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Community survey on awareness and use of obstetric ultrasonography in rural Sarlahi District, Nepal

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Abstract

Objective—To assess levels of awareness and use of obstetric ultrasonography in rural Nepal.

Methods—Between March 2014 and March 2015, a cross-sectional survey was conducted among married women aged 15–40 years residing in rural Sarlahi District, Nepal, regarding their knowledge and use of obstetric ultrasonography during their most recent pregnancy. Regression analyses were used to identify reproductive health, socioeconomic, and other characteristics that increased the likelihood of undergoing an obstetric ultrasonographic examination.

Results—Among 6182 women, 1630 (26.4%) had undergone obstetric ultrasonography during their most recent pregnancy, of whom 1011 (62.0%) received only one examination. Odds of receiving an ultrasonographic examination were higher among women with higher education than among those with none (≥11 years' education: adjusted odds ratio [aOR] 10.28, 95% confidence interval [CI] 5.55–19.04), and among women whose husbands had higher education than among those with husbands with none (≥11 years' education: aOR 1.99, 95% CI 1.47–2.69). Odds were lower among women younger than 18 years than among those aged 18–34 years (aOR 0.72, 95% confidence interval 0.59–0.90).

Conclusion—Utilization of obstetric ultrasonography in rural Nepal was very limited. The health community should actively work toward researching the potential health impact of obstetric ultrasonography in low-resource settings, while addressing limitations such as cost and misuse.

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Conflict of interest
The authors have no conflicts of interest.

Keywords

Global health; Intrapartum-related complications; Maternal health; Neonatal health; Ultrasonography

1. Introduction

Ultrasonography is an invaluable medical diagnostic technology that allows for noninvasive imaging of internal organs and other tissues. In the context of obstetric use, ultrasonography is used to confirm a pregnancy, verify multiple pregnancies, assign gestational age, monitor growth, detect fetal abnormalities, and diagnose placental or amniotic fluid problems. Even in settings where the equipment or operator skill does not enable all such examinations to be completed, providing a basic examination could be beneficial in both managing the prenatal period and assessing potential intrapartum-related risk. For example, early diagnosis of risk factors such as multiple pregnancy, non-cephalic presentation, and preterm birth (via gestational age dating) might be useful to inspire birth preparation in areas where access to tertiary-level care—or any facility-based care—is limited. An early examination at 10–14 weeks of pregnancy facilitates accurate gestational age dating and the detection of abnormalities, whereas later examinations (~18–22 weeks and/or ~30–34 weeks) allow an examination of fetal anatomy and growth [1].

Access to ultrasonography remains very limited in low-income countries, particularly in rural settings [2]. In Nepal, a diploma medical radiology diagnostic course was started in 1988 at the main teaching hospital in Kathmandu (Tribhuvan University Teaching Hospital), producing its first graduates in 1990 [3]. There are approximately 150 radiologists in the country (1 per ~185 000 individuals), and this small cadre is largely concentrated in Kathmandu Valley and other major cities [4]. In the USA, by contrast, more than 37 000 radiology professionals are registered with the American College of Radiology for a population of approximately 319 million [5]; the USA has approximately 20 times more radiologists per person than Nepal.

The primary aims of the present study were to describe current use and awareness of obstetric ultrasonography in rural Nepal and to identify predictors of use. A secondary aim was to understand the extent to which obstetric ultrasonography has been incorporated into prenatal care messaging at birthing centers in the study area.

2. Materials and methods

The present cross-sectional study was conducted in rural Sarlahi District, Nepal. Sarlahi District is located in the southern plains of Nepal, and its inhabitants mainly belong to the Madheshi ethnic group [6]. The study was nested in the Nepal Oil Massage Study, a cluster-randomized community-based trial examining the impact of topical application of sunflower seed oil on neonatal mortality and morbidity as compared with traditionally used mustard seed oil (Clinicaltrials.gov NCT01177111). The parent trial initiated enrollment in November 2010, but data for the present substudy on ultrasonography awareness and use were collected between March 1, 2014 and March 31, 2015. The parent study is still ongoing at the time of publication of the present report. Both the parent study and the substudy received ethical approval from the Johns Hopkins Bloomberg School of Public Health Institutional Review Board, Baltimore, MD, USA, and the Tribhuvan University Institute of Medicine, Kathmandu, Nepal. Owing to the low rate of female literacy in the community, the study staff verbally read the consent form to participants and the participants provided oral consent.

