Perinatal risk and the cultural ecology of health in Bihar, India

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Abstract

The objective of the current study is to examine the cultural ecology of health associated with mitigating perinatal risk in Bihar, India. We describe the occurrences, objectives, and explanations of health-related beliefs and behaviors during pregnancy and postpartum using focus-group discussions with younger and older mothers. First, we document perceived physical and supernatural threats and the constellation of traditional and biomedical practices including taboos, superstitions, and rituals used to mitigate them. Second, we describe the extent to which these practices are explained as risk-preventing versus health-promoting behavior. Third, we discuss the extent to which these practices are consistent, inconsistent, or unrelated to biomedical health practices and describe the extent to which traditional and biomedical health practices compete, conflict, and co-exist. Finally, we conclude with a discussion of the relations between traditional and biomedical practices in the context of the cultural ecology of health and reflect on how a comprehensive understanding of perinatal health practices can improve the efficacy of health interventions and improve outcomes.

Keywords: folkbiology, India, maternal-child health, perinatal health, ritual, traditional medicine
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The perinatal period is associated with substantial health risks to mothers and infants. These risks vary in amount and kind based on environmental risk factors and access to high quality health care. Maternal and infant mortality rates have declined rapidly over the past several decades worldwide, but continue to vary substantially among populations (1). For example, in 2017, the maternal mortality ratio (maternal deaths per 100,000 live births) was 917 in Nigeria, 145 in India, and 3 in Finland (1). In 2017, the infant mortality rate (per 1,000 live births) was 77 in Nigeria, 32 in India, and 3 in Finland (2–4). Maternal and infant mortality rates also vary substantially within populations. Despite a commendable 77% nationwide decline in maternal and infant mortality rates in India in the past two decades (1,5), in the predominately rural state of Bihar, the maternal mortality ratio was 165, and the infant mortality ratio was 35 in 2017 (5).

High levels of risk require strategies for reducing it and alleviating the anxiety associated with perceived threats. All human populations use a diverse repertoire of traditional and biomedical health practices in response to risk or to mitigate negative outcomes (6,7). Research on folkbiological concepts (8) has shown that introducing biomedicine into populations does not replace traditional (folk) medicine or supernatural explanations for health (7,9–13). Instead, traditional medicine and biomedicine *coexist*. For example, although information about the transmission of the AIDS virus is widely available via health and education programs in South Africa (14), supernatural accounts of infection based on witchcraft are commonplace (7,15,16). Traditional medicine and biomedicine are often used to explain outcomes or events at different levels of causality. In the context of AIDS in South Africa, supernatural explanations such as witchcraft provide distal explanations of why HIV was contracted; biomedical explanations such
as germ theory provide proximate explanation for how it was contracted; for example, “a witch can make a condom weak, and break” (7).

An especially informative domain for studying the coexistence of natural (biomedical) and supernatural practices is perinatal health. Most disease is caused by multiple factors (17); biological, social, supernatural, and religious explanations are used for illness transmission (18–20). Contagion can also occur through physical, supernatural, mental, or moral processes. Illness often has a human vector and thus can be both an interpersonal and a biological process (21). For example, witchcraft and biological contagion are widely used by the same individuals to explain the same instances of illness (16,22).

Globalization is changing the cultural ecology of perinatal health throughout the world, resulting in the introduction of biomedical treatments for illness and infirmity into populations with rich and complex traditional health ecologies and perinatal health practices, many of which are infused with religious meaning. In some cases, biomedical health practices supplant traditional perinatal medical practices. In other cases, biomedical health practices and traditional perinatal medical practices co-exist in ways that range from conflict to complementarity (11,13). For example, in a recent 11 country study of habitual health-promoting behavior (e.g., hand-washing with soap), one of the barriers to the adoption of a biomedical practice was a religious ritual (e.g., hand-washing with plain water as part of ritual cleansing) (23).

In Bihar, India, multiple kinds of health care are available including traditional medicine, religious healing, and biomedical services. Perhaps the most prominent supernatural explanation for misfortune in this context is evil eye, ku drishti or buri nazar. Evil eye is a curse caused by a malicious gaze, usually when a person is unaware, and is believed to cause a wide variety of
misfortunes, including illness and death (24). Charm bracelets, amulets, markings on the face or body, or slogans are used to ward-off the evil eye.

