

Investigating the Cultural Meaning of Obstetric Ultrasound in Rural Pakistan

by

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## **Abstract**

**Background and Rationale:** Obstetric ultrasounds have become a routine practice in pregnancy management globally. Evidence, however, suggests that while obstetric scans in high-income countries are associated with positive experiences to mothers, the technology may not be having similar positive impact in low-and middle- income countries. Available evidence shows the detrimental impact of obstetric ultrasounds on fetal sex identification and consequent abortions of female fetuses in India. Studies from Vietnam, Tanzania and Uganda suggest some women have started perceiving ultrasound scans as the entirety of antenatal care. Other studies suggest mothers are overestimating the diagnostic abilities of ultrasound technology to the point where they are not receiving the appropriate care. The concerning nature of the current evidence available in the literature indicates the need for a detailed, qualitative investigation that examines both women and providers' understandings and practices of obstetric ultrasound use.

**Objective:** To explore the impact of ultrasound technology on both the biomedical, and lay, cultural management of pregnancy in Rural Pakistan.

**Method:** Data were drawn from two qualitative research projects conducted in Pakistan between 2009 and 2015. The first study, entitled “Are community midwives addressing the inequities in access to skilled birth attendance in Pakistan? Gender, class, and social exclusion”, used a mixed methods approach - an institutional ethnography and a cross-sectional survey to explore whether a new cadre of midwives were improving access to skilled maternity care for poor and socially excluded women in two districts – Layyah and Jhelum in Punjab. Qualitative data were collected using in-depth interviews with 83 health care providers and 139 community members, and 180 formal and informal observations of patient-provider interactions in health facilities. The survey interviewed 1457 women who had given birth in the two years prior. The second project,

“Addressing disparities in maternal health care in Pakistan: gender, class and exclusion” is a critical ethnography of maternal health services in a village in Chakwal, Punjab. Data were generated over the course of 10-months using 134 observations, 94 in-depth interviews, and 11 focus group discussions. Transcripts were selected if they contained the term “ultrasound” and related terms, e.g., “scan”. Qualitative data were organized using Quirkos software and analyzed through thematic analysis. The survey data were analysed using STATA 14.

**Results:** Our findings revealed that an obstetric ultrasound was a common procedure for pregnant women in rural Pakistan as part of their pregnancy management. In fact, the data suggests women perceived the scan as synonymous with antenatal care and assumed it was an integral part of their antenatal visit, irrespective of any stated medical indication. It was sometimes the only care they sought during pregnancy, with 80% reporting a scan while only 49% reported receiving a blood test, blood pressure measurement or a urinalysis. A common reason underlying these patterns of use was the mothers’ strong trust in ultrasound technology’s abilities to diagnose ill-health broadly and believing it alone would ensure a healthy pregnancy and healthy baby. So strong was this trust in the powers of ultrasound technology, that mothers expected delivery dates and fetal sex reports to be precise. Any deviations were unacceptable. Wider societal level forces – a highly privatized health care sector and strong son-preference - are driving a mutually reinforcing supply-demand cycle of potentially unnecessary scans during a healthy pregnancy. Researchers observed the providers, mostly in the private sector implementing different strategies to market their ultrasound services including prioritizing ultrasound scans during appointments over other elements of antenatal care, encouraging monthly scans, and offering special discounts. A desire to ensure birth of a son is driving pregnant women’s demand for repeat scans in the hope of either

expecting a different ‘diagnosis’ if a female fetus is suspected or repeatedly confirming a male fetus.

**Conclusions:** Obstetric ultrasound has become the preferred method of surveillance to women during healthy pregnancies to the extent that its use is understood as synonymous and equivalent to antenatal care. It appears that both providers, particularly those in the profit-driven private sector, and patients have mutually reinforced the demand for un-necessary ultrasound scans during pregnancy. Given the limited role of obstetric ultrasound in pregnancy surveillance, it is important to ensure that the technology does not replace routine elements of antenatal care. While a culture that prizes sons is not going to be easily amenable to change, health policy makers can address the market forces underlying the for-profit private health care sector to the limit unscrupulous use of ultrasound technology. Measures must be taken to ensure that health care provision for women during pregnancy is driven not by profit, but by medical recommendation.

## **Preface**

This thesis is an original work by Janat Ibrahim. The research project, of which this thesis is a part of received ethics approval from the University of Alberta Research Ethics Board, Project Name “Investigating the Cultural Meaning of Ultrasound Technology” No. Pro00103670, 10/8/2021.

## **Dedication**

To all the women in my life, whom I have already met, and whom I have yet to meet and learn from.

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Completion of my degree could not have happened without the guidance, and support of all of incredible people in my life. I cannot thank my thesis supervisor, Prof. Zubia Mumtaz enough for her guidance and mentoring during this degree. I have my supervisor to thank for this newfound confidence in myself and my writing ability. Thank you to my supervisory committee member, Dr. Stephen Hodgins, who provided valuable insight to my thesis. Thank you to the School of Public, and all of the wonderful people I have met through this program. My deepest gratitude to my family for always being my number one support. Thank you to my mother for listening to my unfinished drafts and getting as excited as I do when I have a productive writing day. Thank you to my father for showing me love and supporting me every day. Last but not least, thank you to my wonderful partner for joining me on this journey.

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## Chapter 1: Manuscript 1

### Ultrasound Imaging and the culture of pregnancy management: a review of the literature

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#### ABSTRACT

**Background and Rationale:** Obstetric ultrasound imaging has become a routine practice of pregnancy management globally. Ultrasound imaging is, essentially, an introduction of a new technology in health care, especially in low- and middle-income contexts. New technologies get incorporated into routine practice when they meet a need and align with the user's culture, described as patterns of thoughts, behaviours, and practices. Given pregnancy management practices are culturally informed, we hypothesize introduction of obstetric ultrasound has impacted the culture of pregnancy management.

**Methods:** We conducted a systematic review of the literature. A comprehensive search of five databases yielded 45 peer-reviewed articles. All articles were assessed for quality and analyzed using a critical interpretive synthesis approach.

**Results:** The literature shows that in certain low and middle-income contexts, ultrasonography is the preferred method of surveillance received by pregnant women, often to the neglect of all other forms of antenatal care. Mothers in some settings seem to understand obstetric ultrasound as an all-powerful tool that can not only identify, but also treat any maternal/fetal abnormalities. They overestimate the diagnostic abilities of the technology, believing it can deliver the 'perfect baby'. The literature further shows providers were driving the commercialization of the technology. With a high demand for nonmedically indicated ultrasound scans, healthcare providers in both public, and primarily private clinics, profit by meeting patient requests.

**Conclusion:** The literature shows that ultrasound technology is sometimes the only care received by pregnant women in low and middle-income countries. This behaviour appears to be driven by the commercialization of ultrasound scans by providers in the private sector. The use of obstetric ultrasound as the only antenatal care sought and provided during pregnancy can have serious negative implications on fetal and maternal health.

## **INTRODUCTION**

An obstetric ultrasound is a routine practice in pregnancy management (Alfirevic et al., 2013). The Society of Obstetricians and Gynecologists of Canada recommends two scans during pregnancy: the first at 11-14 weeks and another at 18-20 weeks (Cargill and Morin, 2017). The ultrasound scans are used for assessing gestational age, locating the placenta, and detecting any fetal anomalies and multiple pregnancies (Makhlouf and Saade, 2013; Whitworth et al., 2015). Obstetric ultrasounds in high-risk pregnancies have also been shown to reduce the risk of perinatal death (Cargill and Morin, 2017).

The practice has become widespread globally. Many low and middle-income countries are steadily incorporating obstetric ultrasound into routine antenatal care (Bashour et al., 2005; Gammeltoft and Nguyen, 2007; Gonzaga et al., 2010). For example, in India, 61% of pregnant women nationally reported receiving an obstetric ultrasound in 2016 (Institute of Population Studies, NFHS, ICF International, 2017). Similar reports were found in Syria, where 97.9% of women received an obstetric ultrasound as a part of their routine antenatal care during their last pregnancy (Bashour et al., 2005). In Vietnam at least one ultrasound scan during pregnancy is universal. The majority of pregnant Vietnamese women have at least four antenatal care contacts, with nearly 100% of these women receiving at least one ultrasound examination (General Statistics

Office and UNICEF, 2015; Ngo et al., 2018). For many healthcare providers, ultrasound is an indispensable tool in pregnancy management (Edvardsson et al., 2016; Ahman et al., 2019; Holmlund et al., 2020). Physicians in Rwanda described an ultrasound as “mandatory in pregnancy management” and “a tool they could not imagine working without” (Edvardsson et al., 2016). Similar findings were reported by midwives in Vietnam who described the technology as a highly valuable tool that plays an important role in maternity care (Holmlund et al., 2020).

The use of ultrasound scans for clinical management of pregnancy is, essentially, an introduction of a new technology in maternal health care in rural low- and middle-income contexts (Campbell, 2013). Healthcare technology is a term used to define any device, tool or machine that is used to prevent, diagnose, or treat a disease, disorder, or abnormal physical state (WHO, 2011). It includes thousands of products, ranging from digital thermometers to life-support machines. Incorporation of a new health care technology into practice is, however, not a straightforward matter. A starting point for technology uptake is its perceived usefulness. Potential users are more likely to adopt a technology if it serves a need (Davidson, 2005; Venkatesh and Bala, 2008). An example of a need is an obstetrician recognizing that abdominal palpations are not adequate in examining for fetal abnormalities. In such a case, an imaging tool would be useful for diagnostic purposes. Most commonly, when an innovation successfully meets a need, the next step is its integration into routine use (Venkatesh and Bala, 2008).

However, according to Thorburn (2011), uptake of technology is more than these elements; it also requires – using a broad term – a cultural transformation. Culture is defined as a sum total of patterns of thoughts and behaviors that are grounded in shared values, attitudes, and norms (Hofstede, 1991). Culture creates an environment into which the technology is integrated. Moreover, there is reciprocity in this interaction due to the interdependent nature of technology

and culture (Hansen et al., 2012). In some cases, the technology must adapt to the culture, while in others the culture may respond to the technology, changing forever in the process (Thorburn, 2011; Masimba et al., 2019). In other words, ‘culture’ provides the structure into which the technology fits, sometimes perfectly, sometimes not.

A large body of literature suggests pregnancy management, while grounded in prioritizing the best possible health outcomes for both mother and child, is also a culturally informed practice. Although largely understood in the realm of lay management of pregnancy, medical culture is also a distinct and powerful system of socialization that modulates medical practice (Martin, 1991). Lay cultural practices of pregnancy management are commonly understood to include practices such as pregnant women refraining from eating culturally defined ‘cold’ foods and use of specific traditional remedies to alleviate nausea, to prohibiting pregnant women from attending certain social events, such as funerals, in order to protect them from malevolent supernatural spirits (Winch et al., 2005; Lau, 2012; Morris et al., 2014; Ahmed et al., 2020). An example of medical cultural practice can be found in physician’s approaches to the use of elective c-sections in the absence of medical indication. For example, providers in Brazil, China, Iran, and Turkey are willing to perform c-sections for non-medical reasons, including maternal requests (Arikan et al., 2011; Bagheri et al., 2013; Ouyang and Zhang, 2013) In contrast, obstetricians in the United Kingdom and Denmark do not always respond to maternal requests for elective c-sections in the absence of medical indication (Bergholt et al., 2004; Kamal et al., 2005). According to Menacker et al (2006), medical culture, rather than lack of physician training or overzealous use of interventions, may potentially underlie the high proportion of cesarian deliveries conducted without medical indication in some countries and not in others.

Viewed together, we hypothesize the introduction of obstetric ultrasound as a new technology in rural low- and middle-income contexts has potentially impacted the culture of pregnancy management, both biomedical and lay. There is some evidence that introduction of ultrasound imaging has led an increase in antenatal attendance in at least some settings in low - and middle-income country contexts which otherwise struggled to promote uptake of antenatal care (Kawooya et al., 2015; Cherniak et al., 2017). There is also some evidence that integration of ultrasound as a clinical technology in pregnancy management has transformed the practice into one that potentially over-uses and even misuses the technology for non-clinical purposes (Gammeltoft and Nguyen, 2007; Gonzaga et al., 2010; Kawooya et al., 2015; Holmlund et al., 2020). The objective of the present paper is to summarize the literature on how the adoption of ultrasound technology may have changed the contemporary culture - or the norms, beliefs, and practices in this case - of pregnancy management as a whole.

## **METHODS**

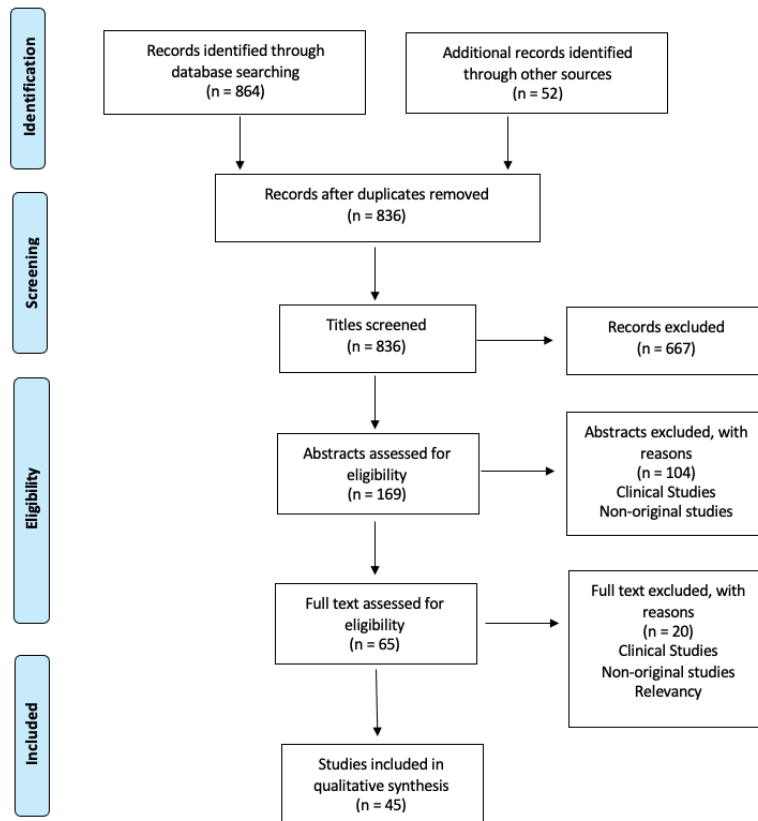
Five major databases were searched for primary literature. These include Medline, Academic, Scopus, Global Health, and CINAHL. Search terms “ultrasound,” “pregnancy,” “culture,” “meaning,” and “significance” in various combinations and variations were used. Database searches were supplemented by going through citations of the eligible full-text articles. As the analysis progressed and themes started emerging, we conducted additional searches using the keywords “commercialization” and “diagnostics” in addition to the words used above.

The paper titles and abstracts were first filtered for relevancy to the study objective and subjected to our inclusion and exclusion criteria. Our inclusion criteria included an original study, peer-reviewed and published in the year 2000 or later. Clinical studies that assessed medical or surgical interventions in physiological or pathological aspects were excluded. A total of 45 studies



were included in the review. See Figure 1 for the flow diagram. Each study was assessed using criteria developed by Morse (2002) and the QualSyst tool (Kmet et al., 2004). Qualitative studies were subjected to Morse’s criteria and the quantitative studies to the QualSyst criteria. All the studies were rated out of fifty on their ability to meeting these criteria. Only high (40-50/50) and medium (30/50) quality studies were included in the review (See Appendix 1).

Figure 1. PRISMA 2009 Flow Diagram



All selected articles were input into data management tool Quirkos (2021). The basic descriptive data of each study were also extracted, primarily information on regions, year of publication, and study purpose. The articles were open coded with broad labels and notes written on the side for reference. Axial coding was then used to identify any relationships between the open codes. Categories were developed through searching axial codes and used to identify

overarching themes. Themes were then refined and named to capture the meaning of each theme in a concise manner.

## **RESULTS**

### *Ultrasounds Replacing Routine Antenatal Care*

Within the literature selected for this systematic review, a key theme emerging from seventeen of the forty-five studies is that pregnant women were replacing routine elements of antenatal care – blood pressure measurements, urinalysis, weight measurement - with ultrasound examinations. For example, a survey of 400 pregnant women in Hanoi, Vietnam found that the mothers had had an average of 6.6 scans in 8.3 antenatal visits. Of note was that some mothers in the study had received an upwards of 15 scans without any other forms of pregnancy management (Gammeltoft and Nguyen, 2007). In a qualitative study from Hanoi, a sample of 25 midwives from three hospitals reported their observation of pregnant women replacing routine antenatal care with repeated ultrasound scans. According to the midwives, some women were even ignoring or refusing to have any other antenatal clinical examinations or diagnostic/screening procedures other than an ultrasound (Holmlund et al., 2020). Consequently, a number of studies suggest ultrasonography is common and, in some cases, the only antenatal care procedure received by women in many low and middle-income countries (Gammeltoft and Nguyen, 2007; Firth et al., 2011; Edvardsson et al., 2015; Doan et al., 2017).

