is a predictor of ANC visits in India and other parts of the world [51, 53]. Moreover, demographic and health surveys in Nepal and Bangladesh reveal a positive association of educational achievement with the use of delivery services [22, 54].

Lacking awareness about the importance of SBA services, many women did not seek such services despite availability (Paper II). They thought that SBA services were necessary only if serious problems arose. Many women still used traditional birth attendants for delivery. Also, because of their inability to predict their delivery date, women and their families could not prepare for obtaining skilled birth care from a health institution (Paper II). Studies from Nepal and other low- and middle-income countries also report that women do not use skilled birth care because they do not know such services were available [55] or think such services are necessary only for childbirth complications [56-58].

Nepal's Safe Delivery Incentive Program provides a transport incentive (maximum NRP 1,500) to every woman who delivers her baby at a health institution. However, the cost of such delivery could exceed NRP 4,000 in remote areas, which require longer travel time to the health facility. Thus, poor families cannot afford the cost of seeking delivery care at a health facility and women deliver at home (Paper II). Our quantitative study also found that women's utilization of SBA services in mid- and far-western Nepal associated positively with household economic status (Paper I).

Barriers for accessing care: geography, distance, means of transport, and family and community support

Distance to a health facility, poor road conditions, and inadequate transport were major barriers to seeking SBA services (Papers I and II). More than two-thirds of our participants had to travel more than 30 minutes to reach the nearest health facility that offered SBA services (Paper I). Distance was main reason for 45% of the women who did not seek SBA services. Likewise, the unavailability of transport prevented 21% of women from seeking SBA services (Paper I). A study from Nepal's rural Kavre district reported that 30% of its participants mentioned distance and inadequate transport as barriers to SBA service utilization [59]. Indeed, long distance to a health facility is known to negatively affect utilization of delivery services [50, 60, 61]. In rural Terai areas, the common means of transport was bull/buffalo cart, whereas people in hill and mountain areas had to carry pregnant women on stretchers because of poor road conditions. Labor that started at night or during the rainy season compounded the problem of reaching a health facility (Paper II). Inadequate transport facilities negatively affected SBA utilization in studies conducted in Uganda, Kenya, and Indonesia [57, 62, 63].

Low utilization of SBA services is not always due to geographical, economic, religious, or cultural factors, but also reflects institutional issues. Additional reasons for low utilization in Nepal include poor quality service, unavailability and inaccessibility of service, inadequate human resources, inadequate logistic supply, and poor referral mechanisms [64]. Sociocultural norms that affect health care seeking change over time. Long-term interventions to train health workers and improve quality of care may accelerate a change toward increased SBA service utilization. However, cost and access remain important barriers to the use of healthcare facilities for childbirth [65].

When vehicles were not available, mothers' groups, FCHVs, and youth groups helped arrange transport or carried women to the health facility on stretchers (Paper II). Temporary work migration by most youths increased the challenge of arranging transport or bringing women to the health facility.

Barriers for receiving care: human resources, health infrastructure, and logistic supply

Most health facilities had at least one health worker who was regularly available. In a few health facilities, ANMs were available 24 hours per day because they lived in rental apartments near the facility. However, many peripheral health facilities lacked an ANM, and facilities with only one ANM had no one during leaves of absence, training, or transfer to another facility (Paper II). The scarcity of health workers resulted from unfulfilled posts, deliveries volume that exceeded SBAs' ability to provide services, and lack of clear work division among available staff. Women appreciated the regular availability of ANMs who were recruited locally by the HFOMCs. However,

ANMs with limited training were unable to handle complicated deliveries (Paper II).

Health facilities' inadequate infrastructure and logistics were barriers to SBA service provision. For the number of deliveries, small facilities lacked an adequate number of buildings and rooms. Inadequate water supply, electricity, toilets, and privacy in labor rooms hindered the provision of SBA services. Other service-side barriers included a limited number of delivery tables, medicines, equipment, and laboratory services.

Strategies to overcome barriers to SBA service utilization

Both service users and service providers suggested organizing awareness programs to inform women about the importance of SBA services and to change the traditional practice of homebirths. In mid- and far-western Nepal, people still support local traditional birth attendants and have conservative attitudes that must be changed through behavioral interventions. Such interventions (e.g., birth preparedness and complication readiness) help women and families appreciate the need for SBA delivery [66]. Such interventions should emphasize the involvement of family members, especially husbands and mothers-in-law.