Our objective is to document and describe the complex, diverse, and wide-ranging health ecology associated with mitigating risk during the perinatal period. There are traditional perinatal medical practices in all human populations, but we propose that the amount and kind of beliefs and behaviors are influenced by local ecologies of health and the amount and kinds of local risk (25–27). The goals of perinatal health practices in high risk contexts are often protective or promotive: to avoid negative outcomes, such as miscarriage, difficult labor, or birth defects, or to achieve positive outcomes, such as infant and maternal wellbeing and health. We document health-related beliefs and behaviors in a population experiencing substantial risk to maternal and infant health, and rapid changes in healthcare. Bihar is India’s most rural state, with over 88% of the population living in rural settings. It is also India’s poorest state, ranking 33rd out of 33 in gross state domestic product per person. Bihar has a high population density by global standards with over 1,100 people per square mile, and is one of India’s fastest growing states, with a decadal growth rate of just over 25% (28).

Traditional and biomedical health care systems exist in parallel in Bihar. Biomedicine is now widely practiced, and has been incorporated into the repertoire of traditional perinatal health practices used in this region. Community members frequently use a range of services from different sectors. For example, it is now common for women to give birth in medical clinics (biomedical health care system) (1) and call the Dai (traditional birth attendant) at home to confirm that their labor has begun prior to going to the hospital. In recognition that India’s rural states are medically underserviced and experiencing poorer health comes, the government of India launched the National Rural Health Mission (NRHM) in 2005. The NRHM introduced
several initiatives aimed at improving the health outcomes of rural Indian populations, including employing health activists and practitioners to provide health education and services, such as vaccination, nutritional supplements, prenatal vitamins, institutional delivery, support for immediate and exclusive breastfeeding, and recommendations for infant caretaking practices to women of reproductive age (29).

Practices associated with traditional medicine, such as perinatal ritual, may be the byproduct of a hazard precaution system, that functions to respond to inferred threats, including social (e.g., ostracism), and physical (e.g., contamination and pathogens) dangers (30). We hypothesize that the perceived function of these practices (by practitioners) in high risk contexts is primarily to avoid danger rather than promote health. Traditional health practices include taboos, superstitions, religious and folk-medical practices, and rituals, all of which operate as culturally-sanctioned responses to perceived threat (30,31). Notably, these traditional medical practices share many of the same characteristics. For example, they are socially transmitted, they operate based on principles of magical contagion, and are often opaque from the perspective of physical causality (7,32,33). Like traditional medicine, biomedical practices are also perceived to be causally opaque by most of the lay population (in rural northern India and everywhere in the world), are socially transmitted, and are heavily ritualized. For these reasons, we propose that biomedicine is a new kind of ritual repertoire that coexists with traditional medical practices.

Rituals, which we define as socially stipulated, normative behavior, are of particular interest in the context of health risk mitigation during the perinatal period. They are widely practiced for protective, restorative, and instrumental or goal-directed purposes around the world (34–36). Evidence for the use of rituals to treat health-related problems dates back to at least ancient Egypt (37). Rituals continue to be practiced by contemporary populations to treat health
problems as diverse in etiology as AIDS, tetanus and tuberculosis (6,7,32,36). Using rituals for instrumental purposes, such as mitigating threat, requires entertaining their potential for causal potency or efficacy (35,38,39). Rituals often involve attention to perceived danger and prescriptive, rigid behavioral patterns for averting threat (40). Pregnancy and birth are both fitness-relevant events; thus, the perinatal period provides unique insight into causal and functional relations of traditional medical practices such as rituals relevant to maternal and child health.

Perinatal rituals serve multiple functions within communities (41,42). Consider Chhathi, a perinatal ritual widely practiced throughout Bihar, India, on the 6th day after birth. It serves social functions; it marks critical transitions in the lifecourse (birth and parenthood), it marks the initiation of the infant into the family, it has symbolic meaning to ritual practitioners, and it reinforces social cohesion within the community (43). It also has instrumental functions; it is believed to reduce the risk of negative outcomes for the new baby (e.g. ward off the threat of evil eye).