Some doctors showed concern over the importance given to ultrasounds and the resultant neglect of other elements of antenatal care (Gammeltoft and Nguyen, 2007). Tautz et al. (2000) found that upon the introduction of ultrasound, healthcare providers in Botswana were found to not take clinical histories or do the recommended examinations and procedures. The doctors in the same study also acknowledged that the ultrasound technology had started replacing their clinical

examinations. Rather than clinically assessing pregnancy progress using abdominal palpation, doctors reported becoming increasingly dependent on the imaging technology (Tautz et al., 2000). These findings were confirmed by Gammeltoft and Nguyen (2007) in Vietnam, where women complained that the doctors tended to focus more on the technology, and less on them.

The literature suggests that while ultrasound scans have been shown to pose no real risk to mothers or babies (Bashour et al., 2005), replacing all other forms of antenatal care with an obstetric ultrasound scan during pregnancy can potentially have serious negative implications on fetal and maternal health (Edvardsson et al., 2016; Holmlund et al., 2020). Comprehensive antenatal care is meant to detect and prevent complications arising from anemia, pre-eclampsia, eclampsia, and sepsis amongst other issues (AbouZahr and Wardlaw, 2013). Ultrasound examination alone cannot detect most of these pregnancy complications (Edvardsson et al., 2016). In Vietnam, Holmlund et al. (2020) interviewed midwives who described situations in which women had developed serious illnesses or even died because of undiagnosed pre-eclampsia, a condition that could have been easily detected through routine antenatal blood pressure measurements and urinalysis had these tests been done. But the only antenatal care the women had only received was an ultrasound scan, which is not designed to measure blood pressure or proteinuria.

#### *Overestimating the Diagnostic Ability of Ultrasound*

The second theme emerging from the literature provided insight into why some women in low- and middle- income contexts were giving greater priority to an ultrasound scan over other elements of routine antenatal care. It suggests mothers are overestimating the diagnostic abilities of ultrasound technology. A number of studies indicate that the pregnant women believed ultrasound technology is the most accurate tool for assessing the well-being of their baby. The mothers

believed it is far superior to abdominal palpitation, but more importantly as superior to urine tests and blood tests that are essential for diagnosing pre-eclampsia and anemia (Tautz et al., 2000; Edvardsson et al., 2014; Edvardsson et al., 2016).

Gammeltoft and Nguyen (2007), for example, reported that women in their study setting in Vietnam believed an ultrasound examination was far better than “ordinary antenatal care” because of the imaging technology’s ability to physically see fetal development. Some women strongly believed that ultrasound screening offered the ability to recognize problems that cannot be physically seen, and that without ultrasound these problems will remain undetected (Tautz et al., 2000; Firth et al., 2011; Edvardsson et al., 2016). A similar sentiment was shared by women in a study in Botswana, who regarded ultrasound as a magical device that can see everything (Tautz et al., 2000). These women had such high confidence in the technology, they even believed that a scan could fix any abnormalities in their own, and their baby’s health (Tautz et al., 2000; Firth et al., 2011). A study in Tanzania found that some women even expected ultrasound technology to detect and treat sexually transmitted diseases, including HIV, both in themselves and the baby. They also believed the technology will prevent their babies from getting infected with HIV and other sexually transmitted diseases (Firth et al., 2011). Across these study settings, at least some women believe an ultrasound guaranteed a safe pregnancy and delivery of the ‘perfect baby’ (Tautz et al., 2000; Gammeltoft and Nguyen et al., 2007; Firth et al., 2011; Rijken et al., 2012; Edvardsson et al., 2016).

These mothers’ faith in the diagnostic abilities of ultrasound technology is, however, not supported by evidence. The accuracy of the technology is limited and highly dependent on the skills of the providers operating the device. Lindgaard and Riisgaard (2017) reported a wide variation in gestational age measurements taken by obstetricians and general physicians.

Inexperienced general physicians were found more likely to provide inaccurate estimates of gestational age (Lindgaard and Riisgaard, 2017). Drukker et al (2020) reported that ultrasound screening missed one in 300 fetal anomalies and Engelbreschtsen et al. (2013) found that only 83% of chromosomal syndromic abnormalities were correctly diagnosed by ultrasound imaging.

One key area where the over-estimation of ultrasound's ability to accurately diagnose can have a detrimental impact is fetal sex identification and the possibility of a wrong fetal disclosure. There is a strong preference for male offspring in many countries in Asia and Africa (Lamichhane et al., 2011; Qadir et al., 2011; Ohagwu et al., 2014; Pradhan et al., 2019). Studies show that parents in these cultural contexts often exhibit a preference for sons for economic and socio-cultural reasons, including for continuing the family lineage, old age security, and death rituals (Chigbu et al., 2008; Rai et al., 2014). In South Asia sons are a source of elevated social status and respect for both men and women (Rai et al., 2014). A lack of sons can lead to marital discord, violence and even divorce (Ataullahjan et al., 2021; Rai et al., 2014). So powerful are these ideals of son-preference that, in much of South Asia and even in Africa, women are considered childless until they have a male offspring (Chigbu et al., 2008; Rai et al., 2014). In such cultures, mothers describe experiencing reassurance when the ultrasound-diagnosed fetal sex matches the preferences of their husbands and extended families, which is often a male fetus (Bashour et al., 2005). A female fetus can lead to threats to marital security, physical abuse from spouses, loss of interest in the pregnancy, or verbal pressure from female in-laws to either undergo sex selection during pregnancy or in some extreme cases, postnatal sex selection (Bashour et al., 2005; Chigbu et al., 2008; Lamichhane et al., 2011 Ohagwu et al., 2014)

The stakes for accurate identification of fetal sex are, therefore, very high. However, fetal identification ability of ultrasound does not support the women's trust in it. Efrat et al. (2006)

found that the accuracy of fetal sex determination increased with gestational age, from 70.3% at 11 weeks to 98.7% at 12 weeks, and 100% at 13 weeks. In this study, male fetuses were wrongly assigned as female in 56% of cases at 11 weeks; 3% at 12 weeks; and 0% at 13 weeks. Another study, by Mensah et al. (2014), found that ultrasound assessment of fetal sex was accurate for 86% of births (Mensah et al., 2014). A full 14% of the results were inaccurate. Provider error also plays a role in inaccurately determining fetal sex. A study investigating fetal sex discordance found that in 28 of 83 (34%) cases, the apparent discordance was caused by human error, with fetal sex misassignment by ultrasonography accounting for 11 of those cases (Dhamankar et al., 2020).

### *Commercialization of Ultrasound Technology*

The third theme emerging from this review of the literature is that pregnant women's excessive number of scans is being driven by profit-motivated providers. Ten articles highlighted the significant role commercialization played in influencing the ultrasound use rates during pregnancy. Evidence suggests two ultrasounds during pregnancy are sufficient for most pregnancies, the first one at 11-14 weeks and another at 18-20 weeks (Cargill and Morin, 2017). However, it seems doctors are recommending far more scans during non-complicated pregnancies. In Vietnam, doctors in both public and private clinics were conducting an ultrasound scan with each antenatal visit to women who were experiencing healthy pregnancies. Some women in Vietnam even reported being encouraged by doctors to have a minimum of one scan per month (Gammeltoft and Nguyen, 2007). Edvardsson et al. (2015) also observed this in Vietnam, with some women experiencing non-complicated pregnancies being advised monthly ultrasounds in the last trimester. Considering the value given to doctors' counsel, it is not surprising that many women were complying with their advice (Gammeltoft and Nguyen, 2007).

The literature describes how private sector clinics in some settings are pushing the growing commercialization of ultrasound scans, viewing it as an opportunity to increase revenues. They are doing so by both creating a demand and providing the services. Currently, studies of private sector clinics in Syria, Vietnam, and Uganda have found them to be playing a major role in providing women with frequent non-medically indicated ultrasound examinations (Bashour et al., 2005; Gammeltoft and Nguyen, 2007; Gonzaga et al., 2009; Edvardsson et al., 2015). This was captured in a survey in Syria in which over 94% of routine ultrasound scans in a sample of 490 women in Syria were conducted by private-sector obstetricians (Bashour et al., 2005). This was observed in Vietnam as well, where Holmlund et al. (2020) found that the use of private clinics for ultrasound examinations was common and preferred, Women in Vietnam receiving antenatal care speculated that the majority of obstetricians prefer doing ultrasound exams despite their reservations because it is easy to operate and garners profit per exam (Bashour et al., 2005). Midwives in Vietnam working in the public sector described common instances of private clinics calling women back for repeat ultrasound examinations in order to increase their profit (Holmlund et al., 2020). Public hospitals in Vietnam have drawn upon this demand as a mechanism to generate funds and have started providing service areas where pregnant women can pay to have ultrasound examinations done whenever they wanted (Holmlund et al., 2020).

## **DISCUSSION**

Our review of the literature aimed to summarize the literature on how the adoption of ultrasound technology may have changed the contemporary culture - or the norms, beliefs, and practices in this case - of pregnancy management practices. The literature showed that in many low and middle-income countries, mothers were starting to replace routine elements of antenatal care with an ultrasound examination only. Repeated ultrasound scans were often the only care sought by

pregnant women, sometimes refusing other forms of antenatal care. They tend to overestimate the diagnostic abilities of the technology to the extent, in some instances, that it is believed to be therapeutic. Some doctors also acknowledged with concern that the ultrasound technology had started replacing their clinical examinations.

The literature also indicated that the commercialization of ultrasound technology may be contributing to the beliefs and practices shared above. The private sector has to become a significant provider of maternal health care in many low- and middle-income countries (Powell Jackson et al., 2014; Mills, 2014; Institute of Population Studies, MEASURE DHS, ICF International, 2018). The global ultrasound market is forecasted to reach USD 10.4 billion by 2027 (Globenewsire, n.d.). While this commercialization is potentially beneficial to mothers because it motivates delivery of a needed service in some of the world's most underserved areas, there is concerning evidence of incongruity in the original motive of providing a service to mothers, and the reality of obstetric ultrasound practices documented above. This incongruity is especially evident when one observes the difference in how ultrasound technology is being used in high-income countries versus low- and middle-income countries. Most of the literature reviewed from high-income countries concerning ultrasound technology in pregnancy management discusses its positive impact on emotional experiences of motherhood, such as bonding with the fetus or wanting photos of the fetus as memorabilia (Rijken et al., 2011; Edvardsson et al., 2015; Roberts et al., 2015; Ahman et al., 2019). In contrast, ultrasound technology has had a more concerning impact on pregnancy management in certain low- and middle-income contexts. Some mothers' misunderstanding of ultrasounds as a treatment, rather than a diagnostic technology, can potentially have adverse health implications. Pregnancy complications such as high-blood pressure, gestational diabetes, or pre-eclampsia cannot be identified by an ultrasound scan. In



circumstances such as these, women risk fetal and maternal health without adequate and appropriate antenatal care (Edvardsson et al., 2015). The technology has also enabled gender disclosures in contexts of son preference with a severely detrimental consequence of increasing skewed sex ratios in much of South Asia and North Africa, or more explicitly, female feticide (Attané and Guilmoto, 2007; Guilmoto, 2009; Gupta et al., 2009).

Our review is limited by the fact that the literature is dominated by research in high-income countries where introduction of ultrasound technology has not had a similar or as detrimental an impact as it has had in low- and middle-income countries. We coded and began our analysis using this literature from high income countries that primarily documented positive emotional experiences of ultrasound scans as a means to bonding with the fetus. As the coding process and thematic development progressed further, these ideas were not deemed important from a policy perspective and were dropped in the final thematic analysis. The more important and potentially detrimental consequences of ultrasound technology on pregnancy management emerged from low and middle-income countries. This literature is, however, limited in number. Moreover, most of the high-quality publications are limited to one country Vietnam. Similar ideas were however identified in varied other countries, such as Uganda, Rwanda, Ghana, Nigeria, and Tanzania. A second potential limitation of our review is that most of the studies were qualitative in nature. While this methodology was important in identifying in-depth thoughts and behaviors, it does not tell us how common these beliefs and practices are at the population levels. However, one mixed-methods study from Vietnam by Gammeltoft and Nguyen (2007) did provide quantitative evidence of the number of ultrasound scans done per pregnancy, which was then used to validate the qualitative findings.

This literature review has important implications for future research and practice. Future research is needed to address the lack of diversity in studies available on the impact of ultrasound technology in low- and middle-income countries. Evidence that some women throughout low- and middle-income countries are replacing ordinary antenatal care surveillance with ultrasound scans needs to be urgently addressed. This may be done through healthcare providers offering better communication with women about the benefits of sufficient antenatal care, and the lack of benefit of repeating unnecessary ultrasound scans.

## **CONCLUSION**

In conclusion, the literature shows that women have been replacing routine antenatal examinations with ultrasound scans during pregnancy management, along with an over-estimation of the technology's diagnostic ability. These beliefs are being potentially perpetuated by the commercialization of ultrasound technology by healthcare providers and the private health sector. Measures must be taken to ensure that provision of ultrasound scans are motivated by medical recommendation, not by profit.

## REFERENCES

- AbouZahr, C., & Wardlaw, T. (2003). Maternal Mortality at the End of a Decade: Signs of Progress? *Bulletin of the World Health Organization*, 79, 561-568.
- Ahman, A., Edvardsson, K., Fagerli, T. A., Darj, E., Holmlund, S., Small, R., & Mogren, I. (2019). A much valued tool that also brings ethical dilemmas - a qualitative study of Norwegian midwives' experiences and views on the role of obstetric ultrasound. *BMC Pregnancy Childbirth*, 19(1), 33.
- Ahmed, J., Raynes-Greenow, C., & Alam, A. (2020). Traditional practices during pregnancy and birth, and perceptions of perinatal losses in women of rural Pakistan. *Midwifery*, 91, 102854. <https://doi.org/10.1016/j.midw.2020.102854>
- Alfirevic, Z., Stampalija, T., & Gyte, G. M. (2013). Fetal and umbilical Doppler ultrasound in high-risk pregnancies. *The Cochrane database of systematic reviews*, 2013(11), CD007529. <https://doi.org/10.1002/14651858.CD007529.pub3>
- Arikan, D.C., Özer, A., Arikan, I., Coskun, A., and Kiran, H. (2011). Turkish obstetricians' personal preference for mode of delivery and attitude toward cesarean delivery on maternal request. *Arch Gynecol Obstet*. 284(3):543-9
- Ataullahjan, A., Vallianatos, H., & Mumtaz, Z. (2021). Violence and precarity: A neglected cause of large family sizes in Pakistan. *Global public health*, 1–10. Advance online publication. <https://doi.org/10.1080/17441692.2021.1879894>
- Attané, I., and Guilmoto, C. (2007). Watering the neighbour's garden: the growing demographic female deficit in Asia. <https://agris.fao.org/agris-search/search.do?recordID=XF2015028131>
- Bagheri, A., Alavi, N.M., and Abbaszadeh, F. (2013). Iranian obstetricians' views about the factors that influence pregnant women's choice of delivery method: A qualitative study. *Women Birth*. 26(1):e45-9.
- Bashour, H., Hafez, R., & Abdulsalam, A. (2005). Syrian Women's Perceptions and Experiences of Ultrasound Screening in Pregnancy: Implications for Antenatal Policy. *Reproductive Health Matters*, 13(25), 147-154.
- Bergholt, T., Østberg, B., Legarth, J., and Weber, T. (2004). Danish obstetricians' personal preference and general attitude to elective cesarean section on maternal request: a nationwide postal survey. *Acta Obstet Gynecol Scand*. 83(3):262-6
- Cargill, Y., & Morin, L. (2017). Content of a Complete Routine Second Trimester Obstetrical Ultrasound Examination and Report. *Journal of Obstetrics and Gynaecology Canada*, 39(8), E144-E149. Retrieved from Pregnancy Info: <https://www.pregnancyinfo.ca/your-pregnancy/routine-tests/ultrasound/>
- Campbell, S. (2013). A short history of sonography in obstetrics and gynaecology. *Facts, views & vision in ObGyn*, 5(3), 213–229.
- Cherniak, W., Anguyo, G., Meaney, C., Kong, L., Malhame, I., & Pace, R. (2017). Effectiveness of advertising availability of prenatal ultrasound on uptake of antenatal care in rural Uganda: a cluster randomized trial. *PLoS ONE*, 12.