The study area encompasses 34 of 99 Village District Committees (an administrative unit) in the district and has a population of approximately 300 000. All married women of reproductive age (15–40 years) residing in this area were eligible for both the parent study and the present study. Eligible women were interviewed every 5 weeks to assess whether there was a missed menstrual period since the previous visit and, if so, they were offered a pregnancy test. If they tested positive, they were invited to participate in the study. Data on their anthropometry and socioeconomic status were recorded at the same visit. Families were instructed to notify the study staff immediately after delivery, and data on maternal and newborn health and conditions during labor and delivery were collected during a home visit made right after this notification was received. During the substudy, questions on awareness and use of obstetric ultrasonography were collected at the postpartum visit.

For data analysis, the characteristics of the respondents were summarized and their survey responses on ultrasonography awareness and use were tabulated. Regression analysis was conducted, with receipt of obstetric ultrasonography during the most recent pregnancy as the outcome of interest. Seven exposure variables were assessed: number of prenatal care visits made (0, 1, 2–4, ≥5); maternal education (no formal education, 1–6 years, 7–10 years, ≥11 years); husband’s education (no formal education, 1–6 years, 7–10 years, ≥11 years); socioeconomic status, as represented by ownership of *bari* (rain-fed uplands) and/or *khet* (irrigated lowlands; <1 katta, ≥1 katta [1 katta is approximately 338 m^2]) and housing structure (mainly thatch, grass, and/or branches; mainly wood, cement, and/or brick); maternal age (<18, 18 to <35, ≥35 years); gravidity (first pregnancy, 1–3 previous pregnancies, ≥4 previous pregnancies); and sex of live-born children before the index delivery (no prior children, ≥1 live-born son, no live-born sons and 1–2 live-born daughters, no live-born sons and ≥3 live-born daughters). The categories for the variable “sex of live-born children” were chosen to understand whether preference for, and/or pressure to have, male children would affect use of obstetric ultrasonography. A logistic regression model was used to calculate the adjusted odds ratio (aOR) and 95% confidence interval (CI). $P<0.05$ was considered to be statistically significant. Stata version 13.0 (StataCorp, College Station, TX, USA) was used for the analyses.

Separately, to address the secondary aim, semi-structured interviews were undertaken with the highest-ranking clinician available at each of the 12 birthing centers in the study area in March 2014. All birthing centers in Nepal provide free prenatal care as well as intrapartum care. Additionally, the Safe Delivery Incentive Program has been in place since 2005; the program offers cash to women who attend four or more prenatal care visits and additional money if they deliver at a birthing center [7]. The interview guide included questions about the availability of supplies, equipment, and staff for intrapartum-related care, and about the protocol for addressing complicated deliveries. The protocol for referral for prenatal ultrasonography during prenatal care visits was also explored. The responses were organized into a matrix in Microsoft Excel 14.5.8 (Microsoft Corporation, Redmond, WA, USA), with each facility interview entered as a row and the main themes from the interview guide entered as columns, and salient themes were extracted.

4. Results

During the study period, 6182 women who had recently delivered were interviewed; 4686 (75.8%) interviews were conducted within 24 hours of delivery, 544 (8.8%) within 3 days of delivery, and 253 (4.1%) within 1 week of delivery. The mothers were young, and most had had between one and three previous pregnancies (Table 1). More than two-thirds of the interviewed women had no formal education (Table 1).

Overall, 3962 (64.1%) women had heard of ultrasonography or "video X-ray" (a more commonly used term). A large majority of those who had heard of ultrasonography believed that the examinations were for determining fetal position, and fewer than half reported that it was more generally for the fetus's health, for the mother's health, and/or for fetal sex determination (Table 2). More than half the women had heard about ultrasonography from their families, neighbors, and/or friends, whereas few had heard about it from certified practitioners (auxiliary nurse midwives, health assistants, community medical assistants, staff nurses) or doctors (Table 2).