In the current study we document the occurrence, objectives, and explanations of health-related beliefs and behaviors during pregnancy and postpartum using focus-group discussions with younger mothers and older mothers in Bihar. First, we document perceived physical and supernatural threats and beliefs about how traditional and biomedical practices mitigate them. Second, we describe the extent to which these practices are explained in the context of risk-preventing versus health-promoting behavior. Third, we discuss the extent to which traditional perinatal medical practices are consistent, inconsistent, or unrelated to biomedical health-practices and describe the extent to which traditional and biomedical health practices compete, conflict, and co-exist. Finally, we conclude with a discussion of the relations between traditional
and biomedical practices in the context of the cultural ecology of health and reflect on how a comprehensive understanding of perinatal health practices can improve the efficacy of health interventions and improve outcomes.

**Methods**

The data presented below are part of a larger research initiative called Project RISE, which aims to harness Ritual to Improve Service-delivery and Empower health workers in Bihar, India. Here we report data from focus group discussions that are the basis for our description of health-related beliefs and behaviors. The goal of the focus group discussion data reported in this paper was to gather rich qualitative information about perceived risks and health-related practices during the perinatal period.

**Participants**

The Indian state of Bihar has 38 districts which are divided into 534 administrative blocks. Most blocks contain several villages. A community development block covers several gram panchayats, the local administrative unit at the village level. Participants were recruited from 21 villages in three blocks from two districts. Participants from four villages in the blocks of Biharsharif in the Nalanda district, six from the Rajgir Block of Nalanda District, and 11 from the Warisnagar Block of Samastipur District participated in the FGDs. These villages were randomly selected from two linguistic sub-divisions. Forty focus group discussions were conducted in total, 20 with younger mothers and 20 with older mothers. For the younger mother sample, women had to have given birth within the last two years. The older mother sample is comprised of mothers who have a married daughter or daughter-in-law who has given birth within the previous two years. Attempts were made to ensure that a locally representative sample of age, religion, parity, and caste was obtained for each sample. The focus group discussions
ranged in size from 4 to 7 participants with a median of 5, in addition to the trained researcher and a note-taker. In total, PCI investigators interviewed 107 younger mothers (mean age: 24, range: 18 to 35) and 106 older mothers (mean age: 52, range: 35 to 75). The younger mother focus group discussions were composed of 69 Hindu and 38 Muslim women. The older mother focus group discussions had 68 Hindu and 37 Muslim women. Most of the focus group discussions had exclusively Hindu or Muslim participants in order to compare the differences and similarities between perceptions of health behaviors between religious groups.

**Procedure**

The focus group discussions were conducted by experienced rural health researchers employed by Project Concern International (PCI), an international non-government organization with extensive experience working in Bihar. Prior to beginning data collection, PCI gave a week-long extensive training to the data collection team on the focus group discussion tools and protocol. Conversations were audio recorded for quality assurance and transcriptions. Basic demographic information was recorded on all participants. Researchers used a standardized set of checklists and followed uniform guidelines to ensure a consistent dialogue across focus group discussions, and used follow-up questions to resolve ambiguity and ensure the discourse was free-flowing. The researchers collected data during a three-week period in January, 2019.

Participants were asked to discuss health-related beliefs and practices, to describe when in the perinatal period (pregnancy and early postpartum) they occurred, and to explain why they are practiced. Beliefs about common threats to maternal and child health and health-related practices were discussed, as were traditional perinatal rituals and biomedical practices. Preferences for public, private, and home-based care were addressed at each stage of the perinatal period. Participants were encouraged to describe health-related beliefs in the context of
beliefs about health outcomes they promote or risks they mitigate. Both home and community rituals were discussed.

**Coding**

The focus group discussions were fully transcribed from audio-recordings to Hindi, then excerpts were translated to English by researchers fluent in Bihari dialects of Hindi and English. In total, data processing resulted in 720 individual descriptions that were consolidated to identify 269 distinct health-related practices. Note that utterances from these data were recorded in a group context and then coded; thus, we are not reporting verbatim quotes that are assignable to individual participants. Rather, the data are a mixture of quotes and paraphrases of utterances made during focus group discussions. The procedure for analyzing the data included coding, sorting, counting, and describing the results of targeted queries. For instance, each utterance is linked to its respective focus group discussion and point in the perinatal period.