- Chigbu, C., Odugu, B., & Okezie, O. (2008). Implications of incorrect determination of fetal sex by ultrasound. *Int J Gynaecol Obstet*, *100*(287-290).
- Davidson, E. J. (2005). Evaluation methodology basics: The nuts and bolts of sound evaluation. SAGE Publications, Inc. <https://www.doi.org/10.4135/9781452230115>
- Dhamankar, R., DiNonno, W., Martin, K., Demko, Z., & Gomez-Lobo, V. (2020). Fetal Sex Results of Noninvasive Prenatal Testing and Differences With Ultrasonography. *Obstetrics and gynecology*, *135*(5), 1198-1206.
- Doan, D. T., Nguyen, H. T., & Bui, H. T. (2017). Patterns of the utilization of prenatal diagnosis services among pregnant women, their satisfaction and its associated factors in Viet Nam. *Int J Public Health*, *62*(1), 35-40.
- Drukker, L., Bradburn, E., Rodriguez, G., Roberts, N., Impey, L., & Papageorghiou, A. (2021). How often do we identify fetal abnormalities during routine third-trimester ultrasound? A systematic review and meta-analysis. *BJOG: Int J Obstet Gy*, *128*(2), 259-269.
- Edvardsson, K., Graner, S., Thi, L. P., Åhman, A., Small, R., Lalos, A., & Mogren, I. (2015). 'Women think pregnancy management means obstetric ultrasound': Vietnamese obstetricians' views on the use of ultrasound during pregnancy. *Global health action*, *8*, 28405. <https://doi.org/10.3402/gha.v8.28405>
- Edvardsson, K., Ntaganira, J., Ahman, A., Sengoma, J. P., Small, R., & Mogren, I. (2016). Physicians' experiences and views on the role of obstetric ultrasound in rural and urban Rwanda: a qualitative study. *Trop Med Int Health*, *21*(7), 895-906.
- Edvardsson, K., Small, R., Persson, M., Lalos, A., & Mogren, I. (2014). 'Ultrasound is an invaluable third eye, but it can't see everything': a qualitative study with obstetricians in Australia. *BMC Pregnancy Childbirth*, *14*(363)
- Efrat, Z., Perri, T., Ramati, E., Tugendreich, D., & Meizner, I. (2006). Fetal gender assignment by first trimester ultrasound. *Ultrasound in Obstetrics and Gynecology*, *27*, 619-621.
- Engelbrechtsen, L; Brondum-Nielsen, K; Ekelund, C. (2013). Detection of triploidy at 11-14 weeks of gestation: a cohort study of 198,000 pregnant women. *Ultrasound Obstet Gynecol*, *42*, 530-535.
- Firth, E., Mlay, P., Walker, R., & Sill, P. (2011). Pregnant women's beliefs, expectations and experiences of antenatal ultrasound in Northern Tanzania. *African Journal of Reproductive Health*, *15*(2).
- Gammeltoft, T., & Nguyễn, H. T. (2007). The Commodification of Obstetric Ultrasound Scanning in Hanoi, Viet Nam. *Reproductive Health Matters*, *15*(29), 163-171.
- General Statistics Office and UNICEF. (2015). Viet Nam Multiple Indicator Cluster Survey 2014, Final Report. Ha Noi, Viet Nam
- Gonzaga, M., Kiguli-Malwadde, E., Businge, F., & Byanyima, R. (2009). Current knowledge, attitudes and practices of expectant women toward routine sonography in pregnancy at Naguru health centre, Uganda. *PanAfrican Medical Journal*, *3*(18).
- Guilmoto, C.Z. (2009). The sex ratio transition in Asia. *Popul Dev Rev*, *35*, 519-49.

- Gupta, M.D., Chung, W., and Shuzhuo, L. (2009). Evidence for an incipient decline in numbers of missing girls in China and India. *Popul Dev Rev*, 35, 401-16.
- Hansen, N., Postmes, T., van der Vinne, N., & van Thiel, W. (2012). Information and communication technology and cultural change: How ICT changes self-construal and values. *Social Psychology*, 43(4), 222–231. <https://doi.org/10.1027/1864-9335/a000123>
- Hofstede, G. (1991). *Cultures and Organizations: Software of the Mind*. London: McGraw-Hill.
- Holmlund, S., Thi Lan, P., Edvardsson, K., Ntagarina, J., Graner, S., Small, R., & Mogren, I. (2020). Sub-optimal use of ultrasound examinations may result in underperformance of Vietnamese maternity care – A qualitative study of midwives' experiences and views. *Sexual & Reproductive Healthcare*, 24.
- International Institute for Population Sciences - IIPS/India and ICF. 2017. India National Family Health Survey NFHS-4 2015-16. Mumbai, India: IIPS and ICF. Available at <http://dhsprogram.com/pubs/pdf/FR339/FR339.pdf>.
- Kamal, P., Dixon-Woods, M., Kurinczuk, J.J., Oppenheimer, C., Squire, P., and Waugh, J. (2005). Factors influencing repeat caesarean section: qualitative exploratory study of obstetricians' and midwives' accounts. *BJOG*. 112(8):1054-60.
- Kawooya, M.G., Nathan, R.O., Swanson, J., Swanson, D.L., Namulema, E., Ankunda, R., et al. (2015). Impact of Introducing Routine Antenatal Ultrasound Services on Reproductive Health Indicators in Mpigi District, Central Uganda. *Ultrasound Q*. 31(4):285–9. <https://doi.org/10.1097/RUQ.0000000000000142>
- Kmet, L. M., Lee, R.C., and Cook, L. S. (2004) Standard quality assessment criteria for evaluating primary research papers from a variety of fields. Edmonton: Alberta Heritage Foundation for Medical Research (AHFMR). *AHFMR - HTA Initiative #13*.
- Lamichhane, P., Harken, T., Puri, M., Darney, P. D., Blum, M., Harper, C. C., & Henderson, J. T. (2011). Sex-selective abortion in Nepal: a qualitative study of health workers' perspectives. *Womens Health Issues*, 21, S37-S41.
- Lau, Y. (2012). Traditional Chinese Pregnancy Restrictions, Health-Related Quality of Life and Perceived Stress among Pregnant Women in Macao, China. *Asian Nursing Research*, 6(1), 27–34. <https://doi.org/10.1016/j.anr.2012.02.005>
- Lindgaard, K., & Riisgaard, L. (2017). Validation of ultrasound examinations performed by general practitioners. *Scand J Prim Health Care*, 35(3), 256-261.
- Makhlouf, M., & Saade, G. (2013). Should second trimester ultrasound be routine for all pregnancies?. *Seminars in perinatology*, 37(5), 323–326. <https://doi.org/10.1053/j.semperi.2013.06.008>
- Martin, E. (1991). *The woman in the body: A cultural analysis of reproduction*. Beacon Press; Boston.
- Masimba, F., Appiah, M., & Zuva, T. (2019). A Review of Cultural Influence on Technology Acceptance. *2019 International Multidisciplinary Information Technology and Engineering Conference (IMITEC)*. <https://doi.org/10.1109/imitec45504.2019.9015877>

- Menacker, F., Declercq, E., and Macdorman, M.F. (2006). Cesarean delivery: Background, trends, and epidemiology. *Seminars in Perinatology*, 30(5):235–241. [PubMed: 17011392].
- Mensah, Y. B., Nkyekyer, K., & Mensah, K. (2014). The Ghanaian woman's experience and perception of ultrasound use in antenatal care. *Ghana Med J*, 48(1), 31-38.
- Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097
- Morris, J. L., Short, S., Robson, L., & Andriatsihosena, M. S. (2014). Maternal health practices, beliefs and traditions in southeast Madagascar. *African journal of reproductive health*, 18(3), 101–117.
- Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification Strategies for Establishing Reliability and Validity in Qualitative Research. *International Journal of Qualitative Methods*, 13–22.
- Ngo, T. T., Nguyen, T. D., Goyens, P., & Robert, A. (2018). Misuse of antenatal care and its association with adverse outcomes of pregnancy in a Southern rural area of Vietnam. *Health care for women international*, 39(4), 472–492. <https://doi.org/10.1080/07399332.2017.1400035>
- Ohagwu, C., Eze, C., Eze, J., Odo, M., Abu, P., & Ohagwu, C. (2014). Perception of male gender preference among pregnant igbo women. *Ann Med Health Sci Res*, 4(2), 173-178.
- Ouyang, Y.Q., and Zhang, Q. A study on personal mode of delivery among Chinese obstetrician-gynecologists, midwives and nurses. *Arch Gynecol Obstet*. 287(1):37-41.
- Pradhan, E., Pearson, E., & Puri, M. (2019). Determinants of imbalanced sex ratio at birth in Nepal: evidence from secondary analysis of a large hospital-based study and nationally-representative survey data. *BMJ Open*, 9.
- Qadir, F., Khan, M., Medhin, G., & Prince, M. (2011). Male gender preference, female gender disadvantage as risk factors psychological morbidity in Pakistani women of childbearing age – a life course perspective. *BMC Public Health*, 11, 745.
- Quirkos 2.4.2 [Computer Software]. (2021). Retrieved from <https://www.quirkos.com>
- Rai, P., Paudel, I., Ghimire, A., Pokharel, P., Rijal, R., & Niraula, S. (2014). Effect of gender preference on fertility: cross-sectional study among women of Tharu community from rural area of eastern region of Nepal. *Reproductive health*, 11(1), 15.
- Rijken, M. J., Gilder, M. E., Thwin, M. M., Ladda Kajeeweha, H. M., Wiladphaingern, J., Lwin, K. M., & McGready, R. (2012). Refugee and migrant women's views of antenatal ultrasound on the Thai Burmese border: a mixed methods study. *PLoS One*, 7(4).
- Tautz, S., Jahn, A., Molokomme, I., & Gørgen, R. (2000). Between fear and relief: how rural pregnant women experience foetal ultrasound in a Botswana district hospital. *Soc Sci Med*, 50, 689-701.
- Thorburn. (2011, September 20). *Technology and Culture: A Circle of Influence*. [https://nuglobalstudies.wordpress.com/global-studies/gls\\_499-2/](https://nuglobalstudies.wordpress.com/global-studies/gls_499-2/).

- Ultrasound Market to Reach USD 10.44 Billion By 2027: Reports and Data. GlobeNewswire Newsroom. <https://www.globenewswire.com/news-release/2020/01/14/1970523/0/en/Ultrasound-Market-To-Reach-USD-10-44-Billion-By-2027-Reports-And-Data.html>
- Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, 39(2), 273–315. <https://doi.org/10.1111/j.1540-5915.2008.00192.x>
- Whitworth, M., Bricker, L., Mullan, C. (2015). Ultrasound for fetal assessment in early pregnancy. *Cochrane Database Syst Rev*, (7). <https://doi.org/10.1002/14651858.CD007058.pub3>
- Winch, P. J., Alam, M. A., Akther, A., Afroz, D., Ali, N. A., Ellis, A. A., Baqui, A. H., Darmstadt, G. L., El Arifeen, S., & Rahman Seraji, M. H. (2005). Local understandings of vulnerability and protection during the neonatal period in Sylhet district, Bangladesh: a qualitative study. *The Lancet*, 366(9484), 478–485. [https://doi.org/10.1016/s0140-6736\(05\)66836-5](https://doi.org/10.1016/s0140-6736(05)66836-5)
- World Health Organization (2011). Health technology assessment of medical devices. *WHO Medical device technical series*.

## **Chapter 2: Methods**

This research is a secondary analysis of pre-existing datasets that were drawn from two qualitative research projects conducted in Pakistan between 2010 and 2015. Both studies were part of the School of Public Health Global Maternal Health program, led by Professor Mumtaz as principal investigator.

### **STUDY ONE**

The first project, entitled “Addressing disparities in maternal health care in Pakistan: gender, class and exclusion” is a critical ethnography of maternal health services in a village in Chakwal, Punjab (Mumtaz et al., 2014). This project sought to understand how social exclusion can affect the ways in which maternal health care services are delivered, and how it influences poor women’s access to, and experiences with health services.

#### *Data Collection*

Participants in study one were poor, disadvantaged women and men living in Ganji village, district Chakwal, northern Punjab (name of village changed to protect privacy). Ganji village (population 1229) was selected because the village was quite heterogenous, both in terms of economic and caste-distribution. Data were generated over the course of 10-months, from May 2010 – February 2011 using 134 observations, 94 in-depth interviews, and 11 focus group discussions (Mumtaz et al., 2014). Data were collected in four phases (Mumtaz et al., 2014). Phase one involved familiarization and rapport building with the villagers through four social-mapping exercises, home visits, and a demographic survey of village households. The survey collected basic socio-demographic data, including education, occupation, caste, landownership, and maternal health service use in the preceding five years (Mumtaz et al., 2014). Phase two explored social norms and everyday practices and their relationship to pregnancy management. Eighteen pregnant women



were longitudinally followed up for the duration of their pregnancies, childbirth, and post-natal period. Data were collected using observations and informal interviews to map women and their families' behaviours and decision-making processes. In addition, in-depth interviews were conducted with 34 young women, 27 older women, 20 young men, and 13 older men (Mumtaz et al., 2014). Phase three explored the five maternal deaths that had occurred in the preceding five years and involved interviews with the dead woman's husband, mother-in-law and/or associated healthcare workers. Phase 4 aimed to get respondent validation around data collected in the first three phases from the villagers. A total of 11 focus group discussions were conducted. Each focus group had 6 -10 individuals each, and were organized along age, gender, and caste lines. In addition, a total of 61 repeated conversations were held with two key informants.

Data were collected by the PI Zubia Mumtaz and her team of field ethnographers. Selection of this study site was purposive: Mumtaz has previously conducted research in the study region between 1997 and 2001. She was also familiar with the local socio-cultural context and speaks the local dialect.

## **STUDY TWO**

The second project, entitled "Are community midwives addressing the inequities in access to skilled birth attendance in Pakistan? Gender, class, and social exclusion", used a mixed methods study design to explore whether a new cadre of midwives were providing services to poor, marginalized women in rural Pakistan (Mumtaz et al., 2012). An institutional ethnography and a cross-sectional survey were conducted. The use of the institutional ethnography method allowed the researchers to map out how community health workers maternity care delivery is coordinated and governed by the existing formal and unspoken but informally shared organizational rules and

practices (Campbell and Gregor, 2002). The cross-sectional survey aimed to assess the levels of maternity care received by women in the field-site.

### *Data Collection*

Data were collected over a period of 9-months from 2011-2012 in districts Jhelum and Layyah, Punjab. A sample of 38 community midwives was randomly selected from a pre-existing list provided by the Punjab government's Maternal, Newborn and Child Health program. Fourteen community midwives in Jhelum and 24 in Layyah were interviewed at least once, often 2-4 times for a total of 91 interviews. Observations of day-to-day activities of the sample community midwives were conducted with 180 formal and informal observations of patient provider interactions. Fifteen local traditional birth attendants and 30 other health care providers were also interviewed at least once. To understand user-perspectives of community midwife services, in-depth interviews were conducted with 78 community women who had given birth in the preceding two years of data collection, 38 husbands of women who had given birth in the preceding two years of data collection, and 23 mothers and mothers-in-law of the community women.

The clustered, and stratified survey in two districts, Jhelum and Layyah was designed to measure what proportion of women were cared for by a community midwife compared to other providers (Mumtaz et al., 2012). The study population consisted of women aged 15-49 who had given birth in the 2 years prior to the survey. A total of 1,457 women were surveyed, 747 in Jhelum and 710 in Layyah. As previously reported elsewhere, the mean age of this sample of women was 28.3 years. More than 38% had received no schooling, while only 7% had received more than high school education. These women had an average of 2.9 children (Mumtaz et al., 2012; Mumtaz et al., 2015). The sampling frame was drawn up using a three-stage stratified sample design. In the first stage, three tehsils in each district were randomly selected. In the second stage, five union

councils were chosen from each tehsil. In the third stage, two villages were randomly selected from each of the selected union council. Households in the village were selected on the basis of a woman aged 15-49 who had given birth in the past three years being present in the home. Data were collected using a pre-tested questionnaire that included questions regarding elements of antenatal and childbirth care and satisfaction with care provided (Mumtaz et al., 2012). Data were collected by a team of four researchers, led by the PI Zubia Mumtaz.

## **DATA ANALYSIS**

Both datasets were shared by the PI Zubia Mumtaz to the first author through Google Drive. Together, the datasets contained a total of 713 transcripts. The original data for both studies were collected in Urdu and translated and transcribed into English by native speakers. The PI, fluent in both English and Urdu, had double checked a sample of the transcripts based on audiotapes to verify the translation. In order to determine which transcripts were relevant to this research, a search function was applied to both data sets in Google Drive to filter the documents using search terms “ultrasound”, “ultra sound”, “US”, “machine”, and “scan”. This search function would allow for an efficient and timely way to filter the relevant documents. The search yielded a total of 107 transcripts. These transcripts were then uploaded to Microsoft Word.

Qualitative data were analyzed through an inductive and iterative process of repeated reading, coding, categorizing, and theming (Mayan, 2009). Thematic analysis was used to determine patterns participants’ experiences with and opinions on ultrasound technology to answer the research question. To become familiar with the data, we first read each transcript at least twice. During each reading, we made comments along the side panel. Data were then coded. Qualitative data management software Quirkos (2021) was used to organize the data. The software supplemented handwritten note taking and brainstorming done through non-technological methods

of analysis. The data were first open coded using broad labels. The open codes were then axially coded to identify relationships. Emergent categories were identified. Finally, a higher-level of categorization identified the themes. Interpretation of the information began when both authors felt that there was sufficient information.