Among the 3962 women who had heard of ultrasonography, 3852 (97.2%) provided responses on its use. Overall, 1630 women had received an ultrasonographic examination during their most recent pregnancy, which equates to 26.4% of all women surveyed. Of those who underwent an examination, most received only one (Table 3). Approximately one-third of those who underwent an ultrasonographic examination reported that they had sought it because of physician recommendation, and almost one-half reported seeking it to check fetal position (Table 3). A small proportion reported that they received the examination to determine fetal sex (Table 3). Half the women underwent their most recent ultrasonographic examination within the study district (Sarlahi) (Table 3). Locations outside the study district included cities with referral facilities in districts to the west (Birganj, Parsa) and east (Janakpur, Dhanusa) of Sarlahi District (3–4-hour drive), and cities in India, mostly to the south of Sarlahi District in the Indian state of Bihar.

The median fee for one ultrasonographic examination was 700 Nepali rupees (NPR; interquartile range 600–750; approximately US$7 as of March 2015). The mean fee was NPR776 (range 200–6400). In 116 (7.1%) cases, the fee was more than NPR1000. The outlier fees above 1000 rupees were, for the most part, for examinations conducted for fetal sex determination. Informal inquiries made with private ultrasonography clinics by the study researchers indicated ultrasonography fees to be NPR400–600.

More prenatal care visits and higher maternal and paternal education were associated with higher odds of a woman receiving an ultrasonographic examination during her pregnancy (Table 4). Educational attainment of the mother had a stronger association with the likelihood of receiving an ultrasonographic examination than did educational attainment of the husband. The two proxies for household income—land ownership and housing materials—had weak but significant associations with receiving an examination. A young mother (<18 years) had lower odds of undergoing an examination than did a woman aged 18 years or older but younger than 35 years (Table 4). Using women who had at least one live-born son before the index pregnancy as a reference, those who had 1–2 live-born daughters and no live-born sons did not have increased odds of ultrasonography, but those who had three or more live-born daughters and no live-born sons had significantly increased odds of undergoing an ultrasonographic examination (Table 4).

Twelve facilities were identified as birthing centers in the study area, covering approximately one-third of the whole district. None of these centers had ultrasonography capacity; as a result, many women attended private clinics within the district to obtain an ultrasonographic examination. Auxiliary nurse midwives were interviewed at 10 facilities and staff nurses at two facilities.

The message given during prenatal care about ultrasonography differed across the 12 birthing centers. Providers from three centers (one primary health center, two health posts) stated that they refer everyone who comes in for a prenatal care visit for ultrasonography. Providers from three other facilities (one primary health center, one sub-health post, one facility run by a non-governmental organization) stated that they refer only if they suspect a risk factor (e.g. non-cephalic presentation, multiple pregnancy, or growth-restricted fetus).

Five interviewees indicated that women usually comply with an ultrasonography referral if they are notified that an abnormality is suspected, but otherwise do not or are less likely to. One provider explicitly indicated that he/she limits referrals to women with suspected risk factors because of concerns about the financial burden on the patient to pay for ultrasonography. Providers from other birthing centers mentioned more vaguely that the importance of ultrasonography is conveyed to the mother, or that they recommend ultrasonography but not in a standardized manner. Lastly, providers from two birthing centers expressed concerns about the quality of ultrasonographic examinations conducted at a private clinic: one indicated that she had received sonograms from the private clinic that were not of the uterus.

4. Discussion

Despite the potential of obstetric ultrasonographic diagnostics to improve fetal, neonatal, and maternal care-seeking, utilization in the rural plains of Nepal was found to be very limited. Only slightly more than one-quarter of recently pregnant women received an obstetric sonographic examination, of whom more than half underwent only one examination. High maternal and paternal educational attainment, having three or more live-born daughters but no live-born sons, and proxy variables for household income significantly increased the odds of receiving an ultrasonographic examination, whereas younger maternal age (<18 years) significantly decreased the odds.