Service users also suggested improving the proximity of health facilities, road construction and maintenance, and arrangements for timely transport. Participants suggested that regular ambulatory services would be more effective than public transport. Other suggestions included providing staff accommodations near health facilities for improved SBA availability, as well as providing accommodation and food for visitors during a mother's stay at the health facility.

Service providers suggested constructing staff accommodations near health facilities and improving the security of staff quarters by fencing. They advocated for improving the infrastructure and logistic supply of the health facilities (e.g., separate delivery rooms, adequate furniture, alternate source of electricity during power shortages, building repairs, and timely supply of adequate equipment). Service providers also perceived a need to fill staff positions sanctioned to local health facilities and recruit additional SBAs to adequately respond to the work volume at the health facility. To maintain SBAs' motivation, they emphasized the need for educational and training opportunities aligned to job description and incentives for night duty.

Timely payment of women's transport incentives and staff salaries would improve SBA service provision and utilization. Health facility management committees should work with VDCs and district development committees to generate funds for construction, maintenance, and logistic support to the health facilities.

Interventions to overcome the barriers

We based our five-component intervention on the findings of our baseline surveys (Papers I and II) and discussions with stakeholders at the local (local health institutions), district (district health offices), national (Ministry of Health), and international (World Health Organization) levels. The intervention was implemented in three districts of mid- and far-western Nepal where SBA utilization was lower compared to other regions and urban areas of Nepal (Paper IV). Although our baseline survey identified several barriers, we selected certain barriers that were amenable to intervention within our 1-year time frame. Our design focused on utilizing the existing health

infrastructure and community structures (i.e., health facilities, HFOMCs, mothers' groups, youth groups) so that the intervention, if found effective, could be scaled-up in other areas of Nepal. To ensure scalability, we did not establish new structures or initiate additional programs that could require further resources. To secure a consensus on the feasibility of implementation, our project staff met with local actors including FCHVs, mothers' groups, youth groups, and HFOMC members.

We faced some challenges during implementation of the intervention. Harvesting season and major festivals (i.e., Dashain and Tihar) delayed FCHV-facilitated mothers' group meetings. Our monitoring records showed variable use of financial assistance from the mothers' group fund (20% in Dailekh district vs. 6% each in Bajhang and Kanchanpur districts). The importance of youth participation did not meet our expectations. Instead, neighborhood women provided transport in two-thirds of all cases in the hill and mountain districts. In Kanchanpur, a Terai district, youths helped transport only about one out of every six pregnant women. Youths' frequent mobility, mainly for employment and education, interfered with their contribution. We encountered no security issues during the intervention, although some SBAs favored the idea of providing better accommodations close to the health facility.

One of the core skills and abilities of an SBA is effective cross-cultural communication to provide holistic women-centered care [17]. Therefore, we provided a 2-day training to all health facility staff in the intervention VDCs, focusing on developing friendly behavior and a supportive attitude toward the women and their families. A systematic review in Africa and Asia reports that rude behavior, poor communication, and verbal and physical abuse by

maternal health care providers result in distress and fear in service users and absence of trust in providers [67].

The issue of SBA security pertained to providing services when deliveries occurred at night. Although a few SBAs were living in rental apartments near the health facility and provided 24-hour service, staff quarters were mostly unavailable. Our intervention included having a youth group member, FCHV, or family member accompany an SBA to the health facility for night deliveries. Providing better SBA accommodations near the health facility is an important factor in improving SBA availability at night.

Evaluation of the intervention

Paper IV examined whether our intervention helped increase women's utilization of ANC and skilled birth care services. In the intervention area, the number of women who attended at least one ANC visit increased from 83.4% at baseline to 92.4% post-intervention, and skilled birth care increased from 30.4% to 56.5%. In the control area, at least one ANC visit increased from 84.4% to 89.4%, and the use of skilled birth care increased from 35.9% to 57.0%. Although the control area did not receive an intervention, increased service utilization might result from longstanding government programs supported by various policies and strategies related to safe motherhood [13-16, 68]. However, our DiD calculation and mixed-effects logistic regression showed increased use of SBA services (4% for ANC services and 5% for skilled birth care) in the intervention area (Paper IV).