Data were analyzed and interpreted by the first author and PI of both studies through a feminist lens. The first author is ethnically Afghan and is familiar with the socio-cultural context both studies took place in.

## **RIGOUR**

In qualitative research, reliability and validity are attained through verification strategies (Morse et al., 2002). The framework of “checking, confirming, and making sure” (Morse et al., 2002) guided the research process. Weekly meetings were held with the first author and her supervisor. Minutes were taken for these meetings, which included an agenda, pre-made questions by the first author for her supervisor, notes during the meeting, and actionable tasks to be completed for the next meeting. During these meetings, verification of the research findings was ensured through discussing concepts emerging from the analysis. Peer checks assisted in determining gaps and areas of improvement in the study as it was being completed. This was an iterative process, in that each discussion led to new categories emerging and themes being developed. The first author practiced reflexivity throughout the entire research process. This process required us to write, then re-write to refine the relationships from the new categories we would develop. Ultimately, this process led us to identify the major over-arching themes.

## **ETHICAL CONSIDERATIONS**

Research Ethics Board approval was received from the University of Alberta prior to use of the pre-existing datasets. As this study involves secondary research that interviewed human participants, there are concerns of identifiable information within the data that may expose subjects' personal views (Tripathy, 2013). For the case of this research project, the datasets being used were anonymized at the time of initial transcription using pseudonyms to protect the participant's identity. Pseudonyms such as man#1 or woman#1 were used to protect the participants' identities.

## REFERENCES

- Campbell, M., and Gregor, F. (2002). *Mapping social relations; A primer in doing institutional ethnography*. Toronto, Ontario, Canada: Garamond Press.
- Mayan, M. J. (2009). *Essentials of qualitative inquiry*. Walnut Creek, CA: Left Coast Press.
- Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods* 1 (2), Article 2.
- Mumtaz, Z., O'Brien, B., Bhatti, A. *et al.* (2012). Are community midwives addressing the inequities in access to skilled birth attendance in Punjab, Pakistan? Gender, class and social exclusion. *BMC Health Serv Res* 12, 326. <https://doi.org/10.1186/1472-6963-12-326>
- Mumtaz, Z., Salway, S., Bhatti, A., & McIntyre, L. (2014). Addressing invisibility, inferiority, and powerlessness to achieve gains in maternal health for ultra-poor women. *Lancet (London, England)*, 383(9922), 1095–1097. [https://doi.org/10.1016/S0140-6736\(13\)61646-3](https://doi.org/10.1016/S0140-6736(13)61646-3)
- Mumtaz, Z., Levay, A., Jhangri, G., and Bhatti, A. (2015). Coverage of private sector community midwife services in rural Punjab, Pakistan: Development and demand. *Health Research Policy and Systems*. 13. 10.1186/s12961-015-0038-3.
- Quirkos 2.4.2 [Computer Software]. (2021). Retrieved from <https://www.quirkos.com>
- Tripathy J. P. (2013). Secondary Data Analysis: Ethical Issues and Challenges. *Iranian journal of public health*, 42(12), 1478–1479.

## Chapter 3: Manuscript 2

### Investigating the cultural meaning of ultrasound technology in Rural Pakistan

Janat Ibrahimi and Zubia Mumtaz

#### ABSTRACT

**Background/Rationale:** Obstetric ultrasounds have become a routine practice in pregnancy management globally. Available evidence in low-and-middle income countries suggests that some women maybe perceiving ultrasound scans as the entirety of antenatal care and are potentially overestimating the diagnostic abilities of the technology to the point where they are not receiving the appropriate care. The concerning nature of this current evidence indicates the need for a detailed, qualitative investigation to examine both women and providers' understandings and practices of obstetric ultrasound use.

**Aim:** The objective of this paper is to explore the impact of ultrasound technology on the cultural management of pregnancy in rural Pakistan.

**Methods:** Data were drawn from two qualitative research projects conducted in Pakistan. The first study investigated maternal health services in Punjab. The second project explored whether midwives were improving access to maternity care in Punjab. Data was organized using Quirkos software and analyzed through thematic analysis.

**Results:** Our findings revealed that pregnant women in our sample perceived an ultrasound scan as synonymous with antenatal care and assumed it was an integral part of their antenatal visit, irrespective of any stated medical indication. It was sometimes the only care they sought during pregnancy. Two wider societal level forces – strong son-preference and a highly privatized health care sector - are driving a mutually reinforcing supply-demand cycle of potentially unnecessary

scans during a healthy pregnancy. In this patriarchal society, women desire to birth sons. They seek repeated scans in the hope of either expecting a different ‘diagnosis’ if a female fetus is suspected or confirming a male fetus. Providers, mostly in the private sector, draw upon this latent demand to profit financially.

**Conclusion:** In conclusion, this research indicates that in the context of our field sites in rural Pakistan, obstetric ultrasound has led to unintended beliefs and practices that have ultimately changed how pregnancy is managed. The use of ultrasound scans as the only antenatal care sought and provided during pregnancy can have serious negative implications on fetal and maternal health.

## **INTRODUCTION**

Obstetric ultrasound is a routine practice in pregnancy management. (Alfirevic et al., 2013). It is a useful procedure for assessing fetal growth and wellbeing, screening for fetal anomalies, locating the placenta, and assessing gestational age, among many other uses (Campbell, 2013; Whitworth et al., 2015). The literature recommends two scans during pregnancy: the first at 11-14 weeks of pregnancy and the second at 18-20 weeks (Cargill and Morin, 2017).

The practice has become widespread globally. As pregnancy care expands in many low and middle-income countries, obstetric ultrasound is becoming a common part of routine antenatal care (Bashour et al., 2005; Gammeltoft and Nguyen, 2007; Gonzaga et al., 2010; Ranji and Dykes, 2012). In Vietnam, one ultrasound scan during pregnancy is nearly universal (General Statistics Office and UNICEF, 2014). Similarly, 98% of women in Syria (Bashour et al., 2005) and 61% in India (Institute of Population Studies, NFHS, ICF International, 2017) reported receiving an obstetric ultrasound scan as a part of their routine antenatal care during their last pregnancy. A



study assessing utilization of obstetric ultrasounds in a Ugandan hospital found that a 100% of pregnant patients attending the facility received at least one ultrasound (Gonzaga et al., 2010).

The use of ultrasound scans in pregnancy management is an example of an introduction of a new technology in obstetric care. The World Health Organization (2011) defines technology in healthcare as “the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of life”. For a technology to be used and to allow it to “solve a health problem”, it must first be introduced to, and adopted and integrated into practice by users. According to the Venkatesh and Bala (2008), potential users are more likely to adopt a technology if it is compatible with their values and needs. It is only when a new technology successfully meets values and needs does it get integrated into routine use (Venkatesh and Bala, 2008).

However, according to some researchers, culture is also an important factor that determines whether a technology will be successfully adopted or not (Masimba et al., 2019; Zhang and Maruping, 2008). Hofstede (1991) defines culture as “the collective programming of the mind” through shared values, beliefs, and norms. Collis (1999) describes how culture influences ways in which people accept, use, and react to technology. The relationship between culture and technology can be understood as reciprocal (Hansen et al., 2012). When a technology is created, it must first adapt into the cultural environment in order to be accepted and be integrated into practice (Hansen et al., 2012). However, technology can then shape the culture by influencing new social behaviours and possibilities, ultimately resulting in a social change (Thornburn et al., 2011; Hansen et al., 2012, Masimba et la., 2019).

Moreover, obstetric ultrasound technology is a unique technology. Most health-care technologies tend to require a high degree of technical expertise to use and to understand its

outputs. The technology often has minimal active patient engagement in its operation or understanding the findings. In contrast, ultrasound technology, especially the new 3-D scans with easy-to-understand images, while requiring operator expertise, also actively engages the parents. A large body of literature, mostly from high-income countries, has documented how these 3D ultrasound scans enable women and families to ‘see’ their unborn baby. Mothers, their partners and even their larger families experience this visualization of the unborn fetus positively, describing its impact in terms of increased bonding with the baby, and an enhancement of their emotional experiences of the pregnancy and impending motherhood. So common are these activities that 3-D fetal images are now considered an integral component mother and babyhood memorabilia in some settings (Liamputtong and Watson, 2002; Edvardsson et al., 2014; Roberts et al., 2015; Roberts et al., 2017).

However, despite the increasing use of this new technology only a few studies to date have explored how obstetric ultrasound technology may be impacting pregnancy management in low and middle-income countries. Available evidence suggests obstetric ultrasound scans may not be having the similar rather positive and harmless cultural impact documented in research from high income countries (Rijken et al., 2011; Edvardsson et al., 2015; Roberts et al., 2015; Ahman et al., 2019). Studies from India and Nepal, for example, show the detrimental impact of obstetric ultrasounds on fetal sex identification and consequent abortions of female fetuses (Ganatra et al., 2001; Lamichhane et al., 2011; Bhalotra et al., 2020). Studies from Vietnam, Tanzania and Uganda suggest that some women have started perceiving ultrasound scans as the entirety of antenatal care (Gammeltoft and Nguyen, 2007; Gonzaga et al., 2010; Firth et al., 2011; Edvardsson et al., 2015; Doan et al., 2017; Holmlund et al., 2020). In fact, according to Gammeltoft and Nguyen, 2007 and Holmlund et al., 2020, some women in Vietnam are replacing routine antenatal care with repeated

scans, some upwards of 15 scans, without receiving other elements of pregnancy care such as assessment of blood pressure, body weight, hemoglobin levels or a urinalysis, all critical for diagnosis of life-threatening disorders including pre-eclampsia and anemia (Gammeltoft and Nguyen, 2007; Holmlund et al., 2020). Other studies suggest that some mothers are overestimating the diagnostic and therapeutic abilities of ultrasound technology to the point where they are not receiving the appropriate care (Tautz et al., 2000; Gammeltoft and Nguyen, 2007; Edvardsson et al., 2015; Edvardsson et al., 2016). For example, Tautz et al (2000) and Firth et al. (2011) report how their study respondent pregnant women in Botswana and Tanzania believe a scan alone can treat HIV/AIDS infection. Overall, the largely qualitative literature suggests that some women in countries ranging from sub-Saharan Africa (Rwanda, Botswana, Tanzania, and Uganda) to the Vietnam and Thailand in South-east Asia believe an ultrasound alone can guarantee a safe pregnancy and delivery of the ‘perfect baby’ (Gammeltoft and Nguyen, 2007; Rijken et al., 2014; Edvardsson et al., 2016).

This small body of emerging literature raises important questions about ways in which obstetric ultrasounds may be having unforeseen impacts on the culture of pregnancy management, specifically beliefs and practices of both pregnant women, and maternal health care providers. The partial and somewhat concerning nature of the current evidence base indicates the need for detailed, qualitative investigation that examines both women and providers’ understandings and practices of obstetric ultrasound use and situates these within the wider socio-cultural, and economic characteristics of prevailing health care system. The present paper draws on data from two studies from Pakistan that provide insight into women’s emic socio-cultural understanding of obstetric ultrasounds and the role of health care providers and the economic characteristics of a local health system context within which ultrasound technology use is expanding.

## **METHODS**

Data were drawn from two research projects conducted in Pakistan between 2010 and 2015. The first study, entitled “Addressing disparities in maternal health care in Pakistan: gender, class and exclusion” is a critical ethnography of maternal health care use in a village in district Chakwal, Punjab (Mumtaz et al., 2014). Data were generated in three phases over the course of 10-months. A total of 134 observations, 94 in-depth interviews, and 11 focus group discussions were conducted. Data generation started with familiarization and rapport building with the villagers through four social-mapping exercises and visiting homes (Mumtaz et al., 2014). In phase two, social norms and everyday practices around pregnancy management were explored in in-depth interviews with 34 young women, 20 young men, 27 older women, and 13 older men and 11 focus group discussions containing 6-10 participants determined by age, gender, and caste. In phase three, eighteen pregnant women were longitudinally followed for the duration of their pregnancies and post-natal period. Mothers, husbands, mothers-in-law, and health care workers associated with the pregnant women were interviewed (Mumtaz et al., 2014).

The second study entitled “Are community midwives addressing the inequities in access to skilled birth attendance in Pakistan? Gender, class, and social exclusion aimed to explore whether a new cadre of midwives were improving access to skilled maternity care for poor and socially excluded women in two districts – Layyah and Jhelum - in Punjab (Mumtaz et al., 2012). This mixed methods research collected both qualitative and quantitative data. Drawing on the institutional ethnographic approach, qualitative data were collected using in-depth interviews and observation methods. A total of 83 health care providers - 30 skilled birth attendants working as physicians, lady health visitors or facility midwives, 38 community midwives and 15 Traditional Birth Attendants were interviewed. In-depth interviews were also conducted with 78 community

women who had given birth in the two years prior to data collection, 38 husbands of women who had given birth in the two years prior to data collection, and 23 mothers and mothers-in-law of the subject women (Mumtaz et al., 2012). Over 180 formal and informal observations of patient-provider interactions in health facilities including the district hospitals, private practices, and midwives home-based clinics were conducted (Mumtaz et al., 2012). Lastly, due to the research team taking residence in the field sites, 170 informal observations occurred through the team's frequent interactions with locals within the community (Mumtaz et al., 2012).

The study also collected quantitative data using a cross-sectional survey methodology. Although we only draw upon this data to contextualize our qualitative findings, some details of the survey are as follows: A sample of 1,457 mothers aged 15-49 were recruited from 747 households in Jhelum and 710 in Layyah using stratified random sampling methods. As previously reported elsewhere, data were collected using a pre-tested questionnaire that included questions regarding socio-demographic characteristics of the respondents and elements of antenatal care received including ultrasound scans, measurement of blood pressure, body weight, blood hemoglobin levels (Mumtaz et al., 2012). As reported elsewhere, the mean age of this sample of 1457 women was 28.3 years. Over 38% had received no schooling, while only 7% had received more than high school education. They had an average of 2.9 children (Mumtaz et al., 2012; Mumtaz et al., 2015).

In order to determine which documents were relevant to the present research questions, all available transcripts were filtered using search the terms “ultrasound”, “ultra sound”, “US”, and “machine”, and “scan” in Microsoft Word. This exercise yielded a total of 107 transcripts that were deemed important for the present study questions.

### *Data analysis*

Qualitative data were analyzed through an inductive and iterative process of repeated reading, coding, categorizing, and theming (Mayan, 2009). We specifically focused on the transcripts that contained information on ultrasounds and participants' experiences with the technology. We started by reading and re-reading the transcripts to familiarize ourselves with the data. The data were then open coded using broad labels. These open codes were then axially coded to identify categories and any relationships between them. Finally, themes were identified through a higher-level of categorization. Through each of these steps, we continuously returned to the data to clarify or confirm emerging findings. Qualitative data management software Quirkos (2021) was used to manage the data, supplemented with handwritten notetaking and analysis.

Quantitative survey data were only used to provide quantitative evidence to complement the qualitative findings. Univariate analysis of four key elements of antenatal care (body weight, Blood pressure measurement, blood test for hemoglobin, and ultrasound scan) were conducted using Stata 14.

## **RESULTS**

Our analysis identified two themes and four subthemes. The first theme "unintended effects of obstetric ultrasound use" describes ultrasound scans being perceived as the entirety of antenatal care, and women's potentially misplaced trust in ultrasound technology. The second theme shows how patients and providers mutually reinforced the supply-demand cycle of unnecessary obstetric scans. Within this theme, we describe the private sector marketing ultrasound scans for profit, and patient and providers mutually reinforcing un-necessary ultrasound scans.

## **Unintended Effects of Obstetric Ultrasound Use**

Overall, both quantitative and qualitative data suggests that use of obstetric ultrasounds was common in rural Pakistan. The survey data showed that 79.8% of women in this sample reported having had at least one ultrasound scan during their last pregnancy. To contextualise, 95% of women reported at least one antenatal care visit. Qualitative data also provided evidence that receiving a least one ultrasound scan during a healthy pregnancy was common. Providers reported that their patients requested monthly ultrasounds during healthy pregnancies. We also observed providers routinely conducting an ultrasound scan on every woman as part of their routine antenatal visit. Below we present the unintended effects of obstetric ultrasound use in our study sites.

### *Ultrasound scans as the entirety of antenatal care*

Our data suggest obstetric ultrasound scans have become synonymous with antenatal care, and in some cases are understood as the entirety of the care. The term used to describe an antenatal visit in this context is the English term ‘check-up’. Our pregnant women respondents often used the term ‘check-up’ to describe both the antenatal visit and an ultrasound scan interchangeably. More concerning was the finding that some women received only an obstetric ultrasound scan during the antenatal visit. The survey data showed that while 80% of women reported receiving an ultrasound scan, only 49.6% reported receiving a blood test, 48.6% a urine test and 49.3% has been weighted over the duration of the of the pregnancy. See Table 1.