Nepal has made great progress in reducing its neonatal and maternal mortality, and has successfully met its Millennium Development Goals 4 and 5. Nevertheless, stillbirths and neonatal and maternal mortality remain high (23 stillbirths per 1000 births [8], 23 neonatal deaths per 1000 live births [9], and 280 maternal deaths per 100 000 live births [9]). Additionally, it is expected that an increasing percentage of these deaths will be attributable to intrapartum-related complications as the mortality rates continue to decrease.

Improving diagnostic capacity for potential intrapartum-related complications might be beneficial, allowing households to make appropriate birth preparation before the start of labor; tertiary referral facilities can be difficult to reach in rural areas owing to distance, transport, and cost. Referral to these locations during labor from the first point of contact with the health system might cause fatal delays for risky conditions that could be diagnosed prenatally. For example, the present study area, which has a population of approximately 800 000 individuals (unpublished data), does not have one facility with cesarean delivery capacity. The nearest comprehensive emergency obstetric care facilities, which by definition have this capacity, are located in Birganj and in Janakpur, both 3–4 hours away by car.

Creating a cadre of fully trained radiologists will require substantial human and financial resource inputs into the medical education system in Nepal, but task-shifting by training lower-level health workers to detect basic obstetric risk factors might be feasible, especially with ultrasonography technologies becoming more affordable and portable [10]. Task-shifting might also help to address concerns regarding the poor quality and misuse of ultrasonography that could be introduced through the proliferation of unregulated private clinics. The potential for remote radiologists to interpret locally conducted ultrasonographic examinations through telemedicine strategies might also leverage the limited number of radiologists for greater coverage. Further research is needed to determine whether provision of obstetric ultrasonographic examinations increases institutional deliveries and subsequently improves pregnancy outcomes in this context.

Various training programs have explored the expansion of ultrasonography use in low-resource settings. A Partners in Health program in Rwanda trained non-radiologist physicians in a 9-week program, and showed that the trainees achieved 96% concordance with a radiologist’s diagnosis [11]. The same study included 345 obstetric and non-obstetric scans, and 43% of patients had their health management plan altered [11]. In South Africa, a controlled trial examined the effect of adding basic ultrasonography services at a community-based midwifery unit, and witnessed reductions in referrals to higher-level facilities [12]. However, the sustainability and long-term quality of such programs are unclear.

Ultrasonography has also been introduced in refugee camp settings [13,14]. In a camp on the Thai–Burmese border, for example, local health workers were able to make accurate fetal anthropometric measurements after a 3-month training period, thereby improving gestational age dating [14]. Mothers attending these clinics reported use of ultrasonography as a way to increase safety during childbirth, with many expressing concerns about the position of the fetus [15]. An ongoing multicountry (Pakistan, Kenya, Zambia, Democratic Republic of Congo, and Guatemala) cluster-randomized trial (Clinicaltrials.gov NCT01990625) is exploring whether the introduction of ultrasonography in rural health clinics might improve pregnancy outcomes [16]. The ultrasonography technology itself is also being addressed to determine whether low-cost, easy-to-use machines can be developed to best meet the level of human resource available in the health systems of low-income countries [17].

Expanding the use of ultrasonography will require caution. Increased access in low-income countries has led to misuse and overuse in some contexts. In a survey of 400 women in Vietnam [18], the average number of scans during pregnancy was 6.6, and one-fifth of the respondents had 10 or more scans. The investigators indicated that this was most probably driven by the facility's desire for extra revenue [18]. Similar excessive use of ultrasonographic examinations—with the examinations being a source of revenue—has occurred in Syria [19]. Additionally, when 232 obstetric scans recorded in a Ugandan hospital were categorized as appropriate (i.e. provided for specific medical reasons, and dating and screening for congenital abnormalities at 10–24 weeks) or inappropriate (i.e. gestational age dating beyond specified time, routine monitoring of growth despite no indication of intrauterine growth restriction, and repeat scans for inability to determine placental position), 53.4% were labeled as inappropriate [20]. Lastly, in a clinic in Botswana where the doctors were all expatriates, overestimation of the diagnostic power of the ultrasonographic examination was observed, with some patients believing that all abnormalities and complications might be detected through sonography [21].