Conversational content was coded for descriptions of physical and supernatural threats to maternal and child health, as well as traditional and biomedical practices. The following codes were applied to the perinatal practices: common threats to physical health, common practices believed to mitigate physical and supernatural threat, including whether they involved placing a visible marker on the body or home as a social signal or for supernatural protection, and the birth ritual of Chhathi. Data were coded for whether the health-related practices was risk avoiding or health promoting. Risk avoiding practices are intended to avoid or prevent a harmful outcome. Health promoting practices are intended to improve visible, physical, and psychological health. Note that a small number of practices that were not explicitly health promoting or risk avoiding (e.g., practices believed to influence the gender of the infant) were coded as unrelated and not included in Table 1 below. Data were also coded for the extent to which practices are consistent,
inconsistent, or unrelated/neutral with current biomedical recommendations. Note that practices related to food recommendations and taboos were not included in this dataset and are not included in the relations to recommended biomedical practices in Table 1 below. Examples of practices relevant to maternal and child health that involved replacement of traditional medical practices with biomedical recommendations, conflict between traditional medical and biomedical recommendations, and coexistence of traditional medical and biomedical recommendations were also documented.

Results

Nearly every belief and practice discussed during the focus group discussions described a health-related outcome or concern (Table 1). These health-related practices varied considerably, and ranged from traditional perinatal rituals based on local customs, to taboos and superstitious practices believed to ward off physical and supernatural threat, to cultural beliefs about impurity of mother and child after birth, to practices based on biomedical recommendations.

Table 1. Counts of health-related practices, descriptions as health promoting or risk avoiding, and relations to recommended biomedical practices

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Pregnancy</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Younger mothers</td>
<td>Older mothers</td>
</tr>
<tr>
<td>Count of practices</td>
<td>155</td>
<td>206</td>
</tr>
<tr>
<td>Health promoting</td>
<td>19 (12%)</td>
<td>29 (14%)</td>
</tr>
<tr>
<td>Risk averting</td>
<td>136 (88%)</td>
<td>177 (86%)</td>
</tr>
<tr>
<td>Neutral re biomedical</td>
<td>104 (67%)</td>
<td>150 (73%)</td>
</tr>
<tr>
<td>Consistent with biomedical</td>
<td>47 (30%)</td>
<td>49 (24%)</td>
</tr>
</tbody>
</table>
Traditional medical practices believed to mitigate physical and supernatural threats to mother and child

Hindu and Muslim mothers reported wide-ranging taboos and superstitions believed to mitigate physical threats to mother and child. Reasons reported for these practices were consistent across regions and groups. Miscarriage, birth complications, and premature delivery were frequently mentioned concerns for both younger and older mothers during the pregnancy period. Taboos and superstitious practices with the intent of mitigating these risks included avoiding lifting heavy objects, labor intensive housework, climbing stairs, sexual activity, and traveling out of the home. Nighttime may be an especially dangerous time for women to leave the house and a commonly stated reason for pregnant women to avoid doing so was risk to mother and child associated with the encountering the supernatural jiloi bird. Participants described the jiloi bird as ugly and dangerous, and distinguished it from bats and owls. Mothers reported that pregnant women should avoid the risk of being outside when the bird flies overhead at night or in the early morning for fear that exposure to the bird may cause the child to be weak, thin, or born with a foul odor. If a pregnant woman is exposed to the jiloi bird during pregnancy, there are remedies one can do postpartum to rid the baby of the negative consequences. For example, bathing an infant in a sugarcane field and replacing their old clothes, or placing dried dung of equivalent weight to the infant in a river.

Postpartum women and infants are considered impure, thus a number of taboos are practiced to prevent contaminating others. For example, new mothers refrain from worship, and avoid touching water or food sources because of their impure status. Places like temples,
handpumps, and kitchens are considered pious and pure, thus postpartum women should avoid them.