*“This woman wanted to have just an ultrasound scan done because she said it covers everything.” (Observation Notes, RHC Kalas).*

A deeper analysis of the data suggests women have come to expect a scan to be an integral part of their antenatal visit, irrespective of any stated medical indication. So ingrained was this idea that

women determined a provider’s quality of care simply in terms of whether the service provider had used an ultrasound scan. For example, many women described feeling satisfied with their provider’s quality of care solely because they conducted an ultrasound scan at every antenatal examination. Without a scan, women described feeling deprived of thorough or high-quality care.

*“I am not totally satisfied with the quality of service here because they didn’t do an ultrasound scan. I am not feeling good about it.” (W11, Chakwal)*

These findings were confirmed by providers. Several community midwives expressed concern that their clients consider an ultrasound scan as the entirety their antenatal care, devaluing other procedures such as measurement of blood pressure, a urinalysis for proteinuria or blood test for documenting haemoglobin levels. Providers confirmed that they were expected to perform an ultrasound scan on each patient, at every antenatal visit. Failure to do so meant they would ‘lose’ the patient to other providers who would be willing to do the expected scans. For the private providers, this loss of patients was a loss of revenue since nearly all operated in the private sector. Our provider respondents reported this demand for ultrasound scans as a ‘trend’ that was pushed by peer pressure. So powerful were these pressures that some providers reported that poor women even borrowed money to do what were essentially unnecessary ultrasound scans.

**Table 1:** Elements of antenatal care received over the duration of pregnancy

Element of antenatal care	Percentage of Women Who Responded “Yes”
Body weight measured	<b>49.3%</b>
Urinalysis	<b>48.6%</b>
Blood testing	<b>49.6%</b>
Ultrasound scan	<b>80%</b>



### *Potentially misplaced trust in ultrasound technology*

A second reason underlying the common and sometimes excessive use of ultrasound scans was mothers' strong trust in ultrasound technology's abilities to diagnose ill-health, both the mother's and baby's. Providers described examples of pregnant women requesting an obstetric ultrasound to assess 'a gas-like pain in the stomach', their 'level of blood', and to 'examine the position of my bones'. In fact, our data suggests some mothers believed an ultrasound was even therapeutic, with requests for a scan to treat urinary tract infections, and even hasten labour. There were instances of women calling for the machine to be "applied" in order to remedy complications during labour.

*"These women believe that with an ultrasound scan, they can more clearly see whatever the problem is." (Provider, Chakwal)*

So strong was this trust in the powers of ultrasound technology, that mothers expected delivery dates and fetal sex reports to be precise. Providers described patients who expected the delivery date of their baby to be exactly the same date in their ultrasound report. In these instances, patients are, at most, described to be annoyed or inconvenienced by a change in delivery date. Expectations for fetal sex report to match the sex upon delivery had much more serious implications, both for providers and mothers. Some hospital staff reported experiencing aggression and physical threats of violence from families when a daughter delivered instead of an expected, ultrasound-scan-determined son. For mothers, a wrong fetal sex disclosure – in other words, the birth of a daughter instead of a son – can potentially have devastating effects on her emotional and physical well-being. Although rarely vocalized, but clearly insinuated, the key reason many mothers sought ultrasound scans was to find out the fetal sex. To be more precise, it was to confirm that the fetus was a male child. Pakistan is a context characterised by strong son preference (Atif et al., 2016; Channon, 2017; Ataullahjan et al., 2021). The importance of sons is woven in the society's social,

economic and gender order and is best understood through the experiences of people who do not have a son. To be son-less was to suffer severe social sanctions, pity, and ridicule. Not having a son can destabilize a woman's position within the household and shapes her relationships with her extended family (Ataullahjan et al., 2021). Mothers in our study who did not have a son felt incomplete, that they have not fulfilled their duty as a woman or a wife. They were at risk of divorce and abandonment.

*“The doctor told them that it was a girl. Her husband said to her that her mother had been giving birth to daughters, and that she would also do the same. The husband kicked her out of his house and told her and not come back to his house until she was able to give birth to a boy.” (Woman 1, Module 1, Chakwal)*

### **Supply-demand reinforcement of unnecessary obstetric ultrasound scans**

Our data suggest both providers and patients are active participants in driving the use of possibly unnecessary obstetrics ultrasounds scans. Below we discuss the two wider societal level forces that led to this supply-demand reinforcement of unnecessary obstetric ultrasound scans

#### *Private sector marketing ultrasound scans for profit*

Pakistan's health care system is a mixed health care system - defined as a health system in which financing and provision of services is characterised by market provision of services with out-of-pocket payments together with a publicly financed government health delivery (Nishtar, 2010). Healthcare delivery is primarily the responsibility of the provincial government (WHO EMRO, n.d.). The state provides healthcare through a three-level healthcare delivery system and a range of public health interventions. Overall, this healthcare delivery system suffers from uneven

distribution of providers, insufficient funding, and limited access to quality healthcare services (WHO EMRO, n.d.)

The private sector has bridged the gap of rising demand in healthcare services, such as antenatal care, and limited public health facilities (WHO EMRO, n.d.). Overall, 70% of the health expenditure in Pakistan is in the private sector, a proportion that is growing under pressure by International Monetary Fund and other bilateral and multilateral donors (Stuckler and Basu, 2009; Nishtar et al., 2013; Mohanan et al., 2016; Tougher et al., 2018). The private sector has expanded its role in the provision of maternity care as well despite initial proponents of such care excluding these services from this modality of service provision. As a consequence, nearly 70% of antenatal care is provided by the private sector and over two-thirds of facility births take place in this sector (Noh et al., 2019).

Our observations and a deeper analysis of the data suggests the beliefs and practices that have constructed ultrasound scans as the entirety of antenatal care and women's deep trust in the technology's abilities have been actively created and nurtured by medically trained providers, largely those providing care in the private sector, but also those public sector workers who moonlight in the private sector.

Our study providers have actively created a market for ultrasound technology in our field sites as a lucrative business. We observed providers recommending and conducting monthly ultrasound scans and prioritizing, and sometimes only providing, ultrasound scans during antenatal visits without providing any other elements of antenatal care such as measuring body weight or blood pressure. The providers used their position and authority as a 'doctor' - with all its attendant clout as an expert - to prescribe an ultrasound scan. The providers had also adopted many business-enhancing techniques to increase the volume of scans performed. Some aggressively advertised

their ultrasound scanning services, even offering discounts such as a scan for only Rs 100 (USD \$1.00) every last Friday of the month. Others had created networks in which the providers send referrals and accepted ultrasound reports only from each other. Providers who did not have an ultrasound scanning machine would refer to specific members of these networks for a commission. This sometimes-meant women had to pay for multiple ultrasound examinations in order to be seen by a provider who was not a member of a network.

*“No one takes blood or urine tests; these doctors only do ultrasound”. (Patient 19, Chakwal).*

*“They charge 200 rupees per patient for an ultrasound scan. The hospital keeps 150 and gives the provider 50 rupees as often as they do them.” (Observation Notes, Layyah).*

#### *Patient and providers are mutually reinforcing use of un-necessary ultrasound scans*

Our data suggest pregnant women are also active participants in driving the use of unnecessary scans. Mothers chose clinics for antenatal care based on the presence of an ultrasound machine. Providers described many instances of losing clients to competitors solely because they lacked ultrasound machines. Private clinics, staffed by physicians, midwives, and even untrained birth attendants, responded to this demand by offering ultrasound scans practically on demand.

*“The Community Midwives (a part of a public-private initiative) were demanding ultrasound machines from the government. They said that patients don’t seek their care because they do not have ultrasound machines.” (Observation notes, Chakwal)*

Mother’s demand for ultrasound scans was primarily driven by strong son-preference, a powerful belief in Pakistan as in much of South Asia (Ataullahjan et al., 2021). Mothers in our field sites went to great lengths to ensure they gave birth to a son. A deeper analysis of the data suggests

mothers sought repeated ultrasound scans not just to reassure fetal health, but actually to either confirm that the sex of the fetus was indeed male or in the event of a female diagnosis, to rule out an error. Mothers would continue seeking scans from different providers – also called *doctor shopping* among providers – if the fetal sex report did not match their preferred sex. They specially sought care from providers who were rumoured to deliver only sons.

*“She said she expects to have a son this time because she is going to Dr. Huma for an ultrasound scan.” (Observations Notes, RHC Kalas, Chakwal).*

Our study providers drew upon this deep cultural need for a son to expand their business. Disclosing fetal sex is illegal in Pakistan. While most government facility providers abided by these rules, private-sector doctors were often observed to reveal fetal sex at the request of the patient. However, the providers only revealed fetal sex if it was male. They acted uncertain and requested additional scans if they saw a female fetus. According to these providers, they risk losing clients if they report a female fetus. Providers who offered the mothers an ability of knowing fetal sex could charge hefty fees, because the benefits of knowing fetal sex heavily outweighed any high costs for often desperate women. Certain providers were even reported to be charging more for a scan reporting a male fetus.

*“It happened a couple of times that a patient insisted on knowing the baby’s sex. It was her first baby. She fell silent when I told her it was a girl. I never saw her again”. (Dr. Huma, Chakwal)*

## **DISCUSSION**

This study aimed to document mothers and providers’ understandings and practices of obstetric ultrasound use and to situate these within the wider socio-cultural, and economic characteristics of

prevailing health care system in Pakistan. Our data shows that ultrasound scans had become a common practice in our sample from rural field-sites in three districts in Punjab, Pakistan. There is also some early evidence that there is possibly excessive use beyond the two recommended scans during a healthy pregnancy. Importantly, ultrasound scans are being perceived by some women as the entirety of antenatal care, and women are potentially misplacing their trust in the technology's ability to offer thorough and complete care during pregnancy. These beliefs have resulted in some women receiving repeated ultrasound scans as their only antenatal care during pregnancy. Our data shows providers in the private sector are marketing ultrasound scans as a lucrative business strategy, while patients are corroborating with them in hopes of giving birth to sons.

Several findings from this study are echoed by the literature from otherwise different settings. Unnecessary scans - beyond the two medically recommended scans for a normal pregnancy – have been reported from Vietnam, Syria, and Iran. A survey of 400 pregnant women in Vietnam found that the women had an average of 6.6 scans in 8.3 antenatal visits (Gammeltoft and Nguyen, 2007). Similar findings were reported in a survey of 500 women in Syria, and 654 women in Iran, with women receiving an average of 5.5 scans and 5.9 scans respectively (Bashour et al., 2005; Ranji and Dykes, 2012). Literature from Vietnam corroborates our research finding that ultrasound technology is perceived by at least some women as the entirety of antenatal care. According to midwives in Hanoi, some pregnant women were replacing routine antenatal care with repeated scans. Some of these women were even described to ignore any other antenatal clinical examinations in favour of an ultrasound scan (Holmlund et al., 2020).

A strong trust in the diagnostic abilities of ultrasound technology has also been documented in the literature. Gammeltoft and Nguyen (2007) reported that some women in Vietnam believed

an ultrasound examination to be far better than “ordinary antenatal care”. A study in Tanzania, found that some women in their sample believed that an ultrasound scan can show any problem during pregnancy, as well as determine if they or their baby had diseases (Firth et al., 2011). Tautz et al. (2000) found that some women in Botswana perceived an ultrasound as a “magical device that can see everything”. Similarly, some women in Rwanda believed that without an ultrasound scan, health concerns would go unnoticed (Edvardsson et al., 2016).

The role of the private sector and providers pushing what are essentially unnecessary ultrasound scans has also been documented in the literature. Notwithstanding the numerous benefits of obstetric ultrasound in pregnancy surveillance for monitoring fetal development and wellbeing, there is limited clinical evidence that routine ultrasound scans have any impact on maternal and child mortality in these contexts. A multi-country cluster randomized trial in the Democratic Republic of Congo, Guatemala, Kenya, Pakistan, and Zambia revealed that in intervention clusters, which provided two routine ultrasound scans during pregnancy, there was no significant difference in maternal, fetal, or neonatal mortality outcomes compared to control clusters (Goldenberg et al., 2018). Similarly, a meta-analysis by Bucher and Schmidt (1993) concluded that routine ultrasound scans do not contribute to any reduction in perinatal morbidity. Clearly, the additional scans being encouraged by providers are of no benefit to many of its pregnant recipients. The additional scans do however add to the providers financial revenue and suggest private-sector providers are pushing unnecessary procedures with no known medical benefit. This finding adds to the literature documenting how the private sector frequently violates medical standards of practice with unnecessary testing and treatment for financial gain (Basu et al., 2012).

The finding that patients are driving the uptake of unnecessary ultrasound scans is potentially not a novel finding, but we could not identify it explicitly stated as such. The literature from sub-Saharan Africa and Vietnam just documents women seeking repeated ultrasound scans without medical indication or a physician's referral (Gammeltoft and Nguyen, 2007; Gonzaga et al., 2009; Edvardsson et al., 2016; Holmlund et al., 2020).

The study has a number of limitations. The first is that it draws upon two studies that collected data for other objectives. The findings presented in this paper emerged incidentally. They point to the unintended effects of ultrasound use and both the patient and provider's role in driving unnecessary ultrasound scans. The translation of data from Urdu to English can be considered another limitation due to the risks of not capturing the full meaning of the data. This risk was mitigated by the PI of both studies, Zubia Mumtaz, who is fluent in both Urdu and English. The PI read through the Urdu transcriptions and English translations of a subsample of data twice. Finally, both studies largely used qualitative data, which limits its generalizability to other parts of Pakistan. Nonetheless, the findings from this study aligns with the literature, suggesting our findings are valid.

The findings of this research have important implications for policy and practice. Pakistani policy makers must address the concerning reality that the private sector routinely prioritizing and driving ultrasound scan use during pregnancy management with a profit motive has led to women in our field sites replacing ordinary antenatal care surveillance with repeated ultrasound scans. Given the evidence that even the two recommended ultrasound scans have no measurable impact on perinatal health and mortality, it stands to reason that additional scans will have no benefit. It can, however, have a detrimental effect if women are not receiving the other, more important elements of antenatal care including weight and blood pressure measurement, blood tests and



urinalysis. The findings also add to the body of evidence raising concerns about the quality of care provided in a private health care system. The finding that patients also play a role in driving unnecessary scans needs to be further investigated in low- and middle-income contexts where the commercialization of obstetric ultrasound is being observed.

## **CONCLUSION**

In conclusion, this research indicates that in the context of our field sites in rural Pakistan, obstetric ultrasound has led to unintended beliefs and practices that have ultimately changed how pregnancy is managed. Obstetric ultrasound has become the preferred method of surveillance for women during healthy pregnancies, so much so that repeated scans are perceived as synonymous and equivalent to antenatal care. It appears that both providers, particularly those in the private sector, and patients play a mutually reinforcing role in driving un-necessary ultrasound use. While obstetric ultrasound has numerous benefits, the technology also has a limited role in pregnancy surveillance. It is important to ensure that the technology does not replace routine elements of antenatal care.