Ultrasonography can also be used for fetal sex determination. Prenatal sex determination and sex-selective abortions are illegal in Nepal [22]. A survey conducted in Nepal by the Center for Research on Environment Health and Population Activities noted that 11.1% women had sought an obstetric ultrasonographic examination, and one-quarter of those sought it for prenatal sex determination [22]. Such use of ultrasonography not only has implications for abortion rates and sex ratios, but also carries the potential consequences of incorrect assessment. In a Nigerian study [23], some women who delivered a female neonate after being told that their fetus was male via ultrasonography reported negative experiences such as marital conflict (including physical violence from their partners) and regret toward tubal ligation. A Ghanaian study [24] showed an ultrasonography accuracy of only 86.5% for detection of fetal sex. Task-shifting to integrate ultrasonography into the public health system and thus reducing the role of unregulated private clinics might help to control misuse of ultrasonography.

The issue of prenatal sex determination has discouraged the expansion of ultrasonography, especially in south Asia. In the present study, approximately 7% of women who reported receiving an ultrasonographic examination during their pregnancy stated that they sought the examination for fetal sex determination. Notably, mothers with three or more live-born daughters and no live-born sons in the family were more likely to seek an ultrasonographic examination during pregnancy, which might hint at plans for sex-selective abortion. Regulatory enforcement has been effective to some degree in addressing misuse of ultrasonography. For example, Nawanshahr District in India conducted a vigorous campaign against fetal sex determination, and successfully corrected the sex ratio [25]. The ratio imbalance reappeared once the campaign ended, and the methods that were used—including rigorous investigation of ultrasonography scans and abortions—could have been too intrusive. It is necessary to explore effective measures at the individual, community, and government level to address this issue; sex selection is a legitimate concern that touches on issues of human rights and sex equality, but the potential health benefit of obstetric ultrasonography must not be dismissed because of these concerns.

The strength of the present study is the quality of the information obtained. The data on maternal characteristics were collected during the pregnancy, and data on knowledge and utilization of ultrasonography were collected very soon after delivery. One of the limitations is that some questions—e.g. reasons for receiving ultrasonography—had the potential for more nuanced responses, but the quantitative nature of the survey restricted the responses. Limited resources prevented the collection of additional qualitative data. Additionally, owing to resource limitations and concerns regarding maternal recall, it was not possible to ask women who received an ultrasonographic examination questions specific to their experience during and results from the examination.

Only one-quarter of women in rural Nepal had received an obstetric ultrasonographic examination during their most recent pregnancy. Approximately 36% of women had never heard of the technology before. Further research is needed to investigate to what extent obstetric ultrasonography can improve pregnancy outcomes in low-resource settings, and to identify and address major barriers to proper utilization of ultrasonography, such as demand for fetal sex determination and limited human resources.

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Synopsis

In rural Nepal, one-quarter of women received an ultrasonographic examination during their most recent pregnancy. Parental education and maternal age were predictors of ultrasonographic examination.

Table 1

Characteristics of included mothers.

Characteristic	Value [a]
No. of prenatal visits during pregnancy (n=6175)	1.6 ± 0.8
0	1081 (17.5)
1	812 (13.1)
2–4	3816 (61.8)
≥5	466 (7.5)
Maternal education, y (n=6181)	2.5 ± 4.1
0	4230 (68.4)
1–6	664 (10.7)
7–10	957 (15.5)
≥11	330 (5.3)
Husband’s education, y (n=6177)	4.7 ± 4.6
0	2490 (40.3)
1–6	1379 (22.3)
7–10	1703 (27.6)
≥11	605 (9.8)
Amount of land owned, katta (n=6168)[b]	16.4 ± 31.1
<1	1831 (29.7)
≥1	4337 (70.3)
Housing (n=6164)	
Mainly thatch, grass, and/or branches	4122 (66.9)
Mainly wood, cement, and/or brick	2042 (33.1)
Maternal age, y (n=6182)	23.3 ± 4.8
<18	520 (8.4)
18 to <35	5492 (88.8)
≥35	170 (2.7)
Gravidity (n=6182)	1.7 ± 1.7
First pregnancy	1761 (28.5)
1–3 previous pregnancies	3605 (58.3)
≥4 previous pregnancies	816 (13.2)
Sex of previous children (n=6181)	
≥1 live-born sons	2773 (44.9)
0 live-born sons, 1–2 live-born daughters	1222 (19.8)
0 live-born sons, ≥3 live-born daughters	246 (4.0)
No previous live-born children	1940 (31.4)

[a]Values are given as mean ± SD or number (percentage).