There are many taboos associated with astrological beliefs about dangers to pregnant women and their fetuses during solar and lunar eclipses. For example, several mothers stated pregnant woman should avoid cutting things during an eclipse. Stated reasons were consistent with associational magic, such as risks that newborns will have cuts on their bodies or other physical deformities. Several mothers also reported that pregnant women should not eat or sleep during an eclipse to avoid their children developing physical deformities. Placing amulets in the home during an eclipse is commonplace. For example, mothers reported that one should hang a piece of thread or wood equivalent to the height of the pregnant woman on the wall during an eclipse.

Hindu and Muslim mothers frequently reported taboos and superstitions associated with avoiding evil eye during pregnancy and the postpartum period. Evil eye is a supernatural curse that is believed to be transmitted through a malicious gaze, and is usually motivated by envy, jealousy, or lack of reciprocity that may cause illness or even death (7,44). Applying visible, physical amulets and substances to the body or the home of the infant and mother to ward off evil eye is commonplace. Taboos for pregnant women to avoid to reduce the risk of evil eye included not walking outside, not looking at or crossing rivers, and not reporting pregnancy to others. Many considered rivers to be open or barren which are believed to be more prone to threats from spirits or demons. Another common risk-avoiding practice reported by mothers is tying a locket around the neck or arm of the mother and infant. During the birthing period, mothers reported that bringing an iron item to the hospital, such as a knife, would protect their newborns from evil eye. Upon returning to their homes post-delivery, younger and older mothers
reported burning wood at the entrance of the family home and keeping iron objects outside of the room the mother and infant sleep in. Adornments applied to the body like asafoetida ("devil’s dung", dried gummy excretion from the tap root of ferula), and tying black thread to the arm of mother and child were frequently discussed.

**Birth ritual: Chhathi**

Chhathi is a ritual widely practiced in northern India to initiate a new baby into the family. Appeals to supernatural agents for protection and blessings are central to the Chhathi ceremony for Hindu and Muslims mothers. Hindus believe in reincarnation, thus some of the practices associated with Chhathi relate to pardoning the sins committed during previous lives, and beginning a new life by giving the child a name and consulting horoscopes to decide their fate in this life. Muslims do not believe in reincarnation, thus some of the elements of Chhathi are instead associated with transitioning the infant from God’s world to the world of the living. Mothers also reported that the newborn should touch a pen during Chhathi. Hindu mothers indicated that this was done so that the God of Creation will record an auspicious future for the infant. Muslim mothers performing this ritual believe that Allah should be invited to decide the fate of the child. Prior to this celebration, both mother and child are bathed. While the mother receives new clothing, the child is wrapped in a cloth and rolled on the floor for a short period of time. Hindu mothers reported that the village pandit gives the child their horoscope. New mothers receive special and diverse foods during Chhathi. Five to seven types of vegetables, pulses (legumes), rice, and fish are prepared for the mother to eat. The child is kept in the mother’s lap so that she is able to touch her lips to the child’s mouth after she has eaten so the baby tastes the food. Doing this is meant to ensure that the child will never remain hungry in life. Black thread is to be worn by the baby around the waist or wrist to help strengthen and increase
the lifespan of the child. Kohl is applied around the eyes of the baby to increase beauty, intelligence, and to protect the child from evil eye.

**Risk aversion versus health promotion**

Nearly every health-related practice could be described as having the goal of promoting the health of the mother or child or of averting risks that could negatively impact the health of mother or child. Risk-avoiding practices were more frequently discussed during pregnancy than health-promoting practices, by younger and older mothers. Health-promoting practices and risk-avoiding practices were equally likely to be discussed postpartum by younger and older mothers (see Table 1).