## REFERENCES

- Ahman, A., Edvardsson, K., Fagerli, T. A., Darj, E., Holmlund, S., Small, R., & Mogren, I. (2019). A much valued tool that also brings ethical dilemmas - a qualitative study of Norwegian midwives' experiences and views on the role of obstetric ultrasound. *BMC Pregnancy Childbirth*, *19*(1), 33.
- Alfirevic, Z., Stampalija, T., & Gyte, G. M. (2013). Fetal and umbilical Doppler ultrasound in high-risk pregnancies. *The Cochrane database of systematic reviews*, *2013*(11), CD007529. <https://doi.org/10.1002/14651858.CD007529.pub3>
- Ataullahjan, A., Vallianatos, H., & Mumtaz, Z. (2021). Violence and precarity: A neglected cause of large family sizes in Pakistan. *Global public health*, 1–10. Advance online publication. <https://doi.org/10.1080/17441692.2021.1879894>
- Atif, K., Ullah, M. Z., Afsheen, A., Naqvi, S. A., Raja, Z. A., & Niazi, S. A. (2016). Son Preference in Pakistan; A Myth or Reality. *Pakistan journal of medical sciences*, *32*(4), 994–998. <https://doi.org/10.12669/pjms.324.9987>
- Bashour, H., Hafez, R., & Abdulsalam, A. (2005). Syrian Women's Perceptions and Experiences of Ultrasound Screening in Pregnancy: Implications for Antenatal Policy. *Reproductive Health Matters*, *13*(25), 147-154.
- Basu, S., Andrews, J., Kishore, S., Panjabi, R., & Stuckler, D. (2012). Comparative performance of private and public healthcare systems in low- and middle-income countries: a systematic review. *PLoS medicine*, *9*(6), e1001244. <https://doi.org/10.1371/journal.pmed.1001244>
- Bucher, H. C., and Schmidt, J. G. (1993). Does routine ultrasound scanning improve outcome in pregnancy? Meta-analysis of various outcome measures. *BMJ (Clinical research ed.)*, *307*(6895), 13–17. <https://doi.org/10.1136/bmj.307.6895.13>
- Campbell S. (2013). A short history of sonography in obstetrics and gynaecology. *Facts, views & vision in ObGyn*, *5*(3), 213–229.
- Cargill, Y., & Morin, L. (2017). Content of a Complete Routine Second Trimester Obstetrical Ultrasound Examination and Report. *Journal of Obstetrics and Gynaecology Canada*, *39*(8), E144-E149. Retrieved from Pregnancy Info: <https://www.pregnancyinfo.ca/your-pregnancy/routine-tests/ultrasound/>
- Channon, M. D. (2017). Son preference and family limitation in Pakistan: A parity-and contraceptive method-specific analysis. *International Perspectives on Sexual and Reproductive Health*, *43*, 99–110
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340. <https://doi.org/10.2307/249008>

- Doan, D. T., Nguyen, H. T., & Bui, H. T. (2017). Patterns of the utilization of prenatal diagnosis services among pregnant women, their satisfaction and its associated factors in Viet Nam. *Int J Public Health, 62*(1), 35-40.
- Edvardsson, K., Graner, S., Thi, L. P., Åhman, A., Small, R., Lalos, A., & Mogren, I. (2015). 'Women think pregnancy management means obstetric ultrasound': Vietnamese obstetricians' views on the use of ultrasound during pregnancy. *Global health action, 8*, 28405. <https://doi.org/10.3402/gha.v8.28405>
- Edvardsson, K., Ntaganira, J., Ahman, A., Sengoma, J. P., Small, R., & Mogren, I. (2016). Physicians' experiences and views on the role of obstetric ultrasound in rural and urban Rwanda: a qualitative study. *Trop Med Int Health, 21*(7), 895-906.
- Edvardsson, K., Small, R., Persson, M., Lalos, A., & Mogren, I. (2014). 'Ultrasound is an invaluable third eye, but it can't see everything': a qualitative study with obstetricians in Australia. *BMC Pregnancy Childbirth, 14*(363)
- Fikree, F. F., & Pasha, O. (2004). Role of gender in health disparity: the South Asian context. *BMJ (Clinical research ed.), 328*(7443), 823–826. <https://doi.org/10.1136/bmj.328.7443.823>
- Firth, E., Mlay, P., Walker, R., & Sill, P. (2011). Pregnant women's beliefs, expectations and experiences of antenatal ultrasound in Northern Tanzania. *African Journal of Reproductive Health, 15*(2).
- Gammeltoft, T., & Nguyễn, H. T. (2007). The Commodification of Obstetric Ultrasound Scanning in Hanoi, Viet Nam. *Reproductive Health Matters, 15*(29), 163-171.
- Ganatra, B., Hirve, S., & Rao, V. N. (2001). Sex-selective abortion: Evidence from a community-based study in western India. *Asia-Pacific Population Journal, 16*(2), 109-124.
- General Statistics Office and UNICEF. (2015). Viet Nam Multiple Indicator Cluster Survey 2014, Final Report. Ha Noi, Viet Nam
- Goldenberg, R. L., Nathan, R. O., Swanson, D., Saleem, S., Mirza, W. *et al.* (2018). Routine antenatal ultrasound in low- and middle-income countries: first look - a cluster randomised trial. *BJOG : an international journal of obstetrics and gynaecology, 125*(12), 1591–1599. <https://doi.org/10.1111/1471-0528.15287>
- Gonzaga, M. A., Kiguli-Malwadde, E., Businge, F., & Byanyima, R. K. (2010). Utilisation of obstetric sonography at a peri-urban health centre in Uganda. *The Pan African medical journal, 7*, 24.
- Hansen, N., Postmes, T., van der Vinne, N., & van Thiel, W. (2012). Information and communication technology and cultural change: How ICT changes self-construal and values. *Social Psychology, 43*(4), 222–231. <https://doi.org/10.1027/1864-9335/a000123>

- Holmlund, S., Thi Lan, P., Edvardsson, K., Ntagarina, J., Graner, S., Small, R., & Mogren, I. (2020). Sub-optimal use of ultrasound examinations may result in underperformance of Vietnamese maternity care – A qualitative study of midwives' experiences and views. *Sexual & Reproductive Healthcare*, 24.
- International Institute for Population Sciences - IIPS/India and ICF. 2017. India National Family Health Survey NFHS-4 2015-16. Mumbai, India: IIPS and ICF. Available at <http://dhsprogram.com/pubs/pdf/FR339/FR339.pdf>.
- International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.
- Lamichhane, P., Harken, T., Puri, M., Darney, P. D., Blum, M., Harper, C. C., & Henderson, J. T. (2011). Sex-selective abortion in Nepal: a qualitative study of health workers' perspectives. *Women's health issues: official publication of the Jacobs Institute of Women's Health*, 21(3 Suppl), S37–S41. <https://doi.org/10.1016/j.whi.2011.02.00>
- Liamputtong, P., & Watson, L. (2002). The voices and concerns about prenatal testing of Cambodian, Lao and Vietnamese women in Australia. *Midwifery*, 18(4), 304–313. <https://doi.org/10.1054/midw.2002.0331>
- Mayan, M. J. (2009). *Essentials of qualitative inquiry*. Walnut Creek, CA: Left Coast Press.
- Mohanan, M., Babiarz, K.S., Goldhaber-Fiebert, J.D., Miller, G., Vera-Hernandez, M. 2016. Effect of a large-scale social franchising and telemedicine program on childhood diarrhea and pneumonia outcomes in India. *Health Affairs (Project Hope)* 35: 1800–9.
- Mumtaz, Z., O'Brien, B., Bhatti, A. *et al.* (2012). Are community midwives addressing the inequities in access to skilled birth attendance in Punjab, Pakistan? Gender, class and social exclusion. *BMC Health Serv Res* 12, 326. <https://doi.org/10.1186/1472-6963-12-326>
- Mumtaz, Z., Salway, S., Bhatti, A., & McIntyre, L. (2014). Addressing invisibility, inferiority, and powerlessness to achieve gains in maternal health for ultra-poor women. *Lancet (London, England)*, 383(9922), 1095–1097. [https://doi.org/10.1016/S0140-6736\(13\)61646-3](https://doi.org/10.1016/S0140-6736(13)61646-3)
- Mumtaz, Z., Levay, A., Jhangri, G., and Bhatti, A. (2015). Coverage of private sector community midwife services in rural Punjab, Pakistan: Development and demand. *Health Research Policy and Systems*. 13. 10.1186/s12961-015-0038-3.
- National Institute of Population Studies (NIPS) [Pakistan] and ICF. 2019. Pakistan Demographic and Health Survey 2017-18. Islamabad, Pakistan, and Rockville, Maryland, USA: NIPS and ICF.
- Nishtar, S., Bhutta, Z.A., Jafar, T.H., et al. 2013. Health reform in Pakistan: a call to action. *The Lancet* 381: 2291–7.

- Nishtar S. (2010). The mixed health systems syndrome. *Bulletin of the World Health Organization*, 88(1), 74–75. <https://doi.org/10.2471/BLT.09.067868>
- Noh, J.W., Kim, Y.M., Lee, L.J., Akram, N., Shahid, F., et al. (2019). Factors associated with the use of antenatal care in Sindh province, Pakistan: A population-based study. *PLOS ONE* 14(4): e0213987. <https://doi.org/10.1371/journal.pone.0213987>
- Quirkos 2.4.2 [Computer Software]. (2021). Retrieved from <https://www.quirkos.com>
- Ranji, A., & Dykes, A. K. (2012). Ultrasound screening during pregnancy in Iran: womens' expectations, experiences and number of scans. *Midwifery*, 28(1), 24–29. <https://doi.org/10.1016/j.midw.2010.10.005>
- Rijken, M. J., Gilder, M. E., Thwin, M. M., Ladda Kajeechewa, H. M., Wiladphaingern, J., Lwin, K. M., & McGready, R. (2012). Refugee and migrant women's views of antenatal ultrasound on the Thai Burmese border: a mixed methods study. *PLoS One*, 7(4).
- Roberts, J., Griffiths, F., & Verran, A. (2017). Seeing the Baby, Doing Family: Commercial Ultrasound as Family Practice? *Sociology*, 51(3), 527–542. <https://doi.org/10.1177/0038038515591945>
- Roberts, J., Griffiths, F.E., Verran, A. and Ayre, C. (2015), Why do women seek ultrasound scans from commercial providers during pregnancy?. *Sociol Health Illn*, 37: 594-609. <https://doi.org/10.1111/1467-9566.12218>
- Rogers, E. M. (1962). Diffusion of innovations. New York: Free Press of Glencoe.
- Stuckler, D., Basu, S. 2009. The International Monetary Fund's effects on global health: before and after the 2008 financial crisis. *International Journal of Health Services* 39: 771–81.
- Tautz, S., Jahn, A., Molokomme, I., & Gørgen, R. (2000). Between fear and relief: how rural pregnant women experience foetal ultrasound in a Botswana district hospital. *Soc Sci Med*, 50, 689-701.
- Tougher, S., Dutt, V., Pereira, S., et al. 2018. Effect of a multifaceted social franchising model on quality and coverage of maternal, newborn, and reproductive health-care services in Uttar Pradesh, India: a quasi-experimental study. *The Lancet Global Health* 6: e211–21.
- Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, 39(2), 273–315. <https://doi.org/10.1111/j.1540-5915.2008.00192.x>
- Whitworth, M., Bricker, L., Mullan, C. (2015). Ultrasound for fetal assessment in early pregnancy. *Cochrane Database Syst Rev*, (7). <https://doi.org/10.1002/14651858.CD007058.pub3>

Winkvist, A. and Akhter, Z.A. (2000). ‘God should give daughters to rich families only’: attitudes towards childbearing among low-income women in Punjab, Pakistan. *Social Science and Medicine*, 51, 73–81

World Health Organization. (n.d.). *Health Service Delivery*. World Health Organization. Retrieved April 12, 2022, from <http://www.emro.who.int/pak/programmes/service-delivery.html>

Zhang, X. and Maruping, L. (2008). Household technology adoption in a global marketplace: Incorporating the role of espoused cultural values. *Information Systems Frontiers*. 10. 403-413. 10.1007/s10796-008-9099-y.

## Chapter 4: Conclusion

The objective of this study was to explore the impact of ultrasound technology on both the biomedical, and lay, cultural management of pregnancy in rural Pakistan. Our data suggests that ultrasounds scans have become a common practice in healthy pregnancies in our sample from rural field-sites in three districts in Punjab, Pakistan. This uptake of what are essentially unnecessary ultrasound scans has ultimately changed how pregnancy is managed by both our respondent women and providers. Women are perceiving ultrasound scans as the entirety of antenatal care. They appear to have such high trust in the technology's ability to offer thorough and complete care during pregnancy, that they have neglected other important elements of antenatal care. Both providers and patients appear to play a mutually reinforcing role in driving the uptake of unnecessary scans during pregnancy. While providers, particularly in the private sector, were documented routinely providing frequent scans without medical indications, patients were also requesting frequent scans during healthy pregnancies in hopes of giving birth to a son.

These findings are echoed by the literature from low-and middle-income contexts. In Vietnam, some women were observed to be replacing routine antenatal care with repeated scans (Gammeltoft and Nguyen, 2007; Holmlund et al., 2020). Gammeltoft and Nguyen (2007) reported that some women in Vietnam believed an ultrasound scans to be far superior to "ordinary antenatal care". Similar sentiments were shared by some women in several studies in sub-Saharan Africa, where some women perceived an ultrasound scan as a "magical device" that can see and treat any anomaly observed in both mother and baby (Tautz et al., 2000; Firth et al., 2011; Edvardsson et al., 2016).

The literature in high-income countries provides insight into how vastly different obstetric ultrasound is perceived and used by women when compared to low-and middle-income contexts.

The literature from high-income countries discusses the emotional and social benefits of obstetric ultrasound on motherhood through bonding with the fetus or receiving ultrasound photos of the fetus as memorabilia (Rijken et al., 2011; Edvardsson et al., 2015; Roberts et al., 2015; Ahman et al., 2019). The difference in women's experiences with obstetric ultrasound, where ultrasound technology appears to be having a more harmful impact in low and middle-income contexts, can potentially be explained by the influence of the private sector on ultrasound technology uptake and use in low-and middle-income contexts. The private sector has become a significant provider of maternal health services in many low and middle-income countries (Stuckler and Basu, 2009; Mohanan et al., 2016; Tougher et al., 2018). The role of the private sector in driving un-necessary ultrasound use has been thoroughly documented in the literature. Throughout low-and-middle income countries, primarily those in south-east Asia and sub-Saharan Africa, providers in the private sector have been documented recommending frequent ultrasound scans without any medical indication. (Bashour et al., 2005; Gammeltoft and Nguyen, 2007; Gonzaga et al., 2009; Edvardsson et al., 2015).

Furthermore, the finding that women are also contributing to the uptake in un-necessary scans may potentially not be a novel finding. The extent to which literature describes women's contribution to un-necessary scans is documented in Vietnam and sub-Saharan African as women seeking ultrasound scans without medical indication or physician's referral (Gammeltoft and Nguyen, 2007; Gonzaga et al., 2009; Edvardsson et al., 2016; Holmlund et al., 2020).

While evidence from the literature and this study show that obstetric ultrasound is being used by women to monitor their pregnancies, there is no clinical evidence that routine ultrasound scans have any impact on maternal or child mortality in low- and middle-income contexts. A meta-analysis by Bucher and Schmidt (1993) reported that routine ultrasound scans do not contribute to



a reduction in perinatal morbidity. Similar conclusions were made by Goldenberg et al. (2018) through a cluster randomized trial in the Democratic Republic of Congo, Guatemala, Kenya, Pakistan, and Zambia. Based on this evidence, providers in our study sites were motivated by profit incentive and were not providing additional scans to the medical benefit of the patient.

The findings of this study have important implications for policy and practice. Policy makers in practice must address the concerning reality that the private sector is prioritizing and driving unnecessary ultrasound scans has led to women in this context perceiving repeated scans as the entirety of their antenatal care surveillance. Given the evidence that routine ultrasound scans have no impact on perinatal healthy and mortality, it is important to ensure that ultrasound technology does not replace routine elements of antenatal care.

## REFERENCES

- Ahman, A., Edvardsson, K., Fagerli, T. A., Darj, E., Holmlund, S., Small, R., & Mogren, I. (2019). A much valued tool that also brings ethical dilemmas - a qualitative study of Norwegian midwives' experiences and views on the role of obstetric ultrasound. *BMC Pregnancy Childbirth*, *19*(1), 33.
- Bashour, H., Hafez, R., & Abdulsalam, A. (2005). Syrian Women's Perceptions and Experiences of Ultrasound Screening in Pregnancy: Implications for Antenatal Policy. *Reproductive Health Matters*, *13*(25), 147-154.
- Bucher, H. C., and Schmidt, J. G. (1993). Does routine ultrasound scanning improve outcome in pregnancy? Meta-analysis of various outcome measures. *BMJ (Clinical research ed.)*, *307*(6895), 13–17. <https://doi.org/10.1136/bmj.307.6895.13>
- Edvardsson, K., Ntaganira, J., Ahman, A., Sengoma, J. P., Small, R., & Mogren, I. (2016). Physicians' experiences and views on the role of obstetric ultrasound in rural and urban Rwanda: a qualitative study. *Trop Med Int Health*, *21*(7), 895-906.
- Edvardsson, K., Graner, S., Thi, L. P., Åhman, A., Small, R., Lalos, A., & Mogren, I. (2015). 'Women think pregnancy management means obstetric ultrasound': Vietnamese obstetricians' views on the use of ultrasound during pregnancy. *Global health action*, *8*, 28405. <https://doi.org/10.3402/gha.v8.28405>
- Firth, E., Mlay, P., Walker, R., & Sill, P. (2011). Pregnant women's beliefs, expectations and experiences of antenatal ultrasound in Northern Tanzania. *African Journal of Reproductive Health*, *15*(2).
- Gammeltoft, T., & Nguyễn, H. T. (2007). The Commodification of Obstetric Ultrasound Scanning in Hanoi, Viet Nam. *Reproductive Health Matters*, *15*(29), 163-171.
- Goldenberg, R. L., Nathan, R. O., Swanson, D., Saleem, S., Mirza, W. *et al.* (2018). Routine antenatal ultrasound in low- and middle-income countries: first look - a cluster randomised trial. *BJOG : an international journal of obstetrics and gynaecology*, *125*(12), 1591–1599. <https://doi.org/10.1111/1471-0528.15287>
- Gonzaga, M. A., Kiguli-Malwadde, E., Businge, F., & Byanyima, R. K. (2010). Utilisation of obstetric sonography at a peri-urban health centre in Uganda. *The Pan African medical journal*, *7*, 24.
- Holmlund, S., Thi Lan, P., Edvardsson, K., Ntagarina, J., Graner, S., Small, R., & Mogren, I. (2020). Sub-optimal use of ultrasound examinations may result in underperformance of Vietnamese maternity care – A qualitative study of midwives' experiences and views. *Sexual & Reproductive Healthcare*, *24*.