Although DiD analyses showed the significant increase of at least one ANC visit in intervention area, changes in the utilization of skilled birth care and four or more ANC visits were not significant. Our mixed-effects logistic

regression analyses showed a 5% increase in the use of skilled birth care in the intervention area (Paper IV). These results suggest that a longer-term intervention could significantly increase the use of skilled birth care.

Methodological considerations

Mixed methods research design

This thesis used a mixed methods approach to identify utilization status and barriers to SBA services. Mixed methods research involves collecting, analyzing, and integrating quantitative and qualitative data [69]. Quantitative research measures occurrences (e.g., estimates prevalence, frequency, magnitude, or association), while qualitative research describes the complexity, breadth, or range of occurrences of phenomena [70]. Problems faced by social and health science researchers are complex, and the use of either quantitative or qualitative approaches alone is inadequate to address this complexity. With the development of both quantitative and qualitative research in the social and human sciences, mixed methods research has gained popularity [71]. Qualitative research is mainly used in public health to (i) study and explain the economic, political, social, and cultural factors that influence health and disease; (ii) gain an understanding of how communities and individuals interpret health and disease; and (iii) study interactions between various players who are relevant to any given public health issue [72].

My quantitative studies assessed the association SBA service utilization with the background characteristics of study participants (Papers I, II, and IV). My qualitative research provided a balanced exploration of service users and service providers regarding perceived barriers to SBA services and solutions

to those barriers (Paper II). Combining quantitative and qualitative methods helped validate my findings on barriers to SBA service utilization (Papers I and II) and also helped me develop an intervention to overcome such barriers. The existing literature suggests that pairing the quantitative and qualitative components of a larger study allows a researcher to achieve various aims (e.g., corroborating findings, generating more complete data, and using results from one method to enhance insights attained with the complementary method) [69-71]. The dual aims of my thesis were to describe and understand communities, so accomplishing those goals effectively called for the application of both qualitative and quantitative techniques [72]. Public health problems result from complex social, economic, political, biological, genetic, and environmental causes. Public health researchers are most effective when they are eclectic in their choice of methods [72].

However, the mixed methods approach has disadvantages. Research design can be very complex and require much time and resources for planning and implementation, and it may be unclear how to resolve discrepancies that arise while interpreting the findings [69, 73]. To overcome such challenges, I collaborated with multidisciplinary members of the research team and utilized a reasonable amount of time and resources available for the research project.

Potential bias in measurement of utilization status

Measuring SBA service utilization status by asking mothers about their previous experience created the possibility of recall bias. However, asking women about their use or non-use of delivery care posed limited recall bias because the question pertained to a single major event. Recall bias regarding the use of ANC services could be more prominent compared to the delivery

care because a woman could attend more than one ANC visit. Such bias could have occurred in both the quantitative and qualitative surveys (Papers I–IV).

Intervention to increase SBA utilization

The development of intervention components was based on extensive baseline surveys involving both quantitative and qualitative techniques and discussion with stakeholders. We ensured that the components added few financial and structural demands on existing health system. The randomized allocation of an adequate number of clusters in the intervention and control groups was a major strength of the study. Our intervention design was limited by simultaneous implementation of all the components. Hence, we were unable to assess the effectiveness of an individual component.

Although our surveys identified various barriers, including distance and service-side barriers, it was not possible to design an intervention that comprehensively addressed all barriers. Because distance was a major barrier, we developed transport arrangements to optimally utilize pre-existing transport and mobilized community groups to bring pregnant women to the health facility. Although we identified several supply-side barriers (i.e., insufficient human resources, inadequate numbers and motivation of health workers, inadequate infrastructure and supply logistics at health facilities, and issues related to the quality of services provided), our intervention mostly addressed demand-side issues. On the supply side, we included training to promote a women-friendly environment in the health facilities and improving SBA security. Thus, a more effective intervention could include more supply-side issues.