**Relations of traditional medical practices to biomedical recommendations**

During pregnancy and postpartum, the vast majority of health practices were neutral with respect to specific biomedical recommendations, some were consistent, and some were inconsistent with biomedical recommendations (Table 1). Examples of practices that are consistent with biomedical recommendations include avoiding hard labor during pregnancy, slide sleeping while pregnant, and immediate skin-to-skin contact and initiation of breastfeeding. Examples of practices that are inconsistent with biomedical recommendations include bathing the mother and child within 24 hours of birth, applying mustard oil to the umbilical cord stump, and colostrum taboos (e.g., discarding instead of feeding colostrum to the newborn). A relatively larger portion of traditional health practices are inconsistent with biomedical recommendations postpartum than prepartum because there are independent risks to mother and infant postpartum and infants are highly susceptible to infection (e.g., umbilical cord stump infection due to contact with water or traditional ointments) and food or water transmitted infections (e.g., feeding newborns unsterilized water or cows’ milk). Examples of practices that are neutral with respect
to biomedical recommendations include pregnant women applying warm water compresses with carom seed to their bodies, placing an iron object by the doorway of the mother’s room to protect from evil eye, tying a string around the infant’s wrist for supernatural protection, and tonsuring (head-shaving) to rid the infant of impurities.

**Coexistence of traditional and biomedical health practices**

There are multiple examples of replacement, conflict, and complementarity of traditional and biomedical health practices. An example of replacement in the context of umbilical cord care is mothers who reported no longer applying mustard oil to the infant’s umbilical cord stump following birth (traditional perinatal health practice), in favor of applying nothing after the wound has dried, which is consistent with the biomedical recommendation for umbilical cord care. An example of conflict is mothers who report continuing to apply mustard oil on the infant’s umbilical cord stump following birth, which is inconsistent with the biomedical recommendation for umbilical cord care. An example of complementarity is mothers who report applying mustard oil on the rest of the infant’s body, but avoiding the umbilical cord stump, which incorporates traditional perinatal ritual massage of the infant following birth, and is consistent with the biomedical recommendation for umbilical cord care.

An example of replacement in the context of breastfeeding is mothers who reported no longer waiting for the Hindu *pandit* or Muslim *maulana* to initiate immediate breastfeeding (traditional perinatal ritual), which is consistent with the biomedical recommendation for immediate and exclusive breastfeeding. An example of conflict is mothers who reported delaying breastfeeding until a Hindu *pandit* or Muslim *maulana* visits the mother and infant at home (traditional perinatal ritual), and instead feeding the newborn a mixture of cows’ milk and water, inconsistent with the biomedical recommendation for immediate and exclusive breastfeeding. An
example of complementarity is mothers who reported calling a Hindu *pandit* or Muslim *maulana* on a mobile phone to receive blessings from the hospital immediately after birth, which incorporates traditional perinatal ritual religious blessings to initiate breastfeeding, *and* is consistent with biomedical recommendation for immediate and exclusive breastfeeding.

**General Discussion**

Our objective was to examine the local cultural ecology of health associated with mitigating risk during the perinatal period in Bihar, a population experiencing high levels of risk to mothers and infants. We documented a substantial number of health-related concerns during the pregnancy and postpartum periods and the physical and supernatural threats associated with them. We also described traditional and biomedical practices believed to mitigate risk and promote health for mother and infant.

Our data demonstrated that the perinatal period, like all fitness-relevant events, is marked by an extensive number of traditional health practices. The large majority of practices in our dataset have the goal of avoiding risk, which is consistent with the proposal that traditional health practices such as perinatal rituals function as a response to perceived threat. The extent to which health-related practices were explained as risk avoiding versus health promoting varied between different points in the perinatal period. For example, health practices during pregnancy were primarily explained in terms of risk avoidance. In contrast, explanations for health practices after birth were evenly distributed between risk avoidance and health-promotion.

Mothers reported an extensive number of traditional medical practices with the goal of reducing physical and supernatural risks to mother and child. Practices associated with placing visible markers or objects on the body were commonly associated with avoiding the “gaze” of evil eye. Common taboos observed and superstitions practiced to reduce risk of miscarriage
include avoiding crossing paths with the jiloi bird and applying kohl around the eyes of the infant. Mothers also mentioned taking precautions to avoid elevated risks during solar eclipses, which are associated with supernatural threat. During a solar eclipse, a thread equivalent to the height of the pregnant woman should be hung on the wall. In the postpartum period, horoscope rituals are practiced to avoid the threat of malefic planets. Multiple mothers discussed a perinatal ritual practiced if a child is born in 27th nakshatra. The father sees the child in the shadow of oil or ghee, and the infant is bathed with water from 27 wells. Pots are made from 27 bamboo trees to worship the god. Seven types of fruits and sweets are prepared. Mothers also mentioned taking precautions during periods of impurity. New mothers and infants are considered impure and thus sleep separately from the family after birth to avoid contaminating others.