- Mohanan, M., Babiarz, K.S., Goldhaber-Fiebert, J.D., Miller, G., Vera-Hernandez, M. 2016. Effect of a large-scale social franchising and telemedicine program on childhood diarrhea and pneumonia outcomes in India. *Health Affairs (Project Hope)* 35: 1800–9.
- Rijken, M. J., Gilder, M. E., Thwin, M. M., Ladda Kajeechewa, H. M., Wiladphaingern, J., Lwin, K. M., & McGready, R. (2012). Refugee and migrant women's views of antenatal ultrasound on the Thai Burmese border: a mixed methods study. *PLoS One*, 7(4).
- Roberts, J., Griffiths, F.E., Verran, A. and Ayre, C. (2015), Why do women seek ultrasound scans from commercial providers during pregnancy?. *Sociol Health Illn*, 37: 594-609. <https://doi.org/10.1111/1467-9566.12218>
- Stuckler. D., Basu. S. 2009. The International Monetary Fund's effects on global health: before and after the 2008 financial crisis. *International Journal of Health Services* 39: 771–81.
- Tautz, S., Jahn, A., Molokomme, I., & Görgen, R. (2000). Between fear and relief: how rural pregnant women experience foetal ultrasound in a Botswana district hospital. *Soc Sci Med*, 50, 689-701.
- Tougher, S., Dutt, V., Pereira, S., et al. 2018. Effect of a multifaceted social franchising model on quality and coverage of maternal, newborn, and reproductive health-care services in Uttar Pradesh, India: a quasi-experimental study. *The Lancet Global Health* 6: e211–21.

## BIBLIOGRAPHY

- AbouZahr, C., & Wardlaw, T. (2003). Maternal Mortality at the End of a Decade: Signs of Progress? *Bulletin of the World Health Organization*, 79, 561-568.
- Ahman, A., Edvardsson, K., Fagerli, T. A., Darj, E., Holmlund, S., Small, R., & Mogren, I. (2019). A much valued tool that also brings ethical dilemmas - a qualitative study of Norwegian midwives' experiences and views on the role of obstetric ultrasound. *BMC Pregnancy Childbirth*, 19(1), 33.
- Ahmed, J., Raynes-Greenow, C., & Alam, A. (2020). Traditional practices during pregnancy and birth, and perceptions of perinatal losses in women of rural Pakistan. *Midwifery*, 91, 102854. <https://doi.org/10.1016/j.midw.2020.102854>
- Alfirevic, Z., Stampalija, T., & Gyte, G. M. (2013). Fetal and umbilical Doppler ultrasound in high-risk pregnancies. *The Cochrane database of systematic reviews*, 2013(11), CD007529. <https://doi.org/10.1002/14651858.CD007529.pub3>
- Arikan, D.C., Özer, A., Arikan, I., Coskun, A., and Kiran, H. (2011). Turkish obstetricians' personal preference for mode of delivery and attitude toward cesarean delivery on maternal request. *Arch Gynecol Obstet*. 284(3):543-9
- Ataullahjan, A., Vallianatos, H., & Mumtaz, Z. (2021). Violence and precarity: A neglected cause of large family sizes in Pakistan. *Global public health*, 1–10. Advance online publication. <https://doi.org/10.1080/17441692.2021.1879894>
- Attané, I., and Guilmoto, C. (2007). Watering the neighbour's garden: the growing demographic female deficit in Asia. <https://agris.fao.org/agris-search/search.do?recordID=XF2015028131>
- Atif, K., Ullah, M. Z., Afsheen, A., Naqvi, S. A., Raja, Z. A., & Niazi, S. A. (2016). Son Preference in Pakistan; A Myth or Reality. *Pakistan journal of medical sciences*, 32(4), 994–998. <https://doi.org/10.12669/pjms.324.9987>
- Bagheri, A., Alavi, N.M., and Abbaszadeh, F. (2013). Iranian obstetricians' views about the factors that influence pregnant women's choice of delivery method: A qualitative study. *Women Birth*. 26(1):e45-9.
- Bashour, H., Hafez, R., & Abdulsalam, A. (2005). Syrian Women's Perceptions and Experiences of Ultrasound Screening in Pregnancy: Implications for Antenatal Policy. *Reproductive Health Matters*, 13(25), 147-154.
- Basu, S., Andrews, J., Kishore, S., Panjabi, R., & Stuckler, D. (2012). Comparative performance of private and public healthcare systems in low- and middle-income countries: a systematic review. *PLoS medicine*, 9(6), e1001244. <https://doi.org/10.1371/journal.pmed.1001244>

- Bergholt, T., Østberg, B., Legarth, J., and Weber, T. (2004). Danish obstetricians' personal preference and general attitude to elective cesarean section on maternal request: a nationwide postal survey. *Acta Obstet Gynecol Scand.* 83(3):262-6
- Bucher, H. C., and Schmidt, J. G. (1993). Does routine ultrasound scanning improve outcome in pregnancy? Meta-analysis of various outcome measures. *BMJ (Clinical research ed.)*, 307(6895), 13–17. <https://doi.org/10.1136/bmj.307.6895.13>
- Campbell, M., and Gregor, F. (2002). Mapping social relations; A primer in doing institutional ethnography. Toronto, Ontario, Canada: Garamond Press.
- Campbell, S. (2013). A short history of sonography in obstetrics and gynaecology. *Facts, views & vision in ObGyn*, 5(3), 213–229.
- Cargill, Y., & Morin, L. (2017). Content of a Complete Routine Second Trimester Obstetrical Ultrasound Examination and Report. *Journal of Obstetrics and Gynaecology Canada*, 39(8), E144-E149. Retrieved from Pregnancy Info: <https://www.pregnancyinfo.ca/your-pregnancy/routine-tests/ultrasound/>
- Channon, M. D. (2017). Son preference and family limitation in Pakistan: A parity-and contraceptive method-specific analysis. *International Perspectives on Sexual and Reproductive Health*, 43, 99–110
- Cherniak, W., Anguyo, G., Meaney, C., Kong, L., Malhame, I., & Pace, R. (2017). Effectiveness of advertising availability of prenatal ultrasound on uptake of antenatal care in rural Uganda: a cluster randomized trial. *PLoS ONE*, 12.
- Chigbu, C., Odugu, B., & Okezie, O. (2008). Implications of incorrect determination of fetal sex by ultrasound. *Int J Gynaecol Obstet*, 100(287-290).
- Davidson, E. J. (2005). Evaluation methodology basics: The nuts and bolts of sound evaluation. SAGE Publications, Inc. <https://www.doi.org/10.4135/9781452230115>
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Doan, D. T., Nguyen, H. T., & Bui, H. T. (2017). Patterns of the utilization of prenatal diagnosis services among pregnant women, their satisfaction and its associated factors in Viet Nam. *Int J Public Health*, 62(1), 35-40.
- Dhamankar, R., DiNonno, W., Martin, K., Demko, Z., & Gomez-Lobo, V. (2020). Fetal Sex Results of Noninvasive Prenatal Testing and Differences With Ultrasonography. *Obstetrics and gynecology*, 135(5), 1198-1206.
- Drukker, L., Bradburn, E., Rodriguez, G., Roberts, N., Impey, L., & Papageorghiou, A. (2021). How often do we identify fetal abnormalities during routine third-trimester ultrasound? A systematic review and meta-analysis. *BJOG: Int J Obstet Gy*, 128(2), 259-269.

- Edvardsson, K., Graner, S., Thi, L. P., Åhman, A., Small, R., Lalos, A., & Mogren, I. (2015). 'Women think pregnancy management means obstetric ultrasound': Vietnamese obstetricians' views on the use of ultrasound during pregnancy. *Global health action*, 8, 28405. <https://doi.org/10.3402/gha.v8.28405>
- Edvardsson, K., Ntaganira, J., Ahman, A., Sengoma, J. P., Small, R., & Mogren, I. (2016). Physicians' experiences and views on the role of obstetric ultrasound in rural and urban Rwanda: a qualitative study. *Trop Med Int Health*, 21(7), 895-906.
- Edvardsson, K., Small, R., Persson, M., Lalos, A., & Mogren, I. (2014). 'Ultrasound is an invaluable third eye, but it can't see everything': a qualitative study with obstetricians in Australia. *BMC Pregnancy Childbirth*, 14(363)
- Efrat, Z., Perri, T., Ramati, E., Tugendreich, D., & Meizner, I. (2006). Fetal gender assignment by first trimester ultrasound. *Ultrasound in Obstetrics and Gynecology*, 27, 619-621.
- Engelbrechtsen, L; Brondum-Nielsen, K; Ekelund, C. (2013). Detection of triploidy at 11-14 weeks of gestation: a cohort study of 198,000 pregnant women. *Ultrasound Obstet Gynecol*, 42, 530-535.
- Fikree, F. F., & Pasha, O. (2004). Role of gender in health disparity: the South Asian context. *BMJ (Clinical research ed.)*, 328(7443), 823–826. <https://doi.org/10.1136/bmj.328.7443.823>
- Firth, E., Mlay, P., Walker, R., & Sill, P. (2011). Pregnant women's beliefs, expectations and experiences of antenatal ultrasound in Northern Tanzania. *African Journal of Reproductive Health*, 15(2).
- Gammeltoft, T., & Nguyễn, H. T. (2007). The Commodification of Obstetric Ultrasound Scanning in Hanoi, Viet Nam. *Reproductive Health Matters*, 15(29), 163-171.
- Ganatra, B., Hirve, S., & Rao, V. N. (2001). Sex-selective abortion: Evidence from a community-based study in western India. *Asia-Pacific Population Journal*, 16(2), 109-124.
- General Statistics Office and UNICEF. (2015). Viet Nam Multiple Indicator Cluster Survey 2014, Final Report. Ha Noi, Viet Nam
- Goldenberg, R. L., Nathan, R. O., Swanson, D., Saleem, S., Mirza, W. *et al.* (2018). Routine antenatal ultrasound in low- and middle-income countries: first look - a cluster randomised trial. *BJOG : an international journal of obstetrics and gynaecology*, 125(12), 1591–1599. <https://doi.org/10.1111/1471-0528.15287>
- Gonzaga, M. A., Kiguli-Malwadde, E., Businge, F., & Byanyima, R. K. (2010). Utilisation of obstetric sonography at a peri-urban health centre in Uganda. *The Pan African medical journal*, 7, 24.
- Guilmoto, C.Z. (2009). The sex ratio transition in Asia. *Popul Dev Rev*, 35, 519-49.

- Gupta, M.D., Chung, W., and Shuzhuo, L. (2009). Evidence for an incipient decline in numbers of missing girls in China and India. *Popul Dev Rev*, 35, 401-16.
- Hansen, N., Postmes, T., van der Vinne, N., & van Thiel, W. (2012). Information and communication technology and cultural change: How ICT changes self-construal and values. *Social Psychology*, 43(4), 222–231. <https://doi.org/10.1027/1864-9335/a000123>
- Hofstede, G. (1991). *Cultures and Organizations: Software of the Mind*. London: McGraw-Hill.
- Holmlund, S., Thi Lan, P., Edvardsson, K., Ntagarina, J., Graner, S., Small, R., & Mogren, I. (2020). Sub-optimal use of ultrasound examinations may result in underperformance of Vietnamese maternity care – A qualitative study of midwives' experiences and views. *Sexual & Reproductive Healthcare*, 24.
- International Institute for Population Sciences - IIPS/India and ICF. 2017. India National Family Health Survey NFHS-4 2015-16. Mumbai, India: IIPS and ICF. Available at <http://dhsprogram.com/pubs/pdf/FR339/FR339.pdf>.
- International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.
- Kamal, P., Dixon-Woods, M., Kurinczuk, J.J., Oppenheimer, C., Squire, P., and Waugh, J. (2005). Factors influencing repeat caesarean section: qualitative exploratory study of obstetricians' and midwives' accounts. *BJOG*. 112(8):1054-60.
- Kawooya, M.G., Nathan, R.O., Swanson, J., Swanson, D.L., Namulema, E., Ankunda, R., et al. (2015). Impact of Introducing Routine Antenatal Ultrasound Services on Reproductive Health Indicators in Mpigi District, Central Uganda. *Ultrasound Q*. 31(4):285–9. <https://doi.org/10.1097/RUQ.0000000000000142>
- Kmet, L. M., Lee, R.C., and Cook, L. S. (2004) Standard quality assessment criteria for evaluating primary research papers from a variety of fields. Edmonton: Alberta Heritage Foundation for Medical Research (AHFMR). *AHFMR - HTA Initiative #13*.
- Lamichhane, P., Harken, T., Puri, M., Darney, P. D., Blum, M., Harper, C. C., & Henderson, J. T. (2011). Sex-selective abortion in Nepal: a qualitative study of health workers' perspectives. *Women's health issues : official publication of the Jacobs Institute of Women's Health*, 21(3 Suppl), S37–S41. <https://doi.org/10.1016/j.whi.2011.02.00>
- Lau, Y. (2012). Traditional Chinese Pregnancy Restrictions, Health-Related Quality of Life and Perceived Stress among Pregnant Women in Macao, China. *Asian Nursing Research*, 6(1), 27–34. <https://doi.org/10.1016/j.anr.2012.02.005>
- Liamputtong, P., & Watson, L. (2002). The voices and concerns about prenatal testing of Cambodian, Lao and Vietnamese women in Australia. *Midwifery*, 18(4), 304–313. <https://doi.org/10.1054/midw.2002.0331>

- Lindgaard, K., & Riisgaard, L. (2017). Validation of ultrasound examinations performed by general practitioners. *Scand J Prim Health Care*, 35(3), 256-261.
- Makhlouf, M., & Saade, G. (2013). Should second trimester ultrasound be routine for all pregnancies?. *Seminars in perinatology*, 37(5), 323–326. <https://doi.org/10.1053/j.semperi.2013.06.008>
- Martin, E. (1991). *The woman in the body: A cultural analysis of reproduction*. Beacon Press; Boston.
- Masimba, F., Appiah, M., & Zuva, T. (2019). A Review of Cultural Influence on Technology Acceptance. *2019 International Multidisciplinary Information Technology and Engineering Conference (IMITEC)*. <https://doi.org/10.1109/imitec45504.2019.9015877>
- Mayan, M. J. (2009). *Essentials of qualitative inquiry*. Walnut Creek, CA: Left Coast Press.
- Menacker, F., Declercq, E., and Macdorman, M.F. (2006). Cesarean delivery: Background, trends, and epidemiology. *Seminars in Perinatology*. 30(5):235–241. [PubMed: 17011392].
- Mensah, Y. B., Nkyekyer, K., & Mensah, K. (2014). The Ghanaian woman's experience and perception of ultrasound use in antenatal care. *Ghana Med J*, 48(1), 31-38.
- Mohanani, M., Babiarz, K.S., Goldhaber-Fiebert, J.D., Miller, G., Vera-Hernandez, M. 2016. Effect of a large-scale social franchising and telemedicine program on childhood diarrhea and pneumonia outcomes in India. *Health Affairs (Project Hope)* 35: 1800–9.
- Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097
- Morris, J. L., Short, S., Robson, L., & Andriatsihosena, M. S. (2014). Maternal health practices, beliefs and traditions in southeast Madagascar. *African journal of reproductive health*, 18(3), 101–117.
- Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification Strategies for Establishing Reliability and Validity in Qualitative Research. *International Journal of Qualitative Methods*, 13–22.
- Mumtaz, Z., O'Brien, B., Bhatti, A. *et al.* (2012). Are community midwives addressing the inequities in access to skilled birth attendance in Punjab, Pakistan? Gender, class and social exclusion. *BMC Health Serv Res* 12, 326. <https://doi.org/10.1186/1472-6963-12-326>
- Mumtaz, Z., Salway, S., Bhatti, A., & McIntyre, L. (2014). Addressing invisibility, inferiority, and powerlessness to achieve gains in maternal health for ultra-poor women. *Lancet (London, England)*, 383(9922), 1095–1097. [https://doi.org/10.1016/S0140-6736\(13\)61646-3](https://doi.org/10.1016/S0140-6736(13)61646-3)