Ethical considerations

My thesis incorporates studies that involve both descriptive and experimental designs. All studies of my thesis adhered to the ethical principles of health research involving human participants. The design, conduct, and reporting of the surveys and intervention followed ethical principles to ensure autonomy, respect, benefit, and justice to the study participants, as mentioned in the National Ethical Guidelines for Health Research in Nepal [74], Helsinki Declaration 1964 as amended by the World Medical Association General Assembly in 2013 [75], and the Belmont Report [76] (described below).

Before seeking informed consent for the questionnaire interviews and FGDs, we explained the nature and rationale of the study to each research participant and described the extent of participant involvement (Papers I–IV). FGDs might limit the confidentiality and anonymity of participants and their views because all participants can listen to each other. Hence, researchers can assure participants that they will maintain the confidentiality of information, but they cannot guarantee that FGD participants would also maintain such confidentiality. We described this limitation to our participants before asking for informed consent (Paper II). To maintain confidentiality among FGD members, we reserved a room at a school or health institution (Paper II). To help find an appropriate location for data collection, we mobilized local resource persons to guide the field researchers (Papers I and II). This process also helped the local participants feel more secure and encouraged them to open up in their responses.

The population-based focus of public health research requires scope expansion and application of Belmont principles (i.e., respect for persons,

justice, and beneficence) to also incorporate non-exploitation [77]. Principles that only emphasize the interests of individual actors are unlikely to capture what is ethically applicable to public health research [77]. Childress et al. have proposed five "justificatory conditions" to resolve ethical concerns in public health policy and interventions: (i) effectiveness of the intervention; (ii) public health benefits that outweigh the infringed autonomy or privacy of individuals; (iii) confirming the necessity of the intervention; (iv) minimizing the degree of infringement of autonomy, privacy, and confidentiality; and (v) publically and transparently explaining and justifying the necessity of such infringement [78]. Our intervention aimed to strengthen the existing health system by mobilizing the community and reinforcing and expanding the scope of the system's capacity (Paper IV). The intervention was non-invasive and posed no health risk to participants, and we anticipated a positive outcome. To avoid a selection bias, we randomly allocated intervention and control VDCs. Before beginning the intervention, we shared baseline findings, objectives, duration, and expected role of the community with local HFOMCs, district health offices, and the Ministry of Health. The Government of Nepal expressed its commitment to expand the intervention, if found successful, to the control VDCs and other areas of Nepal with low SBA utilization.

CONCLUSIONS

By identifying barriers to SBA service utilization and developing and testing the effectiveness of a cluster-randomized controlled trial, this thesis adds to the evidence on interventions designed to improve maternal and newborn health through increased SBA service utilization in rural and remote areas of Nepal. In the context of existing evidence on barriers to SBA service utilization through the descriptive research, this thesis widens the evidence base by intervening to remove barriers and evaluating the effects of such intervention. Although the utilization of SBA services has increased as a secular trend in Nepal in recent decades, the wide rural–urban gap in such utilization suggests the need to implement such interventions in rural areas.

An effective intervention for increasing SBA utilization includes (i) mobilizing more active and stable community groups, (ii) improving service quality and physical infrastructure at health facilities, (iii) providing adequate numbers of SBAs at health facilities, and (iv) providing longer-term and repeated interventions. Although community mobilization efforts are effective, they need supervision and support to ensure the quality of implementation. Remote areas require an expanded and modified intervention package because geographic and transport barriers compound the difficulties in accessing care.

This thesis developed and tested an intervention to increase utilization of SBA services in a rural Nepalese setting and also highlighted additional strategies to address barriers to service utilization. Although the conclusions of this thesis derive from rural mid- and far-western Nepal, the inferences of our

studies could be relevant to other rural areas of Nepal and other low- and middle-income countries.

FUTURE PERSPECTIVES

Based on the analysis and synthesis of evidence from mixed methods research and intervention on increasing the use of SBA services, this thesis suggests that future studies should focus in-depth on service-side issues. Possible areas for future study include quality of service, recruitment and retention of adequate SBAs in local health facilities, improving health infrastructure and logistic supply, and developing interventions to address those barriers.

The health sector alone cannot address some of the barriers identidifed in this thesis (e.g., distance to health facility and inadequate transportation, low health literacy and lower educational attainement, and cultural barriers). Thus, future interventions should involve multisector collaboration and strong political commitment in terms of resource allocation and longer-term intervention to address the identified barriers.

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PAPERS I – IV