The extensive use of traditional medical practices for protection from supernatural harm in Bihar is consistent with previous research in South Africa and Haiti on the use of traditional medical practices to protect people from witchcraft (7,16). Many of the perinatal rituals documented in the study, including initiation rituals (e.g., Chhathi) and horoscope rituals also included practices believed to avoid supernatural threat (e.g., applying kohl around the eyes and avoiding images of goddesses). This suggests that the emphasis on risk mitigation in traditional medicine is common across highly diverse cultural ecologies of health.

Many of the perinatal rituals documented in this study, such as Chhathi, involved repetition and high levels of procedural detail, consistent with previous research on perceptions of ritual efficacy. Supernatural agents were also frequently associated with both Hindu and Muslim perinatal ritual practices, also consistent with previous research associating supernatural agency with perceptions of ritual efficacy (6,39). The involvement of the family and local religious leaders, the special clothing and artifacts worn by mother and child, and the consistency
in the practices associated with Chhathi ceremony across Hindu and Muslim mothers provide convergent support for the social functions of initiation rituals.

Traditional medical practices based on associational magic (45) were also reported. For example, to reduce the risk of a child being bitten by a scorpion, a mother mentioned that a scorpion is pasted on the wall with cow dung and after delivery the dung cake is burnt on fire. Another mother mentioned that during an eclipse, a pregnant woman should not cut hair or rope to avoid her infant being born with physical deformities associated with cuts, such as a cleft lip. Burying the umbilical cord stump to ensure the longevity of family ancestry was a frequently mentioned traditional medical practice.

We documented a number of ways in which traditional and biomedical health practices compete, conflict, and co-exist. There were infrequent examples of conflict between traditional and biomedical practices, such as women who gave birth in facilities applying mustard oil to the cord stump during ritual massage of the infant or delaying the initiation of breastfeeding for several days for the pandit or maulana to bless the infant. Most traditional medical practices were neutral or unrelated, and often coexisted alongside biomedical practices. For example, many mothers who gave birth in hospitals, a recommended biomedical practice, also used traditional superstitions to ward off the threat of evil eye, such as bringing iron objects to delivery and placing them in the doorway of the home.

We propose that the relations between traditional and biomedical practices in the context of cultural ecologies of health is critical to improving the efficacy of health education interventions and policies. Practices associated with traditional health are widely assumed to negatively impact health, often without evidence. We show that the vast majority of traditional perinatal health practices are consistent or neutral re biomedical health practice. Future research
should examine how the social capital associated with traditional medicine can be harnessed to improve the efficacy of biomedical health interventions. For example, many of the recommended biomedical health practices, such as immediate breastfeeding, institutional delivery, and cord care can be accommodated within existing perinatal rituals. For example, leveraging the important social functions of birth rituals like Chhathi provides a unique opportunity for local health activists, educators, and practitioners to communicate with new mothers and families about health-promoting behaviors. Local health activists and educators often attend Chhathi ceremonies and could use these opportunities to provide information about recommended biomedical practices to mothers and families. Recognizing the similarities between traditional medicine and biomedicine has the potential to provide unique insight into how both health care systems function within local ecologies of health. Both operate as ritualistic remedies; they are socially-transmitted, causally opaque, and used to mitigate risk.

Examining the extent to which traditional perinatal medical practices are consistent, inconsistent, or unrelated to biomedical health-practices and documenting the extent to which traditional and biomedical health practices compete, conflict, and co-exist provides unique insight into cultural ecologies of health. Our dataset provides evidence for the relations between risk and health practices during the perinatal period and reveals strong associations between health practices and avoiding negative outcomes. We argue that a comprehensive understanding of traditional health practices can improve the efficacy of health interventions and encourage future research on maternal and child health to examine traditional medicine worldwide.
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