[b]1 katta is equivalent to approximately 338 m^2.

Table 2

Knowledge of ultrasonography among included mothers (n=6182).

Question	No. (%)
Have you heard of ultrasonography/video X-ray before?	
No	2220 (35.9)
Yes	3962 (64.1)
What is it for?[a]	
Baby's health	1566 (39.5)
Mother's health	1224 (30.9)
Fetal position	2868 (72.4)
Fetal sex	1539 (38.8)
From whom did you hear about it?[a]	
Family	2208 (55.7)
Neighbor/friend	2622 (66.2)
Traditional birth attendant/chamain [b]	178 (4.5)
Community health volunteer	196 (4.9)
Local doctor (not certified)	369 (9.3)
Auxiliary nurse midwife/health assistant/community medical assistant/staff nurse	502 (12.7)
Qualified doctor	565 (14.3)

[a]Up to three can be selected.

[b]Individuals not formally trained in health work who take on some childbirth-related duties (e.g. cutting the umbilical cord and massaging the neonate).

Table 3

Use of obstetric ultrasonography.

Question	No. of respondents	% of women who had an ultrasonographic examination (n=1630)	% of all women interviewed (n=6072)[a]
How many ultrasonographic examinations were received during the most recent pregnancy?			
0	4442	–	73.2
1	1011	62.0	16.7
2	398	24.4	6.6
3	141	8.7	2.3
4	61	3.7	1.0
5	12	0.7	0.2
≥6	7	0.4	0.1
Reason for having sought ultrasonographic examination			
Advised by doctor	564	34.6	9.3
For the fetus's health	529	32.5	8.7
For the mother's health	515	31.6	8.5
To determine the position of the fetus	784	48.1	12.9
To determine fetal sex	111	6.8	1.8
Where was the most recent ultrasonographic examination conducted?			
Within the district	819	50.2	13.5
Birganj (3–4-h drive)	238	14.6	3.9
Janakpur (3–4-h drive)	296	18.2	4.9
Kathmandu (6–7-h drive)	36	2.2	0.6
Elsewhere in Nepal	55	3.4	0.9
India	165	10.1	2.7
Other	4	0.2	0.1

[a]Excludes 110 women who reported having heard of ultrasonography before but did not provide responses on utilization.

Table 4

Association between potential predictor variables and receiving an ultrasonographic examination during pregnancy.

Variable	Adjusted odds ratio (95% confidence interval)
Number of prenatal visits during pregnancy	
0	Ref.
1	1.48 (1.22–1.79)
2–4	1.91 (1.65–2.21)
≥5	5.08 (3.72–6.93)
Maternal education, y	
0	Ref.
1–6	1.58 (1.31–1.90)
7–10	3.40 (2.74–4.23)
≥11	10.28 (5.55–19.04)
Husband's education, y	
0	Ref.
1–6	1.38 (1.19–1.58)
7–10	1.84 (1.58–2.14)
≥11	1.99 (1.47–2.69)
Amount of land owned, katta [a]	
<1	Ref.
≥1	1.14 (1.01–1.29)
Housing	
Mainly thatch, grass, and/or branches	Ref.
Mainly wood, cement, and/or brick	1.23 (1.08–1.39)
Maternal age, y	
<18	0.72 (0.59–0.90)
18 to <35	Ref.
≥35	0.80 (0.58–1.12)
Gravidity	
First pregnancy	0.76 (0.52–1.10)
1–3 previous pregnancies	Ref.
≥4 previous pregnancies	0.95 (0.79–1.14)
Sex of previous children	
≥1 live-born sons	Ref.
0 live-born sons, 1–2 live-born daughters	1.04 (0.89–1.21)
0 live-born sons, ≥3 live-born daughters	1.55 (1.15–2.08)
No previous live-born children	1.07 (0.75–1.54)

[a] 1 katta is equivalent to approximately 338 m^2.