- Mumtaz, Z., Levay, A., Jhangri, G., and Bhatti, A. (2015). Coverage of private sector community midwife services in rural Punjab, Pakistan: Development and demand. *Health Research Policy and Systems*, 13. 10.1186/s12961-015-0038-3.
- National Institute of Population Studies (NIPS) [Pakistan] and ICF. 2019. Pakistan Demographic and Health Survey 2017-18. Islamabad, Pakistan, and Rockville, Maryland, USA: NIPS and ICF.
- Nishtar, S., Bhutta, Z.A., Jafar, T.H., et al. 2013. Health reform in Pakistan: a call to action. *The Lancet* **381**: 2291–7.
- Nishtar S. (2010). The mixed health systems syndrome. *Bulletin of the World Health Organization*, 88(1), 74–75. <https://doi.org/10.2471/BLT.09.067868>
- Ngo, T. T., Nguyen, T. D., Goyens, P., & Robert, A. (2018). Misuse of antenatal care and its association with adverse outcomes of pregnancy in a Southern rural area of Vietnam. *Health care for women international*, 39(4), 472–492. <https://doi.org/10.1080/07399332.2017.1400035>
- Noh, J.W., Kim, Y.M., Lee, L.J., Akram, N., Shahid, F., et al. (2019). Factors associated with the use of antenatal care in Sindh province, Pakistan: A population-based study. *PLOS ONE* 14(4): e0213987. <https://doi.org/10.1371/journal.pone.0213987>
- Ohagwu, C., Eze, C., Eze, J., Odo, M., Abu, P., & Ohagwu, C. (2014). Perception of male gender preference among pregnant igbo women. *Ann Med Health Sci Res*, 4(2), 173-178.
- Ouyang, Y.Q., and Zhang, Q. A study on personal mode of delivery among Chinese obstetrician-gynecologists, midwives and nurses. *Arch Gynecol Obstet*. 287(1):37-41.
- Pradhan, E., Pearson, E., & Puri, M. (2019). Determinants of imbalanced sex ratio at birth in Nepal: evidence from secondary analysis of a large hospital-based study and nationally-representative survey data. *BMJ Open*, 9.
- Qadir, F., Khan, M., Medhin, G., & Prince, M. (2011). Male gender preference, female gender disadvantage as risk factors psychological morbidity in Pakistani women of childbearing age – a life course perspective. *BMC Public Health*, 11, 745.
- Quirkos 2.4.2 [Computer Software]. (2021). Retrieved from <https://www.quirkos.com>
- Rai, P., Paudel, I., Ghimire, A., Pokharel, P., Rijal, R., & Niraula, S. (2014). Effect of gender preference on fertility: cross-sectional study among women of Tharu community from rural area of eastern region of Nepal. *Reproductive health*, 11(1), 15.
- Quirkos 2.4.2 [Computer Software]. (2021). Retrieved from <https://www.quirkos.com>
- Ranji, A., & Dykes, A. K. (2012). Ultrasound screening during pregnancy in Iran: women's expectations, experiences and number of scans. *Midwifery*, 28(1), 24–29. <https://doi.org/10.1016/j.midw.2010.10.005>

- Rijken, M. J., Gilder, M. E., Thwin, M. M., Ladda Kajeechewa, H. M., Wiladphaingern, J., Lwin, K. M., & McGready, R. (2012). Refugee and migrant women's views of antenatal ultrasound on the Thai Burmese border: a mixed methods study. *PLoS One*, 7(4).
- Roberts, J., Griffiths, F., & Verran, A. (2017). Seeing the Baby, Doing Family: Commercial Ultrasound as Family Practice? *Sociology*, 51(3), 527–542. <https://doi.org/10.1177/0038038515591945>
- Roberts, J., Griffiths, F.E., Verran, A. and Ayre, C. (2015), Why do women seek ultrasound scans from commercial providers during pregnancy?. *Sociol Health Illn*, 37: 594-609. <https://doi.org/10.1111/1467-9566.12218>
- Rogers, E. M. (1962). Diffusion of innovations. New York: Free Press of Glencoe.
- Stuckler, D., Basu, S. 2009. The International Monetary Fund's effects on global health: before and after the 2008 financial crisis. *International Journal of Health Services* 39: 771–81.
- Tautz, S., Jahn, A., Molokomme, I., & Görgen, R. (2000). Between fear and relief: how rural pregnant women experience foetal ultrasound in a Botswana district hospital. *Soc Sci Med*, 50, 689-701.
- Thorburn. (2011, September 20). *Technology and Culture: A Circle of Influence*. [https://nuglobalstudies.wordpress.com/global-studies/gls\\_499-2/](https://nuglobalstudies.wordpress.com/global-studies/gls_499-2/).
- Tougher, S., Dutt, V., Pereira, S., et al. 2018. Effect of a multifaceted social franchising model on quality and coverage of maternal, newborn, and reproductive health-care services in Uttar Pradesh, India: a quasi-experimental study. *The Lancet Global Health* 6: e211–21.
- Tripathy J. P. (2013). Secondary Data Analysis: Ethical Issues and Challenges. *Iranian journal of public health*, 42(12), 1478–1479.
- Ultrasound Market to Reach USD 10.44 Billion By 2027: Reports and Data. GlobeNewswire Newsroom. <https://www.globenewswire.com/news-release/2020/01/14/1970523/0/en/Ultrasound-Market-To-Reach-USD-10-44-Billion-By-2027-Reports-And-Data.html>
- Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, 39(2), 273–315. <https://doi.org/10.1111/j.1540-5915.2008.00192.x>
- Whitworth, M., Bricker, L., Mullan, C. (2015). Ultrasound for fetal assessment in early pregnancy. *Cochrane Database Syst Rev*, (7). <https://doi.org/10.1002/14651858.CD007058.pub3>
- Winch, P. J., Alam, M. A., Akther, A., Afroz, D., Ali, N. A., Ellis, A. A., Baqui, A. H., Darmstadt, G. L., El Arifeen, S., & Rahman Seraji, M. H. (2005). Local understandings of vulnerability and protection during the neonatal period in Sylhet district, Bangladesh: a

qualitative study. *The Lancet*, 366(9484), 478–485. [https://doi.org/10.1016/s0140-6736\(05\)66836-5](https://doi.org/10.1016/s0140-6736(05)66836-5)

Winkvist, A. and Akhter, Z.A. (2000). ‘God should give daughters to rich families only’: attitudes towards childbearing among low-income women in Punjab, Pakistan. *Social Science and Medicine*, 51, 73–81.

World Health Organization (2011). Health technology assessment of medical devices. *WHO Medical device technical series*.

World Health Organization. (n.d.). *Health Service Delivery*. World Health Organization. Retrieved April 12, 2022, from <http://www.emro.who.int/pak/programmes/service-delivery.html>

Zhang, X. and Maruping, L. (2008). Household technology adoption in a global marketplace: Incorporating the role of espoused cultural values. *Information Systems Frontiers*. 10. 403-413.

## APPENDIX 1: Quality Assessment

### Quantitative Paper Assessment

Study	Question/objective suff. described?	Study design evident?	Method of subject/comparison groups described + Approp?	Subject/comparison groups suff. described?	If intervention + random allocation possible, described?	Outcome + measures of assessment reported	Appropriate sample size	Analysis justified	Results suff. reported	Conclusion supported by results?	Rating /50
Doan et al., 2017	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	50/50
Ohagwu et al., 2014	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	50/50
Chigbu et al., 2007	✓	✓	✓	✓	N/A	✓	X	✓	✓	✓	40/50
Mensah et al., 2014	✓	✓	✓	✓	N/A	✓	✓	✓	✓	✓	50/50
Cherniak et al., 2017	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	50/50

### Qualitative Paper Assessment

Study	Research Responsiveness	Methodological Coherence	Sampling	Collecting + Analyzing Concurrently	Thinking Critically	Rating /50
Edvardsson et al., 2015	YES -altered sample size as needed	YES -ethnography, interviews, content analysis	YES -participants that can speak on it -data saturation	NO	YES -Continue through 17 interviews until data saturation is reached	40/50
Gammeltoft and Nguyen, 2007	YES -found new information on excessive use being revealed, sought to ask more about it	YES -ethnography, interviews, observations	YES -participants that can speak on it	NO	YES -Sought out more information in order to answer new questions arising	40/50
Holmlund et al., 2020	YES -translated transcribed re-read by authors and categories adjusted for correct translation	YES -ethnography, focus group, content analysis	YES -25 purposive participants -data saturation	YES -manifest + latent analysis used → used at diff levels of interpretation + abstraction -findings concurrently discussed	YES -continue through interviews without stopping until data saturation is reached	50/50
Tautz et al., 200	YES -adaptations to interview guideline after initial interviews	YES -interviews, observation	YES -Purposive sampling -data saturation	NO	YES -continue through interviews without stopping until data saturation is reached	40/50
Firth et al., 2011	YES -alterations to research proposal	YES	YES -purposive -data saturation	YES -continual analysis throughout study	YES	50/50

	due to new findings	-Interviews, thematic analysis -			-translations verified by independent non-medical translator	
Bashour et al., 2005	NO	YES -ethnography, interviews, 30 women, thematic coding	YES -Purposive sampling -participants that can speak on it	NO	YES	30/50
Liamputtong and Watson, 2002	YES -each interview reviewed to provide guidelines for subsequent interviews	NO? -ethnography, interviews, 67 participants, thematic analysis	YES -Purposive sampling -participants that can speak on subject -data saturation	YES -bi-monthly meetings attended by research team to discuss research -review after each interview	YES - continue through interviews without stopping until data saturation is reached	50/50
Rijken et al., 2011	YES -observations of ultrasound scans used to develop interview topics	YES -ethnography, Interviews, observations, FGDs, content analysis	YES -purposive sampling -participants that can speak on subject	YES -data collection employed iteratively; observations guided interviews	YES	50/50
Edvardsson et al., 2014	YES -discussions on the possibility of new data arising	YES -ethnography, interviews, content analysis	YES -convenience sampling -data saturation	NO	YES -continue through interviews without stopping until data saturation is reached	40/50
Edvardsson et al., 2016	YES -interruptions in recruitment and interviews due to	YES -ethnography, interviews, content analysis	YES -convenience sampling	YES -iterative process	YES	50/50

	emergencies → adjustments		-participants that can speak on subject			
Puri et al., 2011	NO	YES -ethnography, interviews, content analysis	YES -convenience -participants that can speak on the subject	NO	NO	20/50
Gonzaga et al., 2009	NO	YES -ethnography, interviews, 30, content analysis	YES -convenience sampling -data saturation	YES -transcripts kept and referred to during research period	YES -continue through interviews without stopping until data saturation is reached	40/50

## APPENDIX 1: Summary of Studies Reviewed

Author	Country	Type of Study	Number of Participants	Participant Characteristics	Significant Findings
<b>Holmlund et al., 2020</b>	Vietnam	Qualitative – Focus Group Discussions	25	Purposive sampling of midwives working in the Department of Obstetrics and Gynecology in three different urban, semi-urban and rural hospitals. Mean ages of the midwives ranged from 31-43 years. Work experience among midwives ranged from 1.5-24 years.	Obstetric ultrasound was considered as a highly valuable tool among midwives. There were reports of misuse of ultrasound without medical indication, as well as women replacing ordinary antenatal care with ultrasound examinations.
<b>Cherniak et al., 2017</b>	Uganda	Quantitative – Non-Blinded Cluster Randomized Controlled Trial	159	Convenience sampling of women in the Kabale district in southwestern Uganda who were aware of being pregnant and presented to antenatal care. The mean age of participants was 26.3 years.	Radio advertising of antenatal care as seeing the baby through obstetric ultrasound significantly improved antenatal care attendance.
<b>Doan et al., 2017</b>	Vietnam	Quantitative – Cross-sectional Study	298	Convenience sampling of pregnant women who visited three prenatal diagnostic centres and received prenatal diagnosis services from February to May 2014. Ages of participants ranged from 22-44 years.	Ultrasonography was the most popular method to detect fetal malformation among the participants. One-fifth of participants were not receiving counselling but were receiving other genetic testing.
<b>Edvardsson et al., 2016</b>	Rwanda	Qualitative – In depth Interviews	19	Purposive sampling of physicians from seven public and private health facilities in Rwanda. Ages ranged from 27-60 years. Experience working with pregnant women ranged from 9 months-29 years.	Many participants saw ultrasound as mandatory in pregnancy management. Participants reported information fetal sex and well-being as women's main expectations of ultrasound.
<b>Edvardsson et al., 2015</b>	Vietnam	Qualitative – In depth Interviews	17	Purposive sampling of medical doctors who did obstetric ultrasound examination. Ages ranged from 28-54.	Participants described an overuse of ultrasound was driven by women's request and increased commercialization. Participants also reported seeing other clinical examinations being replaced by ultrasound due to women's preferences.
<b>Edvardsson et al., 2014</b>	Australia	Qualitative – Semi-structured Interviews	14	Convenience sampling of obstetricians from two large hospitals who work with obstetric ultrasounds. Ages ranged from 33-39. Experience as an obstetrician ranged from 4-30 years.	Participants reported expectant parents seeking ultrasound examinations primarily for non-clinical purposes such as acquiring keepsakes and family bonding.
<b>Mensah et al., 2014</b>	Ghana	Quantitative – Cross-sectional Study	337	Convenience sampling of postpartum women awaiting discharge. Only those who carried their pregnancy to term and had healthy live	For 86.5% of the participants, the sex of their baby at the time of delivery was the same as what was determined by the sonographer.



				babies were included. Ages of participants ranged from 16-42 years.	
<b>Ohagwu et al., 2014</b>	Nigeria	Quantitative – Cross-sectional Survey	790	Convenience sampling of pregnant women who presented for prenatal ultrasound at four selected hospitals. Ages of participants ranged from 21-35 years.	The results show that male gender preference is strongly perceived by women irrespective of age, years of education, and number of male and female children already had. Loss of interest in the pregnancy associated with disclosure of undesired fetal gender.
<b>Firth et al., 2011</b>	Tanzania	Qualitative – Semi-structured Interviews and Open-ended Questionnaire	66	Convenience sampling of pregnant women aged 18 years and over attending BomaNg'ombe antenatal clinic during the research period.	Women were found to be over-estimating the capacity of ultrasound. They had expectations of discovering fetal position, fetal sex, and identifying pregnancy problems.
<b>Rijken et al., 2011</b>	Thai-Burmese Border	Mixed Methods: (1) Observations, Interviews, Focus Group Discussions and (2) Cross-sectional Survey	(1) 60 (2) 644	(1) Convenience sampling of pregnant women aged 15-47 years attending an antenatal care clinic, and purposive sampling of senior midwives and sonographers with more than 10 years of experience working in ANC.  (2) Convenience sampling of women aged 15-47 years who had attended the antenatal care clinic.	Qualitative data indicated women were overestimating the diagnostic ability of ultrasound technology.  Quantitative data revealed that almost all (98.4%) participants desired to know fetal sex, but only 0.6% reported hearing of women seeking sex-selective abortions after learning the fetal sex.
<b>Gonzaga et al., 2009</b>	Uganda	Mixed Methods: Semi-structured interviews and Cross-sectional Survey	30	Convenience sampling of pregnant women at the local health centre who had had an ultrasound during their pregnancy. Ages ranged from 19-42 years.	Some women reported having an unrealistic expectation of what ultrasound can and cannot achieve.
<b>Chigbu et al., 2007</b>	Nigeria	Quantitative – Prospective Cohort Study	102	Purposive sampling of women who had delivered babies whose birth sex differed from the sex determined during the antenatal ultrasound scan. Ages ranged from 16-42 years.	Women who had received an incorrect determination of fetal sex by ultrasound experienced marital conflicts, domestic violence, negative perceptions of ultrasound, and a desire for reversal of tubal ligation
<b>Gammeltoft and Nguyen, 2007</b>	Vietnam	Mixed Methods: (1) Semi-structured interviews and (2) Cross-sectional Survey	(1) 139 (2) 400	(1) Convenience sampling of women who had obtained a 3D scan at the maternity hospital, and purposive sampling of doctors working with ultrasound at the hospital and ministry of health officials.  (2) Convenience sampling of women giving birth at the maternity hospital.	Quantitative data revealed a dramatic overuse of ultrasound scanning. The women surveyed averaged 6.6 scans and 8.3 antenatal visits during pregnancy. 20% of those women had 10 scans or more.  Qualitative data revealed that some doctors were recommending monthly scans during pregnancy. The majority of doctors found no problem in encouraging women to have repeated scans.

<b>Bashour et al., 2005</b>	Syria	Qualitative – In depth Interviews	30	Purposive sampling of women found through the official birth register who represented a varied sub-sample in terms of place of residence and place of delivery. Ages ranged from 18-40 years.	Some women reported seeking as many as 20 ultrasound scans from private providers primarily for non-clinical purposes such as familial bonding, easing concerns of fetal well-being, and determining fetal sex.
<b>Liamputtong and Watson, 2002</b>	Australia	Qualitative – In depth Interviews	67	Purposive sampling of Cambodian, Lao, and Vietnamese women who had given birth in Australia either five or ten years before the research period. Ages ranged from 21-50 years.	Nearly all the women had prenatal testing as advised by their doctors. Most women saw no issue with getting ultrasounds done and perceived the testing as routine.
<b>Tautz et al., 2000</b>	Botswana	Qualitative – In depth Interviews	51	Convenience sampling of women aged 15-40 years who had an ultrasound within three months of the research period, women who had just had an ultrasound examination in the hospital, and purposive sampling of healthcare providers in the hospital.	Many women described having a high degree of trust in the diagnostic power of ultrasound and prenatal therapeutic possibilities. Doctors also saw a pattern of women overestimating the therapeutic capabilities of ultrasound.